Spring 2023

Subject: Physical Sciences

Physical Sciences 3

Electromagnetism, Circuits, Waves, Optics, and Imaging (122576)

Melissa Franklin

2023 Spring (4 Credits) **Schedule:** T, TH 0900 AM - 1015 AM

Instructor Permissions: None **Enrollment Cap:** n/a

This course is an introduction to electromagnetism, digital information, waves, optics and sound. Topics covered include: electric and magnetic fields, electrical potential, circuits, simple digital circuits, wave propagation in various media, microscopy, sound and hearing. The course will draw upon a variety of applications to the biological sciences and will use real-world examples to illustrate many of the physical principles described. There are six laboratories.

Course Notes:

This course is part of an integrated introduction to the physical sciences intended for students who plan to pursue a concentration in the life sciences and/or satisfy pre-medical requirements in Physics. May not ordinarily be taken for credit in addition to Physics 15b

Physical Sciences 12A

Mechanics and Statistical Physics from an Analytic, Numerical and Experimental Perspective (109274)

Anna Klales

2023 Spring (4 Credits) **Schedule:** MWF 0900 AM - 1015 AM

Instructor Permissions: None **Enrollment Cap:** n/a

This is the first term of a two-semester introductory course in physics. The focus is on quantitative scientific reasoning, with the first term exploring Newtonian mechanics. Topics include kinematics, linear and rotational motion, forces, energy, momentum, collisions, gravitation, oscillations, waves, and a brief introduction to statistical physics. Examples are drawn from across the physical sciences and engineering.

Students will gain competence in both analytic (using pencil, paper, and single-variable calculus) and numerical methods (using the python programming language) to model simple physical systems and to analyze experimental data.

The course is aimed at first year students who have an interest in pursuing a concentration in the sciences or engineering. The course includes lecture, laboratory, and discussion components.

Course Notes:

Physical Sciences 12a may not be taken for credit by students who have passed Physics 15a or 16.

Physical Sciences 70

Introduction to Digital Fabrication (215717)

Nathan Melenbrink

2023 Spring (4 Credits)		**Schedule:**	T, TH 0300 PM - 0415 PM
Instructor Permissions:	Instructor	**Enrollment Cap:**	15

A hands-on introduction to rapid prototyping, integrating physics and engineering, design, computer science and art. Students will learn to safely use software and hardware to fabricate programmable projects. Tools and topics will include electronic circuit design, 3D CAD, programmable microcontrollers, and wireless networking (Internet of Things). Additionally, students will learn operational principles for techniques such as laser cutting, 3D printing, and computer-controlled milling. Students will work with course staff to prepare their design files and remotely operate machines, after which the fabricated components will be mailed to them. Applications may include personal fabrication, product prototyping, fine arts and the creation of scientific research tools. The course will culminate with an individual final project, integrating as many of the weekly topics as possible. Each student will document work on each weekly topic in a personal website, thereby finishing the course with an online portfolio that not only illustrates their new skill sets, but also contributes to a collective repository of knowledge that serves as a foundation for continued learning.

Course website: https://tinyurl.com/tasr7b6

Related Sections: In addition to class times, the course staff will be available for lab sections scheduled throughout the week. Students are required to attend at least one lab section per week to check in with course staff on their progress, and are otherwise free to attend as many additional sections as they like.

Course Notes:

Attendance is mandatory since safety training will occur during class times. Class will meet twice each week. The first meeting will consist of a brief review of the previous week's assignment, followed by a short introduction to the current week's topic and assignment. The second meeting will primarily focus on a hands-on training session for the accompanying assignment. Meetings may also include appearances by guest presenters or experts on a particular topic.

Physics

Subject: Physics

Physics 15A

Introductory Mechanics and Relativity (111164)

David Morin

2023 Spring (4 Credits) **Schedule:** T, TH 1200 PM - 0115 PM

Instructor Permissions: None **Enrollment Cap:** n/a

Newtonian mechanics and special relativity. Topics include vectors; kinematics in three dimensions; Newton's laws; force, work, power; conservative forces, potential energy; momentum, collisions; rotational motion, angular momentum, torque; static equilibrium, simple harmonic motion, damped and driven oscillations; gravitation; fictitious forces; fluids; special relativity.

Course Notes:

Principles of Scientific Inquiry (PSI) is the laboratory component of Physics 15a. Topics include experimental design, model testing, error analysis, basic programming, oral presentations, and scientific writing. PSI will meet weekly throughout the semester.

Physics 15B

Introductory Electromagnetism (111896)

Carlos Arguelles Delgado

Amir Yacoby

2023 Spring (4 Credits) **Schedule:** T, TH 1200 PM - 0115 PM

Instructor Permissions: None **Enrollment Cap:** n/a

Electricity and magnetism. Topics include electrostatics, electric currents, magnetic field, electromagnetic induction, Maxwell's equations, electromagnetic radiation, magnetic fields in materials, and some basic notions in kinetic theory, entropy, temperature, and phase transition associated with electricity and magnetism.

Course Notes:
Principles of Scientific Inquiry (PSI) is the laboratory component of Physics 15b. The labs are designed to enhance your understanding of material presented in lectures. They also present applications of electricity and magnetism, as well as offering opportunities to build simple circuits and develop experience using measuring instruments, including oscilloscopes.

Physics 15C

Wave Phenomena (124154)

John Huth

Mara Prentiss

2023 Spring (4 Credits) **Schedule:** MW 1030 AM - 1145 AM

Instructor Permissions: None **Enrollment Cap:** n/a

Forced oscillation and resonance; coupled oscillators and normal modes; Fourier series; Electromagnetic waves, radiation, longitudinal oscillations, sound; traveling waves; signals, wave packets and group velocity; two- and three-dimensional waves; polarization; geometrical and physical optics; interference and diffraction. Optional topics: Water waves, holography, x-ray crystallography, solitons, music, quantum mechanics, and waves in the early universe.

Course Notes: Principles of Scientific Inquiry (PSI) is the laboratory component of Physics 15c. Topics include experimental design, model testing, error analysis, basic programming, oral presentations, and scientific writing. PSI will meet weekly throughout the semester.

Physics 90R

Supervised Research (111672)

David Morin

2023 Spring (4 Credits) **Schedule:** TBD

Instructor Permissions: None **Enrollment Cap:** n/a

Primarily for selected concentrators in Physics, or in Chemistry and Physics, who have obtained honor grades in Physics 15 and a number of intermediate-level courses. The student must be accepted by some member of the faculty doing research in the student's field of interest. The form of the research depends on the student's interest and experience, the nature of the particular field of physics, and facilities and support available. Students wishing to write a senior thesis can do so by arranging for a sponsor and enrolling in this course.

Course Notes:
A list of possible faculty sponsors and their fields is available in Lyman 238 and on the Physics Department Web page. Course enrollment forms may be obtained from Lyman 238.

Physics 91R

Supervised Reading Course for Undergraduates (110569)

David Morin

2023 Spring (4 Credits) **Schedule:** TBD

Instructor Permissions: None **Enrollment Cap:** n/a

Open to selected concentrators in Physics, Chemistry and Physics, and other fields who wish to do supervised reading and studying of special topics in physics. Ordinarily such topics do not include those covered in a regular course of the Department. Honor grades in Physics 15 and a number of intermediate-level courses are ordinarily required. The student must be accepted by a member of the faculty.

Course Notes: A list of possible faculty sponsors and their fields is available in Lyman 238 and on the Physics Department's website. Course enrollment forms may be obtained from Lyman 238.

Physics 95

Topics in Current Research (111967)

Isaac Silvera

2023 Spring (4 Credits)

Schedule: M 0300 PM - 0415 PM
W 0730 PM - 0845 PM

Instructor Permissions: Instructor

Enrollment Cap: n/a

This tutorial is based on the Wednesday Night Seminars. Each Wednesday, two Harvard faculty members introduce their research to interested students, including undergraduates enrolled in the course, as well as graduate students who would like to learn about the topics investigated. The talks illustrate how research is done, and provide examples of projects graduate students might study if they join the group. Before each seminar, the enrolled students read examples of previous work, and they present and discuss the concepts. In the course, students learn how to express scientific concepts verbally, and in writing for their final report. The course is aimed at juniors and seniors who are familiar with the basics in classical mechanics, electricity and magnetism, and quantum mechanics.

Course Notes: Primarily for junior and senior concentrators, however interested sophomores are welcome.

Physics 113

Electronics for Physicists (216641)

Masahiro Morii

Kathryn Ledbetter

2023 Spring (4 Credits)

Schedule: WF 0130 PM - 0415 PM

Instructor Permissions: Instructor

Enrollment Cap: 20

Introduction to electronics for the physical sciences, focusing on skills applicable to laboratory work. Topics include instruments (multimeter, oscilloscope, function generator, power supply), analog circuits (amplifiers, filters, integrators), digital logic, analog/digital interfaces, noise reduction, PID control, and microcontrollers. Emphasis on circuit understanding and use of laboratory instrumentation. The class meets twice weekly, with an hour of lecture/discussion, followed by lab.

Recommended Prep:

Some familiarity with resistance, capacitance, inductance, and dc circuits (e.g., Physics 12B, 15B, or equivalent) is helpful; no prior coursework or experience with electronics is required.

Physics 123B

Laboratory Electronics - Digital Circuits (124108)

David Abrams

2023 Spring (4 Credits) **Schedule:** T, TH 0130 PM - 0530 PM

Instructor Permissions: Instructor **Enrollment Cap:** 10

A lab-intensive introduction to digital electronic circuit design. Develops circuit intuition and debugging skills through hands-on lab exercises, each preceded by class discussion, with minimal use of mathematics and physics. After a short introduction to the basics of electronic circuits and MOSFET switches, we move onto digital devices including logic families, Boolean arithmetic, combinatorial and sequential circuits including finite state machines. We continue with analog-digital interfacing, the use of microcontrollers in embedded systems and programmable logic devices (FPGAs). We will also discuss data conversion techniques.

Course Notes:

Physics 123b is the same course as Physics 223b; students may not take both for credit. If you are a graduate student, please enroll in 223b. Limited to 10 students. The analog portion of the course, 123a/223a is offered as a separate course in the fall semester

Physics 129

Energy Science (125656)

Lene Hau

2023 Spring (4 Credits) **Schedule:** T, TH 0130 PM - 0245 PM

Instructor Permissions: None **Enrollment Cap:** n/a

Non-fossil energy sources are important for our future. In lectures, we cover main subjects to which students with a background in physics, engineering, or physical chemistry could make paradigm changing contributions: photovoltaic cells, nuclear power, and photosynthesis. Further subjects are covered in student projects. Fundamentals of electrodynamics, statistical/thermal physics, and quantum mechanics are taught as needed to give the students an understanding of the topics covered.

Physics 137

Conceptual Foundations of Quantum Mechanics (218289)

Jacob Barandes

2023 Spring (4 Credits) **Schedule:** T, TH 0130 PM - 0245 PM

Instructor Permissions: Instructor **Enrollment Cap:** 20

Quantum theory is our best-tested and most predictive scientific theory by many quantitative measures. The theory reliably accounts for the measurement results of atomic clocks and particle accelerators to many decimal places, and much of our modern technology relies on it. However, the theory's standard textbook postulates are controversial, and there is still no consensus over what precisely the theory entails about the world. This course will cover the century-long effort to resolve these mysteries and others, a story that features fantastical notions like parallel universes, pilot waves, quasi-probabilities, alive-and-dead cats, and spooky action at a distance.

Topics: In the first part of the course, we will review some history, lay out the textbook postulates of quantum theory, and cover how to use the theory in practice. In the second part of the course, we will examine the internal logic of the theory, ultimately explaining why the theory's traditional axioms are not universally regarded as internally consistent or complete. In the third part of the course, we will examine various attempts to patch up and re-interpret the theory to solve these consistency problems. As we proceed, we will continually refer back to relevant questions in philosophy, including debates over metaphysics, instrumentalism, scientific realism, determinism, epistemology, and the meaning of probability.

Physics 143A

Quantum Mechanics I (108465)

Louis Deslauriers

2023 Spring (4 Credits) **Schedule:** TR 1030 AM - 1145 AM

Instructor Permissions: None **Enrollment Cap:** n/a

Introduction to nonrelativistic quantum mechanics: uncertainty relations; Schrödinger equation; Dirac notation; matrix mechanics; one-dimensional problems including particle in box, tunneling, and harmonic oscillator; angular momentum, hydrogen atom, spin, Pauli principle; and if time allows: time-independent perturbation theory; and scattering.:

Physics 153

Electrodynamics (111822)

Philip Kim

2023 Spring (4 Credits) **Schedule:** MW 1200 PM - 0115 PM

Instructor Permissions: None **Enrollment Cap:** n/a

Aimed at advanced undergraduates. Emphasis on the properties and sources of the electromagnetic fields and on the wave aspects of the fields. Course starts with electrostatics and subsequently develops the Maxwell equations. Topics: electrostatics, dielectrics, magnetostatics, electrodynamics, radiation, wave propagation in various media, wave optics, diffraction and interference. A number of applications of

Physics 175

Laser Physics and Modern Optical Physics (121941)

Markus Greiner

2023 Spring (4 Credits) **Schedule:** WF 0130 PM - 0245 PM

Instructor Permissions: None **Enrollment Cap:** n/a

Introduction to laser physics and modern optical physics aimed at advanced undergraduates. Review of electromagnetic theory and relevant aspects of quantum mechanics. Wave nature of light. Physics of basic optical elements. Propagation of focused beams, optical resonators, dielectric waveguides. Interaction of light with matter, introduction to quantum optics. Lasers. Physics of specific laser systems. Introduction to nonlinear optics. Modern applications.

Physics 181

Statistical Mechanics and Thermodynamics (143450)

Girma Hailu

2023 Spring (4 Credits) **Schedule:** TR 1200 PM - 0115 PM

Instructor Permissions: None **Enrollment Cap:** n/a

This course provides an introduction to statistical mechanics and thermal physics. It surveys the fundamental elements of classical and quantum statistical mechanics (ensembles and partition functions) and thermodynamics (temperature, heat, work, free energy) and their application to a variety of physical systems. Topics covered may include heat engines, solid-state physics, blackbody radiation, phase transitions, physical chemistry, stellar physics, quantum information, Bose-Einstein condensation, and transport phenomena.

Course Notes:

May not be taken for credit in addition to Engineering Sciences 181.

Physics 191

Advanced Laboratory (121993)

Jenny Hoffman

Matteo Mitrano

2023 Spring (4 Credits) **Schedule:** T, TH 0130 PM - 0530 PM

Instructor Permissions: Instructor **Enrollment Cap:** n/a

Students will engage in the practice and discussion of experimental science by completing three projects, drawn from the fields of condensed matter, atomic, optical, nuclear, and/or particle physics. Laboratory techniques, theoretical understanding, data analysis methods, and scientific reading and writing skills are developed in collaboration with a lab partner, and with guidance from a team of experimental physics faculty and staff. Students will learn to write the results of each project in a format that is appropriate for a peer-reviewed journal. Available experiments range from classics of the twentieth century such as relativistic mass of the electron, lifetime of the muon, superfluid helium, and the quantum Hall effect, to topics of current interest such as slow light, nitrogen-vacancy centers in diamond, superconductivity and the Meissner effect, and optical tweezers.

Course Notes: A substantial amount of outside reading is expected. Physics 191 is the same course as Physics 247; if you are a graduate students, please enroll in 247.

Physics 195B

Introduction to Quantum Materials and Devices (218288)

Robert Westervelt

2023 Spring (4 Credits) **Schedule:** MWF 0300 PM - 0415 PM

Instructor Permissions: None **Enrollment Cap:** n/a

This course provides an introduction to quantum materials and devices, including low-dimensional materials, single and double quantum dots, Josephson junctions, and graphene. Their behavior is explained using quantum and semiclassical transport, the Coulomb blockade, and superconductivity. Quantum devices offer new approaches for electronics and photonics.

Course Notes:

Formerly ENGSCI 171. Physics 195b is also offered as Applied Physics 195b. Students may not take both for credit.

Physics 201

Data Analysis for Physicists (161201)

Vinothan Manoharan

2023 Spring (4 Credits) **Schedule:** MWF 1030 AM - 1145 AM

Instructor Permissions: None **Enrollment Cap:** n/a

This course covers methods for analyzing experimental data. Students will learn a Bayesian framework for statistical inference, modern computational methods such as Markov-chain Monte Carlo techniques, and the application to problems in particle physics, biophysics, condensed matter, applied physics, astrophysics, and other fields. The course emphasizes an intuitive, principled approach to data analysis and will involve discussions of ethics and reproducible research.

Course Notes:

This course is suitable for students with limited or rusty programming skills. Students with more advanced programming skills may wish to take APMTH 207 or ENG-SCI 255.

Physics 210

General Theory of Relativity (114266)

Daniel Jafferis

2023 Spring (4 Credits) **Schedule:** MW 0300 PM - 0415 PM

Instructor Permissions: None **Enrollment Cap:** n/a

An introduction to general relativity: the principle of equivalence, Riemannian geometry, Einstein's field equation, the Schwarzschild solution, the Newtonian limit, experimental tests, black holes.

Recommended Prep:

Physics 143a (quantum mechanics), 151 (mechanics) and 153 (electromagnetism), and Mathematics 21 (multivariable calculus) or equivalents.

Physics 211BR

Holography and the infrared structure of gravity

(117201) *Andrew Strominger*

2023 Spring (4 Credits) **Instructor** **Schedule:** W 0300 PM - 0500 PM

Permissions: None **Enrollment Cap:** n/a

A pedagogical introduction to soft theorems, asymptotic symmetries and memory effects in gravitational, abelian and nonabelian gauge theories; the triangle of equivalence relations between them and the problem of holographically reformulating quantum gravity in four-dimensional asymptotically flat spacetimes.

Physics 212

Cosmology (203431)

Cora Dvorkin

2023 Spring (4 Credits) **Schedule:** T, TH 1030 AM - 1145 AM

Instructor Permissions: None **Enrollment Cap:** n/a

Graduate course on Physical Cosmology. Topics will include: the physics of Inflation, Cosmic Microwave Background anisotropies, evidence for Dark Matter, discovery of the accelerated expansion of the Universe, primordial gravitational waves, gravitational lensing, likelihood analysis, structure formation.

Physics 216

Mathematics of Modern Physics (127815)

Arthur Jaffe

2023 Spring (4 Credits) **Schedule:** TR 1030 AM - 1145 AM

Instructor Permissions: None **Enrollment Cap:** n/a

Introduction to mathematical methods relevant for understanding quantum field theory beyond perturbation theory. Topics include algebras of linear operators on Hilbert space, representation theory, semi-definite programming, and topological quantum field theory.

Physics 218

Quantum Chaos and Localization (110678)

Eric Heller

2023 Spring (4 Credits) **Schedule:** TR 1030 AM - 1145 AM

Instructor Permissions: None **Enrollment Cap:** n/a

The important subject of quantum ergodicity and thermalization is under active investigation. This course is designed to address the questions that arise, developing the fundament tools right up to the research frontier. Chaos theory, Anderson localization, scarring, random matrix theory, decoherence, entanglement, and measurement theory are considered. As much as possible, this course will adopt a seminar format, with student discussion and presentations becoming more important as the term progresses.

Physics 223B

Laboratory Electronics - Digital Circuits (109346)

David Abrams

2023 Spring (4 Credits) **Schedule:** TR 0130 PM - 0530 PM

Instructor Permissions: Instructor **Enrollment Cap:** 10

A lab-intensive introduction to digital electronic circuit design. Develops circuit intuition and debugging skills through hands-on lab exercises, each preceded by class discussion, with minimal use of mathematics and physics. After a short introduction to the basics of electronic circuits and MOSFET switches, we move onto digital devices including logic families, Boolean arithmetic, combinatorial and sequential circuits including finite state machines. We continue with analog-digital interfacing, the use of microcontrollers in embedded systems and programmable logic devices (FPGAs). We will also discuss data conversion techniques.

Course Notes: Physics 223b is the same course as Physics 123b; students may not take both for credit. If you are a graduate student, please enroll in 223b. Limited to 10 students. The analog material will be offered as a separate course at a later date.

Physics 230

Active Matter (220552)

L Mahadevan

2023 Spring (4 Credits) **Schedule:** F 1200 PM - 0245 PM

Instructor Permissions: None **Enrollment Cap:** n/a

Active matter describes out of equilibrium systems that consume energy to do work and become functional. Understanding their behavior and function has implications for biology and complex systems across scales, from cells to ecosystems, e.g., morphogenesis, collective behavior of flocks and herds, neurodynamics of locomotion, etc. The tools and concepts needed include non-equilibrium statistical mechanics, kinetic theory, soft matter, and hydrodynamics; methods for the analysis of the models include scaling, coarse-graining (homogenization, renormalization) and computational algorithms (for stochastic and deterministic DE). This course will provide an introduction to the questions, techniques and successes of this exploding field that cuts across the physical and biological sciences.

Course Notes: Open to PhD students and [AB/SM students or advanced undergraduate students] by permission of instructor. Physics 230 is also offered as Applied Math 230. Students may not take both for credit.

Physics 232

Advanced Electromagnetism (112263)

Girma Hailu

2023 Spring (4 Credits) **Schedule:** MWF 0300 PM - 0415 PM

Instructor Permissions: None **Enrollment Cap:** n/a

Maxwell's equations in macroscopic media, conservation laws, Green's functions, time-dependent solutions and radiation, scattering and diffraction, and gauge invariance. Time permitting: geometrical optics and caustics, negative refractive index materials and radiation from rapidly accelerating charges.

Physics 247

Laboratory Course in Contemporary Physics (145024)

Jenny Hoffman

Matteo Mitrano

2023 Spring (4 Credits) **Schedule:** T, TH 0130 PM - 0530 PM

Instructor Permissions: Instructor **Enrollment Cap:** n/a

Students will engage in the practice and discussion of experimental science by completing three projects, drawn from the fields of condensed matter, atomic, optical, nuclear, and/or particle physics. Laboratory techniques, theoretical understanding, data analysis methods, and scientific reading and writing skills are developed in collaboration with a lab partner, and with guidance from a team of experimental physics faculty and staff. Students will learn to write the results of each project in a format that is appropriate for a peer-reviewed journal. Available experiments range from classics of the twentieth century such as relativistic mass of the electron, lifetime of the muon, superfluid helium, and the quantum Hall effect, to topics of current interest such as slow light, nitrogen-vacancy centers in diamond, superconductivity and the Meissner effect, and optical tweezers.

Course Notes:

A substantial amount of outside reading is expected. Physics 247 is the same course as Physics 191; if you are an undergraduate, please enroll in 191.

Physics 251B

Advanced Quantum Mechanics II (111876)

Susanne Yelin

2023 Spring (4 Credits) **Schedule:** TR 0130 PM - 0245 PM

Instructor Permissions: None **Enrollment Cap:** n/a

Path integrals; relativistic quantum mechanics and quantum fields; identical particles; scattering theory; quantum information theory.

Physics 253B

Quantum Field Theory II (115442)

Xi Yin

2023 Spring (4 Credits) **Schedule:** WF 0130 PM - 0245 PM

Instructor Permissions: None **Enrollment Cap:** n/a

A continuation of Physics 253a. Topics include: the renormalization group, implications of unitarity, Yang-Mills theories, spontaneous symmetry breaking, weak interactions, anomalies, and quantum chromodynamics. Additional advanced topics may be covered depending on time and interest.

Physics 254

The Standard Model (109328)

Matthew Reece

2023 Spring (4 Credits) **Schedule:** MW 0900 AM - 1015 AM

Instructor Permissions: None **Enrollment Cap:** n/a

The Standard Model of particle physics: theory and experimental implications. Topics include nonabelian gauge theory, spontaneous symmetry breaking, anomalies, the chiral Lagrangian, QCD and jets, collider physics and simulation, the Higgs at the LHC.

Physics 264 Section: 1

Lie Algebras in Particle Physics (203512)

Howard Georgi

2023 Spring (4 Credits) **Schedule:** T, TH 1200 PM - 0115 PM

Instructor Permissions: None **Enrollment Cap:** n/a

Lie algebras and their representations are indispensible tools in quantum mechanics. Starting from the operator treatment of angular momentum, this course explores some of the (many) useful approaches to this subject with applications in various areas of physics.

Physics 265

Statistical Mechanics of Spin Glasses and Neural Networks (220597)

Haim Sompolinsky

2023 Spring (4 Credits) **Schedule:** MW 0300 PM - 0415 PM

Instructor Permissions: None **Enrollment Cap:** n/a

The course will survey advanced statistical physics approaches in the study of complex natural and artificial systems, spanning theory of spin glasses, random matrices, random dynamical systems, random graphs, and neural networks, with applications to the physics of spin glasses, chaos in random circuits, memory and learning in recurrent and deep neural networks. Surveyed methods include Replica Theory, Dynamic Mean Fields, Cavity and Message Passing, Kernels and Gaussian Processes.

Physics 295B

Quantum Theory of Solids (127979)

Subir Sachdev

2023 Spring (4 Credits) **Schedule:** T 0300 PM - 0545 PM

Instructor Permissions: None **Enrollment Cap:** n/a

A course on the application of the principles of many-particle quantum mechanics to the properties of solids. The objective is to make students familiar with the tools of second quantization and diagrammatic perturbation theory, while describing the theory of the electron liquid, the BCS theory of superconductivity, and theory of magnetism in metals and insulators. Modern topics on correlated electron systems will occupy the latter part of the course.

Course Notes:

Physics 295b is also offered as Applied Physics 295b. Students may not take both for credit.

Physics 297

Professional Writing for Scientists and Engineers (217830)

Jenny Hoffman

Suzanne Smith

2023 Spring (4 Credits) **Schedule:** W 0300 PM - 0500 PM

Instructor Permissions: Instructor **Enrollment Cap:** 20

This class leads students to develop their skills in the critical reading and writing of science and engineering. Genres will include research articles, grant proposals, school/fellowship/job applications, or lay abstracts & press releases for the non-scientific public. Crucially, students will be empowered not only to achieve their own writing goals, but also to break down these learned skills and impart them to others, as effective collaborators and mentors of younger students.