Faculty of Arts and Sciences
Course Catalog Preview

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Physics

Subject: Physics

Physics 15A

Introductory Mechanics and Relativity (111164)

David Morin

Amir Yacoby

Keith Zengel

2020 Fall (4 Credits) **Schedule:** TR 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.**

Class Notes: **Students who are unable to attend the T/Th 12:00-1:15 lecture time due to incompatible time zones will be able to watch the lecture videos at other scheduled times (to be determined). These viewings will take place in groups where students will periodically work together on short problems, as they would do in the main lecture.**

Recommended Prep: **Mathematics preparation at least at the level of Mathematics 1b concurrently is required. However, some elementary ideas from multivariable calculus may be used and students are encouraged to take Mathematics 21a concurrently.**

Additional Course Attributes:

Attribute	Value(s)
Quantitative Reasoning with Data	Yes
FAS: Course Level	Primarily for Undergraduate Students
FAS Divisional Distribution	Science & Engineering & Applied Science
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 15B

Introductory Electromagnetism and Statistical Physics (111896)

Girma Hailu

Robert Westervelt

Keith Zengel

2020 Fall (4 Credits) **Schedule:** TBD

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. Students use creative problem-solving in applying theoretical topics to explore physical phenomena and design real life applications. Topics include experimental design, model testing, error analysis, basic programming, introductory circuit analysis, and practical applications of electromagnetism. PSI will meet weekly throughout the semester.**

Class Notes: **The instructors of the course will survey the students enrolled in the course to find out the best times for lectures and labs.**

Recommended Prep: **Physics 15a, Physics 16, or written permission of the Head Tutor in Physics. Mathematics preparation at least at the level of Mathematics 21a taken concurrently is required. Vector calculus, (div, grad and curl) are used extensively--in principle, this is taught in the course. Students taking Mathematics 21a concurrently will likely find that some concepts are introduced in Physics 15b before they have seen them in Mathematics 21a. Some students may wish to postpone Physics 15b until they have completed Mathematics 21a.**

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Primarily for Undergraduate Students
Quantitative Reasoning with Data	Yes
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	Science & Engineering & Applied Science

Physics 15C

Wave Phenomena (124154)

Matteo Mitrano

Markus Greiner

2020 Fall (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.**

Class Notes: **Links to the lectures will be provided on Canvas and all lectures will be**

recorded. Students who are unable to attend the lecture time due to incompatible time zones will be able to watch the lecture videos at other scheduled times (to be determined). These viewings will take place in groups where students will periodically work together on short problems, as they would do in the main lecture. Sections (1.5 hours) meet once each week, and attendance is required and part of your grade. The course has an interactive lab component, taught by Prof. Greiner with weekly lab sessions.

Recommended Prep: **Physics 15a and 15b or Physical Science 12a-b or equivalent. Mathematics at least at the level of Math 21b. Mathematical topics introduced during lectures will include matrix calculus, complex numbers, differential equations, and Fourier analysis.**

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Primarily for Undergraduate Students
All: Cross Reg Availability	Available for Harvard Cross Registration
Quantitative Reasoning with Data	Yes
FAS Divisional Distribution	Science & Engineering & Applied Science

Physics 16

Mechanics and Special Relativity (111197)

Howard Georgi

Keith Zengel

2020 Fall (4 Credits) **Schedule:** TR 0430 PM - 0545 PM

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

Newtonian mechanics and special relativity for students with good preparation in physics and mathematics at the level of the advanced placement curriculum. Topics include oscillators damped and driven and resonance (how to rock your car out of a snow bank or use a swing), an introduction to Lagrangian mechanics and optimization, symmetries and Noether's theorem, special relativity, collisions and scattering, rotational motion, angular momentum, torque, the inertia tensor (dynamic balance), gravitation, planetary motion and a little glimpse of quantum mechanics.

Course Notes: **Principles of Scientific Inquiry (PSI) is the laboratory component of Physics 16. Topics include experimental design, model testing, error analysis, basic programming, oral presentations, and scientific writing. PSI will meet weekly throughout the semester. Emphasis is placed on collaborative teaching and learning. Many class materials are Mathematics notebooks.**

Class Notes: **Prof Georgi will go over the same material at both class times listed. Both sessions will be recorded and students are free to attend both but students MUST attend the time for which they sign up because the sessions will have pre-assigned breakout rooms and interactive polls. In-class interactions will contribute to student grades. It is likely that the morning class will be smaller than the afternoon class. See the SCHEDULE link in Canvas for more details.**

Recommended Prep: **Score of 5 on the mechanics section of the Physics C Advanced Placement exam, or equivalent. Mathematics preparation at least at the**

level of Mathematics 21a taken concurrently is required. Thorough knowledge of calculus of one variable and vectors plus some mathematical sophistication. The mathematical level will be significantly higher than that of Physics 15a. If in doubt, check the Canvas site ahead of time, or email the professor at hgeorgi@fas.harvard.edu, or just shop.

Additional Course Attributes:

Attribute	Value(s)
Quantitative Reasoning with Data	Yes
FAS Divisional Distribution	Science & Engineering & Applied Science
FAS: Course Level	Primarily for Undergraduate Students
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 16 Section: 002

Mechanics and Special Relativity (111197)

Howard Georgi

Keith Zengel

2020 Fall (4 Credits) **Schedule:** TR 0730 AM - 0845 AM

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

Newtonian mechanics and special relativity for students with good preparation in physics and mathematics at the level of the advanced placement curriculum. Topics include oscillators damped and driven and resonance (how to rock your car out of a snow bank or use a swing), an introduction to Lagrangian mechanics and optimization, symmetries and Noether's theorem, special relativity, collisions and scattering, rotational motion, angular momentum, torque, the inertia tensor (dynamic balance), gravitation, planetary motion and a little glimpse of quantum mechanics.

Course Notes: **Principles of Scientific Inquiry (PSI) is the laboratory component of Physics 16. Topics include experimental design, model testing, error analysis, basic programming, oral presentations, and scientific writing. PSI will meet weekly throughout the semester. Emphasis is placed on collaborative teaching and learning. Many class materials are Mathematics notebooks.**

Class Notes: **Prof Georgi will go over the same material at both class times listed. Both sessions will be recorded and students are free to attend both but students MUST attend the time for which they sign up because the sessions will have pre-assigned breakout rooms and interactive polls. In-class interactions will contribute to student grades. It is likely that the morning class will be smaller than the afternoon class. See the SCHEDULE link in Canvas for more details.**

Recommended Prep: **Score of 5 on the mechanics section of the Physics C Advanced Placement exam, or equivalent. Mathematics preparation at least at the level of Mathematics 21a taken concurrently is required. Thorough knowledge of calculus of one variable and vectors plus some mathematical sophistication. The mathematical level will be significantly higher than that of Physics 15a. If in doubt, check the Canvas site ahead of time, or email the professor at hgeorgi@fas.harvard.edu, or just shop.**

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Primarily for Undergraduate Students
Quantitative Reasoning with Data	Yes
FAS Divisional Distribution	Science & Engineering & Applied Science
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 90R

Supervised Research (111672)

David Morin

2020 Fall (4 Credits) **Schedule:** TBD

Instructor Permissions: Instructor **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.**

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Primarily for Undergraduate Students
FAS Divisional Distribution	Science & Engineering & Applied Science
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 91R

Supervised Reading Course for Undergraduates (110569)

David Morin

2020 Fall (4 Credits) **Schedule:** TBD

Instructor Permissions: Instructor **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.**

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Primarily for Undergraduate Students

FAS Divisional Distribution	Science & Engineering & Applied Science

Physics 95

Topics in Current Research (111967)

Isaac Silvera

2020 Fall (4 Credits) **Schedule:** W 0430 PM - 0545 PM
M 0300 PM - 0415 PM

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

Prior to taking this tutorial course, most juniors and seniors have learned physics by topics: Classical Mechanics, E&M, Quantum Mechanics, Particle Theory, Statistical Mechanics, etc. This tutorial is built around the Wednesday Night Seminar (WNS): every Wednesday two Harvard Faculty members give accessible presentations on their research to entering or interested graduate students (Gs), joined by the P95 students. Modern research uses all of the topics learned in physics courses, thus UGs are introduced to current research, including old and new developments and burning problems; they will learn from the Harvard experts as well as each other. The WNS is preceded by assigned reading and student presentations to the class on the basic underlying physics. Students develop critical skills in oral presentations, writing about research topics, and engaging in self and peer evaluation.

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

Class Notes:

All students and Gs are welcome to the WNS. During Covid, faculty presentations will be recorded and videos are watched prior to the WNS. Students prepare at least one Monday introductory presentation on Zoom and these are recorded. At the WNS the faculty describes their career trajectory and attending students ask questions on their career, physics research, and research opportunities. To accommodate students who may be in different time zones the WNS will be held on Wednesday at 4:30 pm; Mondays will be at 3 pm.

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	Science & Engineering & Applied Science
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Primarily for Undergraduate Students

Physics 123B

Laboratory Electronics (124108)

David Abrams

2020 Fall (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 at the assembly and machine code level 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. If you would like to take the course including the analog material, you should wait until it is offered as Physics 123 or ES153.**

Class Notes: **The course will consist of a combination of pre-recorded and live lectures. We will meet virtually twice a week for the live lectures or a review of the pre-recorded material, followed by the course lab. Students will work in breakout rooms in groups of two on the lab exercises. The instructor and course TFs will be available during the lab session to help students debug and understand their circuits.**

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	Science & Engineering & Applied Science
FAS: Course Level	For Undergraduate and Graduate Students

Physics 141

The Physics of Sensory Systems in Biology (121885)

Aravinthan Samuel

2020 Fall (4 Credits) **Schedule:** TR 0900 AM - 1015 AM

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

Living organisms use sensory systems to inform themselves of the sights, sounds, and smells of their surrounding environments. Sensory systems are physical measuring devices, and are therefore subject to certain limits imposed by physics. Here we will consider the physics of sensory measurement and perception, and study ways that biological systems have solved their underlying physical problems. We will discuss specific cases in vision, olfaction, and hearing from a physicist's point of view.

Class Notes: **The scheduled class meetings (Tu, Th 9-10:15 EST) will be discussions of the material presented in the pre-recorded lectures and reading assignments. If any students are unable to attend at 9 AM (e.g., because of time zone), Prof. Samuel will hold a second class meeting later on Tuesdays and Thursdays (which will be regularly scheduled based on a student poll at the start of class). Attendance at either the 9 AM or later meeting is mandatory. Students are free to join both. All zoom meetings will be recorded and made available on the website. Class participation is expected either live during these class meetings or through online discussions on Slack. For more information about the course and the schedule, please see the Canvas site.**

Recommended Prep: **Math 21a,b, Physics 15, or by permission of the instructor.**

Requirements: **Anti-Requisite: Cannot be taken for credit if NEURO 141 already complete.**

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	For Undergraduate and Graduate Students
FAS Divisional Distribution	Science & Engineering & Applied Science
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 143A

Quantum Mechanics I (108465)

John Doyle

2020 Fall (4 Credits) **Schedule:** TBD

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.

Class Notes: **Class times will be determined to maximize the overlap with students in different time zones.**

Recommended Prep: **Linear algebra including matrix diagonalization; Physics 15c or written permission of the Head Tutor.**

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	For Undergraduate and Graduate Students
FAS Divisional Distribution	Science & Engineering & Applied Science

Physics 143B

Quantum Mechanics II (111731)

Lisa Randall

2020 Fall (4 Credits) **Schedule:** WF 0130 PM - 0245 PM

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

Introduction to path integrals, identical particles, many-electron theory, WKB approximation, time-dependent perturbation theory, scattering theory, relativistic quantum mechanics, and basics of quantum information.

Class Notes: **Students who are unable to attend the WF 1:30pm - 2:45pm lecture time due to incompatible time zones will be able to watch the lecture videos at other scheduled times to be determined at the beginning of the semester. These viewings will take place in groups where students will periodically work together on short problems, as they would do in the main lecture.**

Recommended Prep: **Physics 143a.**

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	Science & Engineering & Applied Science
FAS: Course Level	For Undergraduate and Graduate Students
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 145

Elementary Particle Physics (117719)

Melissa Franklin

2020 Fall (4 Credits) **Schedule:** WF 1030 AM - 1145 AM

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

Introduction to elementary particle physics. Emphasis on concepts and phenomenology rather than on detailed calculational development of theories. Starts with the discovery of the electron in 1897 and ends with the theoretical motivations for the Higgs boson, and attempts to cover everything important in between. Students will also have a brief experience of particle physics research using Atlas experiment open data.

Recommended Prep: **Physics 143a. Physics 143b or equivalent is useful.**

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	For Undergraduate and Graduate Students
FAS Divisional Distribution	Science & Engineering & Applied Science
Quantitative Reasoning with Data	Yes

Physics 151

Mechanics (111231)

Arthur Jaffe

2020 Fall (4 Credits) **Schedule:** TR 1200 PM - 0115 PM

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

One can consider this course as a general introduction and overview to theoretical physics, even though it centers on the theoretical aspects of classical mechanics. We will study problems in the mechanics of particle motion and also problems in continuum mechanics, including classical field theory. We will consider linear systems and non-linear ones. We stress the role of conserved quantities in studying the laws of physics, and emphasize the relation between conserved quantities and symmetry. We study Langrangian and Hamiltonian mechanics from the point of view of their relation to different fields of physics, including quantum theory. We discuss soliton solutions to some non-linear classical equations. Time permitting, we will discuss other non-linear phenomena that are important in physics.

Recommended Prep: **Physics 15a, 15b or written permission of the Head Tutor; Mathematics 21a, b or equivalent.**

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	For Undergraduate and Graduate Students

FAS Divisional Distribution	Science & Engineering & Applied Science

Physics 195

Introduction to Solid State Physics (112107)

Julia Mundy

2020 Fall (4 Credits) **Schedule:** MW 0300 PM - 0415 PM

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

The physics of crystalline solids and their electric, magnetic, optical, and thermal properties. Designed as a first course in solid-state physics. Topics: free electron model; Drude model; the physics of crystal binding; crystal structure and vibration (phonons); x-ray diffraction; electrons in solids (Bloch theorem) and electronic band structures; metals and insulators; semiconductors (and their applications in pn junctions and transistors); magnetism; superconductivity.

Course Notes: **Physics 195 is also offered as Applied Physics 195. Students may not take both for credit.**

Class Notes: **If 3-4:15 PM EST falls outside of 7 AM - 10:15 PM in a student's local time zone, we will provide an alternative viewing of the lecture with the TF. This will likely be held at 8 AM EST although exact time subject to enrollment. Please note, we not not anticipate being able to offer lecture time accommodations based on conflicts with other courses, commitments or preferences.**

Recommended Prep: **Physics 15a, 15b and 15c or the equivalent. Physics 143a. Physics 181 and Physics 143b (taken concurrently) helpful but not required.**

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	For Undergraduate and Graduate Students
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	Science & Engineering & Applied Science

Physics 212

Cosmology (203431)

Cora Dvorkin

2020 Fall (4 Credits) **Schedule:** TR 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.

Class Notes: **Lectures will be held live on Tuesdays and Thursdays 10:30am - 11:45am EST. Meeting times for sections (providing 2-4 hours of synchronous interaction) will be determined together with students enrolled in the class. Lectures will be based on a Flexible Live Lecture model. Lectures and sessions will be recorded.**

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Primarily for Graduate Students
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	Science & Engineering & Applied Science

Physics 223B

Electronics for Scientists (109346)

David Abrams

2020 Fall (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 at the assembly and machine code level and programmable logic devices (FPGAs). We will also discuss data conversion techniques.

Course Notes: **Physics 223b is the same course as Physics 123b; if you are an undergraduate student, please enroll in 123b. Limited to 10 students. If you would like to take the course including the analog material, you should wait until it is offered as Physics 223.**

Class Notes: **The course will consist of a combination of pre-recorded and live lectures. We will meet virtually twice a week for the live lectures or a review of the pre-recorded material, followed by the course lab. Students will work in breakout rooms in groups of two on the lab exercises. The instructor and course TFs will be available during the lab session to help students debug and understand their circuits.**

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Primarily for Graduate Students
FAS Divisional Distribution	Science & Engineering & Applied Science
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 248R

Topics in Experimental Particle Physics (109993)

Masahiro Morii

2020 Fall (4 Credits) **Schedule:** MW 0900 AM - 1015 AM

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

Topics in the elementary particle physics, focusing on experimental studies of the Standard Model and new physics beyond the Standard Model in the past 20 years. Half of the course will review ongoing experimental research in particle physics, with or without accelerators. The other half will cover particle detector technologies and data analysis methods.

Class Notes: **Class will meet at the listed time (Mon/Wed 9:00-10:15 AM). The lectures will be recorded, but students are strongly encouraged to attend in real time. The section time (or times) will be determined after the enrollment.**

Recommended Prep: **Physics 145 or equivalent, i.e. a course at the level of Griffiths, Introduction to Elementary Particles.**

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Primarily for Graduate Students
FAS Divisional Distribution	Science & Engineering & Applied Science
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 251A

Advanced Quantum Mechanics I (111314)

C. Vafa

2020 Fall (4 Credits) **Schedule:** MW 0300 PM - 0415 PM

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

Basic course in nonrelativistic quantum mechanics. Review of wave functions and the Schrödinger Equation; Hilbert space; the WKB approximation; central forces and angular momentum; spins and their addition, measurement theory; the density matrix; perturbation theory.

Class Notes: **Prof. Vafa will hold lectures for Physics 251a on Mondays and Wednesdays, 3:00pm - 4:15pm. The lectures will be recorded, and students who cannot attend the main lecture will have the opportunity to watch the lectures the following morning - Tuesdays and Thursdays, 8:00am - 9:15am, together with a Teaching Fellow who will be able to answer any questions. In addition, there will be two sections where TFs will go over the material.**

Recommended Prep: **Physics 143a, b or equivalent, or permission of instructor.**

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Primarily for Graduate Students
FAS Divisional Distribution	Science & Engineering & Applied Science
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 253A

Quantum Field Theory I (122930)

Matthew Schwartz

2020 Fall (4 Credits) **Schedule:** TR 1030 AM - 1145 AM

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

Introduction to relativistic quantum field theory. This course covers quantum electrodynamics. Topics include canonical quantization, Feynman diagrams, spinors, gauge invariance, path integrals, ultraviolet

and infrared divergences, renormalization and applications to the quantum theory of the weak and gravitational forces.

Class Notes: **Times listed are preliminary. Please fill out the survey under quizzes so we can get a better sense of the course needs. Prof. Schwartz will give live lectures twice a week, Tuesday and Thursday from 10:30-12pm EST. Lectures will be recorded. Attendance at live lecture is not mandatory but encouraged. The lectures will be reviewed the same days at 8-9:30pm EST by the head TF Arindam. Sections are Monday at 10:30am and 8pm EST.**

Recommended Prep: **Physics 143a, b or equivalents.**

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Primarily for Graduate Students
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	Science & Engineering & Applied Science

Physics 253CR

Quantum Field Theory III (118459)

Daniel Jafferis

2020 Fall (4 Credits) **Schedule:** TR 0130 PM - 0245 PM

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

This course will cover a variety of topics related to conformal field theories, including: an introduction to conformal field theories and the conformal bootstrap with an emphasis on greater than two dimensions; large N expansions; the a-theorem; analytic bootstrap methods; a self-contained introduction to the AdS/CFT correspondence.

Class Notes: **The format of the class will be lectures at the set times via Zoom whiteboard with discussion strongly encouraged and attendance required, and an optional TF led section.**

Recommended Prep: **Quantum field theory at the level of Physics 253a.**

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Primarily for Graduate Students
FAS Divisional Distribution	Science & Engineering & Applied Science

Physics 254

The Standard Model (109328)

Matthew Reece

2020 Fall (4 Credits) **Schedule:** TBD

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.

Class Notes: **Lectures and meetings providing 2-4 hours of synchronous interaction will be determined together with students enrolled in the class.**

Recommended Prep: **Introductory relativistic field theory, at the level of Physics 253a.**

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	Science & Engineering & Applied Science
FAS: Course Level	Primarily for Graduate Students

Physics 262

Statistical Mechanics (110526)

Eugene Demler

2020 Fall (4 Credits) **Schedule:** MWF 1200 PM - 0115 PM

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

Basic principles of statistical physics and thermodynamics, with applications including: the equilibrium properties of classical and quantum gases; phase diagrams, phase transitions and critical phenomena, as illustrated by the liquid-gas transition and simple magnetic models. Time permitting, introduction to nonequilibrium phenomena including Langevin dynamics and Boltzmann equation.

Course Notes: **Also offered as Applied Physics 284. Either course can be used to satisfy the statistical mechanics requirement in the Physics PhD program or the Applied Physics model PhD program.**

Recommended Prep: **Physics 143a and Physics 181 or Engineering Sciences 181.**

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Primarily for Graduate Students
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	Science & Engineering & Applied Science

Physics 268R

Quantum Phases of Matter (122818)

Subir Sachdev

2020 Fall (4 Credits) **Schedule:** MWF 0300 PM - 0415 PM

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

Quasiparticles: Fermi liquids, superfluids, and solids. BCS theory of superconductivity. Interacting bosons. Fractionalization and the Z2 spin liquid. Quantum Ising models and gauge theories. Quantum liquids in one dimension. Kosterlitz-Thouless transitions and

dualities. Berry phases and band topology. Emergent gauge fields. Quantum liquids in high magnetic fields. Deconfined criticality. Kondo effect. The SYK model and correlated metals.

Class Notes: **Given the pandemic, we are open to rescheduling the class time, depending upon student constraints.**

Recommended Prep: **Graduate courses in quantum mechanics and statistical mechanics, including familiarity with second quantization and path integrals.**

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Primarily for Graduate Students
FAS Divisional Distribution	Science & Engineering & Applied Science
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 271

Topics in the Physics of Quantum Information (121970)

Mikhail Lukin

2020 Fall (4 Credits) **Schedule:** MW 1030 AM - 1145 AM

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

Introduction to physics of quantum information, with emphasis on ideas and experiments ranging from quantum optics to condensed matter physics. Background and theoretical tools will be introduced. The format is a combination of lectures and class presentations.

Class Notes: **Students who are unable to attend the M/W 10:30 – 11:45 lecture time due to incompatible time zones will be able to watch the lecture videos at other times, attend sections and office hours. They will work in groups to solve homework problems and to prepare and deliver the class presentations during the class time and sections, which will also be recorded.**

Recommended Prep: **Quantum mechanics at the level of introductory graduate courses.**

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Primarily for Graduate Students
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	Science & Engineering & Applied Science

Physics 287A

Introduction to String Theory (111191)

Xi Yin

2020 Fall (4 Credits) **Schedule:** TR 0300 PM - 0415 PM

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

Introduction to the perturbative formulation of string theories and dualities. Quantization of bosonic and superstrings, perturbative aspects of scattering amplitudes, supergravity, D-branes, T-duality and mirror symmetry. Also a brief overview of recent developments in string theory.

Recommended Prep: **Physics 253a, b or equivalent.**

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Primarily for Graduate Students
FAS Divisional Distribution	Science & Engineering & Applied Science
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 295A

Introduction to Quantum Theory of Solids (127980)

Prineha Narang

2020 Fall (4 Credits) **Schedule:** MW 0900 AM - 1015 AM

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

This is an introductory graduate level course in solid-state physics. Lattices and symmetries. Phonons. Electronic Structure of Crystals. Metals, semiconductors, and insulators will be covered. Electrical, optical, and thermal properties of solids will be treated based on an atomic scale picture and using the independent electron approximation. Additional topics from the theory of interacting electrons, including introduction to magnetism and superconductivity, and an introduction to topological insulators.

Class Notes: **We will meet at the lecture times listed (MW 9-10:15am). Additional times for sections and seminal paper discussions will be based on student polls during the first week. Some (not all) lecture content will be recorded and made available to make class time more interactive and to better accommodate time zone differences. Recorded lecture content is not a replacement for in-class work. We will hold expanded office hours and Q&A sessions this Fall.**

Recommended Prep: **Physics 181 or equivalent, Applied Physics 195 or equivalent, and a graduate level quantum mechanics course similar to Physics 251a. (Physics 251b would be helpful and may be taken concurrently.)**

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	Science & Engineering & Applied Science
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Primarily for Graduate Students

Physics 300C

Course-Related Work (210875)

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Not Available for Cross Registration
FAS Divisional Distribution	None
FAS: Course Level	Graduate Course

Physics 300R

Research-Related Work (210873)

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None
All: Cross Reg Availability	Not Available for Cross Registration

Physics 300T

Teaching-Related Work (210874)

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None
All: Cross Reg Availability	Not Available for Cross Registration

Physics 301A

Experimental Atomic and Elementary Particle Physics (110965)

Gerald Gabrielse

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
FAS: Course Level	Graduate Course
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 301B

Experimental Atomic and Elementary Particle Physics (110966)

Gerald Gabrielse

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 302B

Instructional Training for New Teaching Fellows (205610)

Jacob Barandes

2020 Fall (4 Credits) **Schedule:** TBD

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

Through this course, first-time teaching fellows in the Physics graduate program engage in supervised training through practice microteaching, video review, evaluation and feedback, development of instructional materials, and follow-up meetings with teaching consultants.

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
FAS: Course Level	Graduate Course
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 303A

Sensory and Behavioral Neuroscience (118884)

Aravinthan Samuel

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	None
FAS: Course Level	Graduate Course

Physics 303B

Sensory and Behavioral Neuroscience (118886)

Aravinthan Samuel

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course

Physics 304A

Topics in Field Theory and String Theory (110256)

Daniel Jafferis

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course

Physics 304B

Topics in Field Theory and String Theory (110257)

Daniel Jafferis

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None

Physics 305A

Experimental High Energy Physics (122762)

John Huth

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
FAS: Course Level	Graduate Course
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 305B

Experimental High Energy Physics (123959)

John Huth

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None

Physics 306A

Experimental Physics in Quantum Materials (211047)

Julia Mundy

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None

Physics 306B

Experimental Physics in Quantum Materials (211048)

Julia Mundy

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 307A

Atomic/Bio-physics, Quantum Optics (114638)

Lene Hau

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	None
FAS: Course Level	Graduate Course

Physics 307B

Atomic/Bio-physics, Quantum Optics (114639)

Lene Hau

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None

Physics 308A

Experimental Astrophysics and Cosmology (215745)

John Kovac

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None

Physics 308B

Experimental Astrophysics and Cosmology (215746)

John Kovac

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 309A

Introduction to String Theory (114009)

C. Vafa

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Graduate Course
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	None

Physics 309B

Topics in Elementary Particle Theory (114014)

C. Vafa

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None

Physics 310A

Experimental Condensed Matter Physics and Biophysics (215747)

Hongkun Park

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	None
FAS: Course Level	Graduate Course

Physics 310B

Experimental Condensed Matter Physics and Biophysics (215748)

Hongkun Park

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None

Physics 311A

Experimental Atomic, Molecular, and Low-Energy Particle Physics (148189)

John Doyle

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None

Physics 311B

Experimental Atomic, Molecular, and Low-Energy Particle Physics (143819)

John Doyle

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course

Physics 312A

Topics in Statistical Physics (215749)

Michael P. Brenner

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None

Physics 312B

Topics in Statistical Physics (215750)

Michael P. Brenner

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	None
FAS: Course Level	Graduate Course

Physics 313A

Experimental Condensed Matter Physics (122839)

Amir Yacoby

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
FAS: Course Level	Graduate Course
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 313B

Experimental Condensed Matter Physics (122840)

Amir Yacoby

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None

Physics 314A

Ultrafast dynamics of quantum materials (216655)

Matteo Mitrano

2020 Fall (16 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 314B

Ultrafast dynamics of quantum materials (216656)

Matteo Mitrano

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None

Physics 315A

Topics in Theoretical Atomic, Molecular, and Condensed Matter Physics (121332)

Eric Heller

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
FAS: Course Level	Graduate Course
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 315B

Topics in Theoretical Atomic, Molecular, and Condensed Matter Physics (145282)

Eric Heller

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 316A

Topics in biophysics and physical chemistry (215741)

Adam Cohen

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None

Physics 316B

Topics in biophysics and physical chemistry (215742)

Adam Cohen

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course

Physics 317A

Topics in Biophysics (119763)

Xiaowei Zhuang

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course

Physics 317B

Topics in Biophysics (119764)

Xiaowei Zhuang

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course

Physics 318A

High-Energy Neutrino Physics (216657)

Carlos Arguelles Delgado

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course

Physics 318B

High-Energy Neutrino Physics (216658)

Carlos Arguelles Delgado

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 319A

Topics in Experimental High Energy Physics (113986)

Melissa Franklin

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None

Physics 319B

Topics in Experimental High Energy Physics (113987)

Melissa Franklin

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	None
FAS: Course Level	Graduate Course

Physics 321A

Experimental Soft Condensed Matter Physics (112282)

David Weitz

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 321B

Experimental Soft Condensed Matter Physics (112283)

David Weitz

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 322A

Physics of Soft, Active and Sentient Matter (215739)

L Mahadevan

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
FAS: Course Level	Graduate Course
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 322B

Physics of Soft, Active and Sentient Matter (215740)

L Mahadevan

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	None
FAS: Course Level	Graduate Course

Physics 323A

Topics in Condensed Matter Physics (203753)

Ashvin Vishwanath

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 323B

Topics in Condensed Matter Physics (203754)

Ashvin Vishwanath

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Graduate Course
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	None

Physics 324A

Topics in Modern Astrophysics (204541)

Douglas Finkbeiner

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	Science & Engineering & Applied Science
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course

Physics 324B

Topics in Modern Astrophysics (204542)

Douglas Finkbeiner

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Graduate Course
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	Science & Engineering & Applied Science

Physics 327A

Topics in Condensed Matter Physics (117548)

David R. Nelson

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course

Physics 327B

Topics in Condensed Matter Physics (118814)

David R. Nelson

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 331A

Topics in String Theory (125320)

Xi Yin

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course

Physics 331B

Topics in String Theory (125321)

Xi Yin

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 333A

Experimental Atomic Physics (112040)

Mara Prentiss

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	None
FAS: Course Level	Graduate Course

Physics 333B

Experimental Atomic Physics (112042)

Mara Prentiss

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None

Physics 337A

Topics in Experimental High Energy Physics (114834)

Masahiro Morii

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 337B

Topics in Experimental High Energy Physics (114835)

Masahiro Morii

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 338A

Experimental Neutrino Physics and Dark Matter (205501)

Roxanne Guenette

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	None
FAS: Course Level	Graduate Course

Physics 338B

Experimental Neutrino Physics and Dark Matter (205502)

Roxanne Guenette

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 339A

Condensed Matter and Atomic Physics (120869)

Subir Sachdev

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None

Physics 339B

Condensed Matter and Atomic Physics (120868)

Subir Sachdev

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
FAS: Course Level	Graduate Course
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 341A

Topics in Experimental Atomic and Condensed Matter Physics (111169)

Markus Greiner

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Graduate Course
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	None

Physics 341B

Topics in Experimental Atomic and Condensed Matter Physics (118950)

Markus Greiner

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 343A

Observational Cosmology and Experimental Gravitation (119051)

Christopher Stubbs

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course

Physics 343B

Observational Cosmology and Experimental Gravitation (119052)

Christopher Stubbs

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course

Physics 345A

Experimental Gravitation: Radio and Radar Astronomy (115102)

Irwin Shapiro

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
FAS: Course Level	Graduate Course
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 345B

Experimental Gravitation: Radio and Radar Astronomy (115113)

Irwin Shapiro

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
FAS: Course Level	Graduate Course
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 347A

Topics in Quantum Optics (115495)

Mikhail Lukin

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course

Physics 347B

Topics in Quantum Optics (115525)

Mikhail Lukin

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	None
FAS: Course Level	Graduate Course

Physics 349A

Topics in Theoretical Particle Physics (125315)

Matthew Schwartz

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
FAS: Course Level	Graduate Course
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 349B

Topics in Theoretical Particle Physics (125316)

Matthew Schwartz

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None

Physics 350A

Experimental Physics in Low Dimensional Materials (116409)

Philip Kim

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
FAS: Course Level	Graduate Course
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 350B

Experimental Physics in Low Dimensional Materials (205462)

Philip Kim

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	None
FAS: Course Level	Graduate Course

Physics 351A

Experimental Soft Condensed Matter and Materials Physics (120872)

Vinothan Manoharan

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course

Physics 351B

Experimental Soft Condensed Matter and Materials Physics (120873)

Vinothan Manoharan

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None

Physics 357A

Experimental Condensed Matter Physics (113916)

Robert Westervelt

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	None
FAS: Course Level	Graduate Course

Physics 357B

Experimental Condensed Matter Physics (115410)

Robert Westervelt

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
FAS: Course Level	Graduate Course
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 359A

Topics in Condensed Matter Physics (115526)

Eugene Demler

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course

Physics 359B

Topics in Condensed Matter Physics (115527)

Eugene Demler

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Graduate Course
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	None

Physics 363A

Topics in Condensed Matter Theory (112091)

Efthimios Kaxiras

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 363B

Topics in Condensed Matter Theory (112092)

Efthimios Kaxiras

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course

Physics 365A

Topics in Mathematical Physics (115341)

Arthur Jaffe

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	None
FAS: Course Level	Graduate Course

Physics 365B

Topics in Mathematical Physics (110837)

Arthur Jaffe

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	None
FAS: Course Level	Graduate Course

Physics 373A

Historical and Philosophical Approaches to Modern and Contemporary Physics (143237)

Peter Galison

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Graduate Course
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	None

Physics 373B

Historical and Philosophical Approaches to Modern and Contemporary Physics (143239)

Peter Galison

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None

Physics 377A

Theoretical High Energy Physics (110740)

Tai Wu

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None

Physics 377B

Theoretical High Energy Physics (111186)

Tai Wu

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Graduate Course
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	None

Physics 379A

Topics in Elementary Particle Research and String Theory (144344)

Andrew Strominger

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
FAS: Course Level	Graduate Course
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 379B

Topics in Elementary Particle Research and String Theory (148230)

Andrew Strominger

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Graduate Course
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	None

Physics 381A

Experimental Condensed Matter Physics (119765)

Jenny Hoffman

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course

Physics 381B

Experimental Condensed Matter Physics (119766)

Jenny Hoffman

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
FAS: Course Level	Graduate Course
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 383A

Low Temperature Physics of Quantum Fluids and Solids; Ultra High Pressure Physics (113458)

Isaac Silvera

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None

Physics 383B

Low Temperature Physics of Quantum Fluids and Solids; Ultra High Pressure Physics (113887)

Isaac Silvera

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course

Physics 387A

Applied Photonics (116745)

Eric Mazur

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 387B

Applied Photonics (116755)

Eric Mazur

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 389A

Topics in Field Theory: The Standard Model and Beyond (116428)

Lisa Randall

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course

Physics 389B

Topics in Field Theory: The Standard Model and Beyond (116429)

Lisa Randall

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course
FAS Divisional Distribution	None

Physics 393A

Topics in Elementary Particle Theory (117710)

Howard Georgi

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
FAS: Course Level	Graduate Course
All: Cross Reg Availability	Available for Harvard Cross Registration

Physics 393B

Topics in Elementary Particle Theory (117913)

Howard Georgi

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Graduate Course
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	None

Physics 395A

Topics in Theoretical High Energy/String Theory (109287)

Matthew Reece

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course

Physics 395B

Topics in Theoretical High Energy/String Theory (109288)

Matthew Reece

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course

Physics 399A

Topics in Cosmology (160981)

Cora Dvorkin

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
FAS Divisional Distribution	None
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS: Course Level	Graduate Course

Physics 399B

Topics in Cosmology (160982)

Cora Dvorkin

2020 Fall (4 Credits) **Schedule:** TBD

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

Additional Course Attributes:

Attribute	Value(s)
All: Cross Reg Availability	Available for Harvard Cross Registration
FAS Divisional Distribution	None
FAS: Course Level	Graduate Course

Subject: Physical Sciences

Physical Sciences 2

Mechanics, Elasticity, Fluids, and Diffusion (122575)

Louis Deslauriers

Gregory Kestin

2020 Fall (4 Credits) **Schedule:** TR 1200 PM - 0115 PM

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

An introduction to classical mechanics, with special emphasis on the motion of organisms in fluids. Topics covered include: kinematics, Newton's laws of motion, oscillations, elasticity, random walks, diffusion, and fluids. Examples and problem set questions will be drawn from the life sciences and medicine.

Class Notes: **Required primary class time will be 12:00 - 1:15pm, but with permission from the instructor students may instead attend the "interactive lecture viewing" 7:30pm -8:45pm, run by the head TF.**

Recommended Prep: **Physical Sciences 1 (or Chemistry 7), Mathematics 1b, or the equivalent.**

Additional Course Attributes:

Attribute	Value(s)
FAS: Course Level	Primarily for Undergraduate Students
FAS Divisional Distribution	Science & Engineering & Applied Science
All: Cross Reg Availability	Available for Harvard Cross Registration

Physical Sciences 12B

Electromagnetism and Quantum Physics from an Analytic, Numerical and Experimental Perspective (109457)

Susanne Yelin

Camille Gomez-Laberge

2020 Fall (4 Credits) **Schedule:** MW 0900 AM - 1015 AM

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

This is the second term of a two-semester course sequence of introductory physical science and engineering. The focus is on quantitative scientific reasoning, with the second term exploring classical electricity and magnetism. Topics include electrostatics and magnetostatics, analog circuits, electromagnetic fields, optics, and a brief introduction to quantum physics and its applications. Examples are drawn from across the physical sciences and engineering.

The course assumes familiarity with mechanics, statistical physics, and computational techniques covered in Physical Sciences 12a offered during Spring Term (see course description). Students will further develop competence in both analytic (using pencil, paper, and multi-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 second 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: **May not be taken for credit by students who have passed Physics 15b or Physics 15c.**

Class Notes: **Physical Sciences 12b will follow a flexible live lecture model - lectures will be held at times shown, but attendance is not mandatory, and lectures will be recorded. Students have to attend mandatory laboratory sections and are expected to participate in sections / homework sessions led by Teaching Fellows. Labs and sections will be scheduled once we know in which time zones our students live. Please see syllabus cover page on Canvas for more details.**

Recommended Prep: **Physical Sciences 12a, Applied Mathematics 10**

Additional Course Attributes:

Attribute	Value(s)
Quantitative Reasoning with Data	Yes
FAS: Course Level	Primarily for Undergraduate Students
FAS Divisional Distribution	Science & Engineering & Applied Science
All: Cross Reg Availability	Available for Harvard Cross Registration