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Department of  
**Philosophy**

Courses of Study:  
Minor  
Major (BA)

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**Objectives**

The primary concern of philosophy is to explore ideas that are central to the ways we live and that we commonly use without much reflection, ideas such as truth and justice, the notion of consciousness, and good and evil. In the course of our daily lives, we take the ideas of time, language, knowledge, and our own identity for granted. Philosophy seeks to push our understanding of these ideas deeper. It is the systematic study of ideas fundamental to all the other disciplines taught at the university—the sciences, social sciences, humanities, and the arts.

The skills philosophy helps to develop—critical thinking, sound reasoning, enlightened use of one’s imagination, and the capacity to analyze complex issues—are invaluable in the study of any subject or the pursuit of any vocation. Philosophy is unavoidable: every thoughtful individual is gripped by philosophical questions and is guided by assumptions that the study of philosophy brings explicitly to light and puts into larger perspective.

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**How to Become a Major**

To become a major in philosophy, students must complete a total of nine required courses and satisfy the distribution requirement (see below) in metaphysics and epistemology; moral, social, and political philosophy; and logic, the history of philosophy. At least four must be upper-level courses. To be a candidate for honors, seniors must complete an honors thesis. For further information, contact the undergraduate advising head.

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**Faculty**

**Andreas Teuber, Chair**

Political philosophy. Moral philosophy. Aesthetics. Modern social theory. History of political thought.

**Alan Berger**

Logic. Philosophy of language. Metaphysics. Philosophy of science. Philosophical logic.

**Robert Greenberg**

Metaphysics. History of philosophy. Kant.

**Eli Hirsch, Undergraduate Advising Head**

Metaphysics. Epistemology. Medical ethics.

**Berislav Marusic**

Theory of knowledge. Philosophy of mind and language. Philosophy of perception. Metaphysics. History of modern philosophy.

**Kate Moran**

Kantian ethics. Practical reason. Moral psychology.

**Jerry Samet, Minors Adviser**

Philosophy of mind. Philosophy of psychology and cognitive science. History of philosophy.

**Marion Smiley, Honors Adviser**

Moral, social, and political philosophy.

**Palle Yourgrau**

Philosophy of language. Philosophy of mathematics. Philosophy of time. Greek philosophy.

**Affiliated Faculty**

**Richard Gaskins (on leave spring 2009)**

American legal culture. Legal rhetoric. Environmental policy. Law, social policy, and philosophy.

**Jon Levisohn (on leave 2008–2009)**

Philosophy of education. Hermeneutics and the epistemology of the humanities. Jewish education.

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**Requirements for the Minor**

**A.** All philosophy minors must complete satisfactorily at least five semester courses from among philosophy and cross-listed courses.

**B.** At least three semester courses counted toward the minor must be taught by faculty of the philosophy department.

**C.** At least one course must be upper-level (100 and above).

**D.** A maximum of one semester of PHIL 98a and b can be counted toward the minor; PEER 94a does not count.

**E.** No course with a grade below a C will count toward meeting the requirement of five courses for the minor; students may petition the department for waiver of this requirement for a maximum of one course.

**F.** No course taken pass/fail may count toward requirements for the minor.

**G.** With the approval of the department minors adviser, transfer students and those taking a year’s study abroad may apply up to two semester courses taught elsewhere toward fulfilling the requirements for the minor. The three-course requirement of B, above, remains in effect. Unless special approval is given by the minors adviser, transfer and cross-listed courses will count as lower-level electives.

## Requirements for the Major

**A.** All philosophy majors must satisfactorily complete at least nine semester courses from among philosophy and cross-listed courses. The philosophy department approves cross-listed courses for philosophy credit on a semester-by-semester basis based on the course content and instructor. Students should check the current *Schedule of Classes* or contact the philosophy undergraduate advising head to make sure that any course under consideration for philosophy credit is cross-listed in the semester in which the student plans to take it.

**B.** At least five semester courses counted toward the major must be taught by faculty of the philosophy department.

**C.** At least four courses must be upper-level (99 and above), distributed as follows:

1. At least one must be among the following core upper-level courses in moral, social, and political philosophy: PHIL 107–PHIL 112, PHIL 114–PHIL 116.

2. At least two must be among the following upper-level courses in metaphysics and epistemology: PHIL 130-147 and 150. PHIL 99 counts as an upper-level elective, but does not satisfy this distribution requirement.

**D.** At least one course must be in the history of philosophy (PHIL 161a, 162b, 168a, 170a, 179a, 180b, 181a).

**E.** At least one course must be in logic (PHIL 6a, PHIL 106b).

**F.** A maximum of one semester of PHIL 98a and b or PHIL 99a and b can be counted toward the major. (PEER 94A does not count.)

**G.** No course with a grade below a C will count toward meeting the requirement of nine courses for the major; students may petition the department for waiver of this rule for a maximum of one course.

**H.** No course taken pass/fail may count toward requirements for the major.

**I.** With the approval of the department undergraduate advising head, transfer students and those taking a year's study abroad may apply up to four semester courses taught elsewhere toward fulfilling the requirements for the major. The five-course requirement of B, above, remains in effect. Unless special approval is given by the undergraduate advising head, transfer and cross-listed courses will count as lower-level electives.

This department participates in the European cultural studies major.

## Courses of Instruction

### (1–99) Primarily for Undergraduate Students

#### PHIL 1a Introduction to Philosophy

[ hum ]

*Enrollment varies according to instructor. Refer to the Schedule of Classes each semester for information regarding applicability to the writing-intensive requirement.*

A general course presenting the problems of philosophy, especially in the areas of metaphysics, epistemology, ethics, and social and political philosophy. Texts include works of selected philosophers of various historical periods from antiquity to the present. Usually offered every semester. Staff

#### PHIL 6a Introduction to Symbolic Logic

[ hum ]

Symbolic logic provides concepts and formal techniques that elucidate deductive reasoning. Topics include truth functions and quantifiers, validity, and formal systems. Usually offered every year. Mr. Samet

#### PHIL 13b The Idea of the Market: Economic Philosophies

[ hum ]

Historical survey of philosophical assumptions in the defense and critique of market capitalism, starting from Adam Smith's views on value, self, and community. Explores philosophical alternatives in Marx, Weber, Durkheim, Dewey, and Nozick, including debates on justice and individualism. Usually offered every second year. Mr. Gaskins

#### PHIL 17a Introduction to Ethics

[ hum ]

Explores the basic concepts and theories of ethical philosophy. What makes a life good? What are our moral obligations to other people? Applications of ethical philosophy to various concrete questions will be considered. Usually offered every year. Ms. Smiley

#### PHIL 18a Philosophy of Race and Gender

[ hum ]

Examines the concepts of race and gender as well as explores the legal and social issues of sexual harassment, educational and workplace affirmative action, and the regulation of hate speech and pornography. Readings are taken principally from the fields of philosophy and law. Staff

#### PHIL 19a Human Rights

[ hum wi ]

Examines international human rights policies and the moral and political issues to which they give rise. Includes civilians' wartime rights, the role of human rights in foreign policy, and the responsibility of individuals and states to alleviate world hunger and famine. Usually offered every third year. Mr. Teuber

#### PHIL 20a Social and Political Philosophy: Democracy and Disobedience

[ hum wi ]

Focuses on the relation of the individual to the state and, in particular, on the theory and practice of nonviolent resistance, its aims, methods, achievements, and legitimacy. Examines the nature of obligation and the role of civil disobedience in a democratic society. Explores the conflict between authority and autonomy and the grounds for giving one's allegiance to any state at all. Examples include opposition to the nuclear arms race, and disobedience in China and Northern Ireland and at abortion clinics. Usually offered every third year. Mr. Teuber

**PHIL 21a Environmental Ethics**

[ hum ]

Explores the ethical dimensions of human relationships to the natural world. Looks at environmental ethical theories such as deep ecology and ecofeminism and discusses the ethics of specific environmental issues such as wilderness preservation and climate change. Usually offered every second year.  
Ms. Moran

**PHIL 22b Philosophy of Law**

[ hum wi ]

Examines the nature of criminal responsibility, causation in the law, negligence and liability, omission and the duty to rescue, and the nature and limits of law. Also, is the law more or less like chess or poker, cooking recipes, or the Ten Commandments? Usually offered every year.

Mr. Teuber and Staff

**PHIL 23b Biomedical Ethics**

[ hum ]

An examination of ethical issues that arise in a biomedical context, such as the issues of abortion, euthanasia, eugenics, lying to patients, and the right to health care. The relevance of ethical theory to such issues will be considered. Usually offered every second year.

Mr. Hirsch

**PHIL 24a Philosophy of Religion**

[ hum ]

An introduction to the major philosophical problems of religion. Discusses traditional arguments for and against the existence of God, the nature of faith and mystical experiences, the relation of religion to morality, and puzzles about the concept of God. Usually offered every second year.

Mr. Hirsch

**PHIL 35a Philosophy of Science**

[ hum ]

Philosophers in the twentieth century have often taken scientific activity to be the ideal source of our knowledge about the world. Discusses the problems involved in the analysis of the principles and methods of scientific activity, with an eye to assessing this claim. Usually offered every third year.

Mr. Berger or Mr. Hirsch

**PHIL 36b Mind, Meaning, and Language**

[ hum ]

Certain sounds we produce are meaningful; others are not. What is it that makes a sound meaningful? What settles what we mean? And how can we know what we mean? Readings include Grice, Searle, Putnam, Quine, and Davidson. Usually offered every second year.

Mr. Marusic

**PHIL 37a Philosophy of Language**

[ hum ]

Theories of meaning, reference, and methodological issues in account of language and translation. Readings from contemporary sources. Usually offered every year.

Mr. Berger, Mr. Greenberg, or Mr. Yourgrau

**PHIL 38b Philosophy of Mathematics**

[ hum ]

*Prerequisite: A course in logic or permission of the instructor.*

Basic issues in the foundations of mathematics will be explored through close study of selections from Frege, Russell, Carnap, and others, as well as from contemporary philosophers. Questions addressed include: What are the natural numbers? Do they exist in the same sense as tables and chairs? How can "finite beings" grasp infinity? What is the relationship between arithmetic and geometry? The classic foundational "programs," logicism, formalism, and intuitionism, are explored. Usually offered every second year.

Mr. Berger or Mr. Yourgrau

**PHIL 39b Philosophy of Mind**

[ hum ]

Covers the central issue in the philosophy of mind: the mind-body problem. This is the ongoing attempt to understand the relation between our minds—our thoughts, perceptions, feelings, and so on—and our bodies. Is the mind just a complex configuration of (neural) matter, or is there something about it that's irreducibly different from every physical thing? Topics include intentionality, consciousness, functionalism, reductionism, and the philosophical implications of recent work in neuroscience, cognitive science, and artificial intelligence. Usually offered every year.

Mr. Samet

**PHIL 66b Contemporary Analytic Philosophy**

[ hum ]

Covers major figures and schools of philosophy in the twentieth century. A basic historical treatment of this period, stressing its continuity with the modern period. Emphasis on the role of logic and language in solving philosophical problems, such as the possibility of doing metaphysics, and whether there are a priori, necessary, or analytic truths. Provides both an excellent introduction to the philosophy curriculum, as well as important grounding for graduate work in philosophy. Usually offered every second year.

Mr. Berger or Mr. Greenberg

**PHIL 74b Foundations of American Pragmatism**

[ hum ]

Introduction to American instrumentalism as a philosophical movement and cultural force. Special attention to pragmatic imprints on law and science across the twentieth century. Recurring critical debates over ethical relativism, religious skepticism, legal activism, and the cult of scientific and professional expertise. Usually offered every fourth year.

Mr. Gaskins

**PHIL 78a Existentialism**

[ hum ]

A study of French existentialist philosophy and its reception, with special attention to the works of Jean-Paul Sartre and Simone de Beauvoir. Usually offered every second year.

Mr. Marusic

**PHIL 98a Readings in Philosophy**

*A maximum of one semester of PHIL 98a,b or PHIL 99a,b can be counted toward the major.*

Readings, reports, and discussions on assigned topics. Usually offered every semester.

Staff

**PHIL 98b Readings in Philosophy**

*A maximum of one semester of PHIL 98a,b or PHIL 99a,b can be counted toward the major.*

Readings, reports, and discussions on assigned topics. Usually offered every semester.

Staff

**PHIL 99a Senior Research I**

*A maximum of one semester of PHIL 98a,b or PHIL 99a,b can be counted toward the major.*

A senior whose GPA in philosophy courses is 3.50 or above may petition to be admitted to the senior honors program and enroll in this course. The course involves the preparation and beginning of a thesis, under the direction of a member of the faculty, that could serve, in the judgment of the faculty member, as progress toward the completion of a senior honors thesis. Usually offered every year.

Staff

**PHIL 99b Senior Research II**

*Prerequisite: Satisfactory completion of PHIL 99a. A maximum of one semester of PHIL 98a,b or PHIL 99a,b can be counted toward the major.*

Seniors who are candidates for degrees with honors in philosophy must register for this course and complete a senior honors thesis, under the direction of a member of the faculty. Usually offered every year.

Staff

## (100–199) For Both Undergraduate and Graduate Students

### PHIL 106b Mathematical Logic

[ hum sn ]

*Prerequisite:* One course in logic or permission of the instructor.

Covers in detail several of the following proofs: the Godel Incompleteness Results, Tarski's Undefinability of Truth Theorem, Church's Theorem on the Undecidability of Predicate Logic, and Elementary Recursive Function Theory. Usually offered every year.

Staff

### PHIL 108a Philosophy and Gender

[ hum ]

*Prerequisite:* PHIL 1a or PHIL 17a.

Explores the place of gender in the works of particular Western philosophers (e.g., Kant, Hume, and Rousseau) and uses the tools of contemporary analytic philosophy to address questions about gender equality, sexual objectification, and the nature of masculinity. Usually offered every third year.

Ms. Smiley

### PHIL 110a The Good Life or How Should One Live?

[ hum wi ]

*Prerequisite:* Two courses in philosophy or permission of the instructor.

Much recent philosophy in the English-speaking world has focused on the nature of things and our knowledge and reasoning about such things. But most human mental activity is not theoretical, but practical; less concerned with how the world is than with what is to be done. In the earliest moments of Western philosophy, Socrates distinguished himself by asking, "How should one live?" Increasingly, however, that question and its variants have taken a back seat in philosophy, abandoned to the best-seller lists and to publications produced by recent graduates of assertiveness training workshops. We reclaim these questions and take them up again from within the discipline of philosophy itself. Questions asked include: "How should I live?" "What are the good things in life?" "Does life have meaning?" Readings include Darwin, Nietzsche, Freud, Murdoch, Dennett, Dawkins, Hacking, Nozick, and Nagel. Usually offered every third year.

Mr. Teuber

### PHIL 111a What Is Justice?

[ hum ]

*Prerequisite:* One course in philosophy or political theory or permission of the instructor.

What is justice and what does justice require? The course examines theories of justice, both classical and contemporary. Topics include liberty and equality, "who gets what and how much," welfare- and resource-based principles of justice, justice as a virtue, liberalism, multiculturalism, and globalization. Usually offered every year.

Ms. Smiley

### PHIL 112b Philosophy and Public Policy

[ hum ]

*Prerequisites:* Two courses in philosophy or economics (or one course in each subject) or permission of the instructor.

The course examines the case that can be made for and against distributing certain goods and services on an open market as the result of free exchange, or through public mechanisms of planning and control. For example, it discusses the arguments for and against public funding of the arts, fire departments, patents, zoning laws, and national health care. Usually offered every fourth year.

Mr. Teuber

### PHIL 113b Aesthetics: Painting, Photography, and Film

[ ca hum wi ]

Explores representation in painting, photography, and film by studying painters Rembrandt, Velazquez, and Vermeer, as well as later works by Manet, Degas, Cezanne, and Picasso; photographers Ansel Adams, Dorothea Lange, Edward Weston, Walker Evans, Alfred Stieglitz, and Diane Arbus; and filmmakers Renoir and Hitchcock. Usually offered every third year.

Mr. Teuber

### PHIL 114b Topics in Ethical Theory

[ hum ]

*Prerequisite:* PHIL 1a, or PHIL 17a, or PHIL 23b.

Is morality something we have reasons to obey regardless of our interests and desires, or do the reasons grow out of our interests and desires? Is the moral life always a personally satisfying life? Is morality a social invention or is it more deeply rooted in the nature of things? This course will address such questions. Usually offered every year.

Ms. Smiley

### PHIL 115a Relativism, Pluralism, and Social Reform

[ hum ]

*Prerequisite:* One philosophy course or permission of the instructor.

Explores the ethical implications of moral difference and disagreement. Does the existence of a moral diversity in the world suggest that morality is culturally relative? If so, is there any way to justify cultural criticism and social reform? Usually offered every second year.

Staff

### PHIL 116a Topics in Political Philosophy

[ hum ]

*Prerequisite:* PHIL 1a, PHIL 17a, or POL 10a.

Explores social contract theories of political obligation, the right to rebel against the state, and the possibility of a global political community. Usually offered every second year.

Ms. Smiley

### PHIL 117b Topics in the Philosophy of Law

[ hum ]

*Prerequisites:* Two courses in philosophy or legal studies, or one course in each, or one in either subject and one of the following:

POL 115a, POL 116a, or permission of the instructor. Topics vary from year to year. Course may be repeated once for credit.

Topics include such key issues as privacy, free speech, theories of judicial review, and legal and moral rights. Usually offered every fourth year.

Staff

### PHIL 119b Chinese Philosophy

[ hum nw ]

Focuses on the major philosophical schools of Classical China, covering the time between the twelfth century BCE through the unification of China in 221 BCE. Special attention is given to the ethical, religious, and political thought of the Confucian, Mohist, Daoist, and Legalist "schools." No knowledge of Chinese is required; all readings are in translation. Usually offered every third year.

Staff

### PHIL 123b Topics in Biomedical Ethics

[ hum ]

Examines a number of philosophical, scientific, social, and ethical issues concerning mental illness. Topics include: radical critiques of psychiatry, the concept of mental illness, the nature and problems of psychiatric diagnostic classification, objectivity and the scientific credibility of research concerning mental illness and its treatment, controversial treatments and intervention practices (e.g., electroconvulsive therapy, suicide prevention, involuntary treatment), and psycholegal issues (e.g., duty to warn, competence to stand trial, insanity defense). Readings are drawn from the relevant disciplinary literatures. Usually offered every second year.

Staff

**PHIL 133a Consciousness, Brain, and Self**

[ hum ]

*Prerequisite: One course in philosophy, psychology, or neuroscience, or permission of the instructor.*

Consciousness—sensing, feeling, thinking—is our life. But it's hard to understand how mere "meat puppets" like us could be conscious. Are scientists closing in on a solution? And if they are, what does that say about who we are and how we ought to live? Usually offered every third year.

Mr. Samet

**PHIL 134b Philosophy of Perception**

[ hum ]

*Prerequisite: PHIL 1a or PHIL 66b or one course numbered PHIL 35a through PHIL 39b.*

What do we perceive? Do we perceive objects in the world or do we infer on the basis of sensory data that there are such objects? And how do our answers to these questions depend on or shape our metaphysics? Usually offered every second year.

Mr. Marusic

**PHIL 135a Theory of Knowledge**

[ hum ]

*Prerequisite: PHIL 1a or PHIL 66b or one course numbered PHIL 35a through PHIL 39b.*

An investigation into the nature, sources, and extent of human knowledge, with emphasis on the problem of justifying our beliefs about the existence and character of the external world. Usually offered every second year.

Mr. Greenberg, Mr. Hirsch, or Mr. Marusic

**PHIL 136a Personal Identity**

[ hum ]

*Prerequisite: PHIL 1a or PHIL 66b or one course numbered PHIL 35a through PHIL 39b.*

An examination of some major issues involved in the question of personal identity. What am I? What are the conditions of self-identity? How does the identity of the self relate to the identity of a physical object? Is identity an illusion? Usually offered every second year.

Mr. Hirsch or Mr. Greenberg

**PHIL 137a Nature or Nurture? The Innateness Controversy**

[ hum ]

*Prerequisite: One course in philosophy or permission of the instructor.*

The question: How much of what we are—what we believe and know, what we think and feel, and how we act—is due to our environment and training and how much is a function of our inherent nature? This interdisciplinary course covers: the main answers in the history of philosophy (from Plato through Logical Positivism); the contemporary philosophical debate on this question; and current scientific research in linguistics, psychology, ethology, artificial intelligence, and evolutionary biology. Usually offered every third year.

Mr. Samet

**PHIL 138a Metaphysics**

[ hum ]

*Prerequisite: PHIL 1a or PHIL 66b or one course numbered PHIL 35a through PHIL 39b.*

Metaphysics is an attempt to describe in a general way the nature of reality and how people fit into the scheme of things. Topics vary from year to year but may include truth, ontology, necessity, free will, causality, temporal passage, and identity. Usually offered every year.

Mr. Berger, Mr. Greenberg, or Mr. Hirsch

**PHIL 139b Topics in Logic**

[ hum ]

*Prerequisite: PHIL 1a or PHIL 66b or one course numbered PHIL 35a through PHIL 39b.*

Topics may vary from year to year and the course may be repeated for credit. Topics in the past have included: Is logic an a priori or empirical science? Does it make sense to say that we can revise or adopt our logic? Is logic true by conventional rules of language? Set theory and the paradoxes. Usually offered every year.

Mr. Berger or Mr. Yourgrau

**PHIL 140a Logic and Language**

[ hum ]

*Prerequisite: PHIL 1a, PHIL 6a, or PHIL 106b, or permission of the instructor.*

Covers basic problems and puzzles regarding reference and identity-topics that dominate issues in philosophy of language today. Topics include puzzles about belief, necessity, substitutivity of identity statements, and formal semantics for parts of language that includes modal and intensional notions. Usually offered every second year.

Mr. Berger or Mr. Yourgrau

**PHIL 141b Topics in Philosophy and Cognitive Science**

[ hum ss ]

*Prerequisite: PHIL 1a or PHIL 66b or one course numbered PHIL 35a through PHIL 39b.*

Explores the various ways in which philosophical ideas are reflected in and illuminate scientific theorizing about the mind and also examines the implications of recent work in the cognitive sciences for traditional philosophical concerns. Topics differ from year to year. Usually offered every fourth year.

Mr. Samet

**PHIL 142b The Subjective Point of View**

[ hum ]

*Prerequisite: PHIL 1a or PHIL 66b or one course numbered PHIL 35a through PHIL 39b.*

Explores the relation between the variable and the constant in experience, a relation embraced by what we as subjects bring to our experience, our subjective point of view of the world. Addresses the question of how our experience, with its inherent subjectivity, variable and constant, can provide us with knowledge of reality. Usually offered every third year.

Mr. Greenberg

**PHIL 143a Consciousness and Self**

[ hum ]

*Prerequisite: PHIL 1a or PHIL 66b or one course numbered PHIL 35a through PHIL 39b.*

The origins of our concept of consciousness can be found among the fundamental ideas of modern philosophy, tied to the concept of self. This connection will be the subject matter of this course. Usually offered every fourth year.

Mr. Greenberg

**PHIL 144a Philosophical Problems of Space and Time**

[ hum ]

*Prerequisite: PHIL 1a or PHIL 66b or one course numbered PHIL 35a through PHIL 39b.*

An examination of philosophical problems concerning the concepts of space and time as these arise in contemporary physics, modern logic and metaphysics, as well as in everyday life. Specific topics usually include philosophical aspects of Einstein's theory of relativity, the possibility of "time travel," the distinction between space and time, and McTaggart's famous distinction between the "A-series" and the "B-series" of time. Usually offered every third year.

Mr. Berger, Mr. Hirsch, or Mr. Yourgrau

**PHIL 145b Topics in the Philosophy of Language**

[ hum ]

*Prerequisite: PHIL 1a or PHIL 66b or one course numbered PHIL 35a through PHIL 39b.*

Topics may vary from year to year and course may be repeated for credit. Topics include the relationship between the language we speak and our view of reality, reference, the sense in which language may structure reality, and formal semantics.

Usually offered every third year.

Mr. Berger or Mr. Hirsch

**PHIL 146a Idea of God**

[ hum ]

*Prerequisite: PHIL 1a or PHIL 66b or one course numbered PHIL 35a through PHIL 39b.*

Engages in a philosophical investigation, not of religion as an institution but of the very idea of God. Studies the distinction between human being and divine being and addresses the issue of the relation of God's essence to his existence. Usually offered every second year.

Mr. Yourgrau

**PHIL 148b Philosophy of the Humanities**

[ hum ]

*Prerequisite: PHIL 1a or PHIL 66b or one course numbered PHIL 35a through PHIL 39b.*

Explores the nature of the humanities, their methods and goals, with a particular focus on the discipline of history. Is history a "science," and should it be? What is the nature of the claims to knowledge that historians (and other humanists) make? How does one know a narrative? How does one know an interpretation? And what is the role of power in legitimating the claims to knowledge advanced by scholars, teachers, and students of history? Usually offered every fourth year.

Mr. Levisohn

**PHIL 149a Leibniz, Hume, and Kant on Necessity**

[ hum ]

*Prerequisite: PHIL 1a or a course in the history of modern philosophy or analytic philosophy.*

An investigation into the views of three historical philosophers—Leibniz, Hume, and Kant—on the concept of necessity, with limited reference to contemporary treatment of the concept by W. V. Quine and early David Kaplan. Related concept of a priori and analyticity are also discussed. Usually offered every fourth year.

Mr. Greenberg

**PHIL 150b Topics in Epistemology and Metaphysics**

[ hum ]

*Prerequisite: PHIL 1a or PHIL 66b, or one course numbered PHIL 35a through PHIL 39b.*

Topics vary each year; course may be repeated for credit. Usually offered every second year.

Mr. Berger, Mr. Hirsch, or Mr. Marusic

**PHIL 161a Plato**

[ hum ]

*Prerequisite: PHIL 1a or permission of the instructor.*

An introduction to Plato's thought through an intensive reading of several major dialogues. Usually offered every second year.

Mr. Yourgrau

**PHIL 162b Aristotle**

[ hum ]

*Prerequisite: PHIL 1a or permission of the instructor.*

An introduction to Aristotle's philosophy through an intensive reading of selected texts. Usually offered every year.

Mr. Yourgrau

**PHIL 168a Kant**

[ hum ]

*Prerequisite: PHIL 1a or permission of the instructor.*

An attempt to understand and evaluate the main ideas of the *Critique of Pure Reason*, the subjectivity of space and time, the nature of consciousness, and the objectivity of the concepts of substance and causality. Usually offered every year.

Mr. Greenberg

**PHIL 170a Special Topics in History of Philosophy: Descartes' Meditations**

[ hum ]

*Prerequisite: One course in philosophy.*

An advanced seminar focusing on a single philosopher or text, or on the way a number of key figures in the history of philosophy have addressed a philosophical problem or topic. Recent offerings: (1) a close reading of Descartes' *Meditations on First Philosophy*, the essential text of continental rationalism and the foundation stone of modern philosophy, and (2) a close reading of Hume's *Enquiry Concerning Human Understanding*, a central text of eighteenth-century British empiricism. Usually offered every fourth year.

Mr. Samet

**PHIL 178b Major Figures in the Christian Faith**

[ hum ]

*Prerequisite: PHIL 1a.*

Presents the important theological contributions of the major thinkers of the Western Church, covering the modern period. Usually offered every fourth year.

Mr. Yourgrau

**PHIL 179a God, Man, and World: Descartes, Spinoza, Leibniz**

[ hum ]

*Prerequisite: One course in philosophy.*

The subject of this course is Rationalism, the seventeenth-century European philosophical movement that maintains the supremacy of "pure reason" as a means of obtaining substantial truths about the world. This course analyzes key writings of the three most influential rationalist thinkers of this period, attempting to elucidate several themes that not only characterize these writers as rationalists, but which continue to inspire philosophers and others who attempt to come to terms with the nature of the world and human existence. Students will read substantial portions of historically significant original works are, dissect and criticize them, consider some of the respected secondary literature, and also consider their relevance to contemporary philosophy. Usually offered every third year.

Mr. Samet

**PHIL 180b From Sensation to Understanding: Locke, Berkeley, and Hume**

[ hum ]

*Prerequisite: One course in philosophy.*

The subject of this course is Empiricism, the (mainly) British philosophical movement of the seventeenth and eighteenth centuries that develops and defends the view that our understanding of ourselves and the world is wholly based on our experience. Empiricism is one of the two great competing traditions characterizing what has come to be known as the Modern period in philosophy. Analyzes key writings of the three most influential empiricist thinkers of this period, and attempts to elucidate several themes which get to the heart of their empiricism, and which continue to exert a powerful influence on contemporary philosophical thought. Students will read substantial portions of historically significant original works, dissect and criticize them, consider some of the respected secondary literature, and also consider their relevance to contemporary philosophy. Usually offered every third year.

Mr. Samet

**PHIL 181a Schopenhauer and Nietzsche: Art and Politics**

[ hum ]

*Prerequisite: One course in philosophy or European cultural studies.*

Examines two philosophers whose subversive ideas and brilliant prose have stirred the deepest human anxieties and hopes for man's relationship to nature, values, aesthetics, religion, law, and society. Their impact on art and politics illustrated through works by Mann and Kafka. Usually offered every third year.

Mr. Gaskins

**PHIL 182a Wittgenstein's Philosophical Investigations**

[ hum ]

An intensive study of Ludwig Wittgenstein's seminal work, *Philosophical Investigations*. This course should be of interest to philosophy and literature students who want to learn about this great philosopher's influential views on the nature of language and interpretation. Usually offered every second year. Mr. Flesch and Mr. Hirsch

**Cross-Listed Courses**

The department approves cross-listed courses for philosophy credit each semester, based on the course content and instructor. If approved, cross-listed courses (irrespective of the number assigned by the home department) count only as lower-level electives and do not satisfy any of the philosophy department's distribution requirements. Please consult the *Schedule of Classes* or contact the undergraduate advising head to confirm if a particular class is cross-listed for philosophy credit in a given semester.

**ED 159b**

Philosophy of Education

**LING 130a**

Formal Semantics: Truth, Meaning, and Language

**NEJS 159a**

Major Trends in Modern Jewish Philosophy

**POL 186b**

Classical Political Thought

**Physical Education****Objectives**

Movement and activity are basic functions necessary for the human body to grow, develop, and maintain health. Realizing that good health is largely self-controlled, the physical education department's curriculum focuses on fitness, dance, and lifetime sports to encourage lifestyle changes in its students.

Brandeis prides itself on education of the body as well as education of the intellect. The physical education department curriculum focuses on cardiovascular fitness, flexibility, body composition (percent of body fat), the maintenance of muscular strength, and endurance.

Students should complete the physical education requirement by the end of their sophomore year. Transfer students may offer toward the requirement physical education courses that appear on the transcript of their previous institutions. Most physical education courses meet for two hours per week and are limited in size; preference is given to first-year students.

Any student who has served in the military, foreign or domestic, is exempt from the entire physical education requirement. Proper documentation must be provided to the physical education department.

**Faculty****Sheryl Sousa, Chair****Jamele Adams**

First-year experience.

**Carol Ann Baer**

Dance.

**Vincent Christiano**

Karate.

**Kelly Cotter**

Fitness—Pilates.

**Michael Coven**

Fitness—weight training. Team sports.

**Denise Dallamora**

Fitness—yoga.

**Lisa DeNicola**

Fitness—aerobics.

**John Evans**

Fitness—D.D.R.

**Scott Foulis**

Team sports—basketball &amp; volleyball.

**Jessica Johnson**

Aquatics. First aid. CPR.

**Ben Lamanna**

Fitness—total body workout. Racquet sports.

**Zabelle Margosian**

Dance.

**Danielle Miller**

Fitness—body sculpture.

**Michelle O'Malley**

First-year experience.

**Mark Reytblat**

Fitness—team sports.

**Niki Rybko**

First aid. CPR.

**William Shipman**

Fencing. Racquet sports. Golf.

**Colin Tabb**

Power walking. Cardio fitness.

**Jean-Robert Theodat**

Fitness—Tae Kwon Do.

**James True**

Personal safety.

**Richard Varney**

Team sports. Racquet sports. Golf.

**James Zotz**

Aquatics. Pilates. Stress management.

## Undergraduate Degree Requirements

Physical education is an undergraduate degree requirement at Brandeis. This requirement is satisfied by successful completion of two, semester-long, noncredit courses, participation on a varsity athletics team, or passing a fitness test taken during the first two years.

Completion of one full season of participation on a varsity athletics team, as certificated by the Department of Athletics, is equal to the completion of one semester-long, noncredit course. A student may satisfy the physical education requirement through the completion of two full seasons of participation on a varsity athletics teams. This policy was instituted in the academic year 2004–2005 and is not retroactive. Participation in club sports or intramurals does not count toward the physical education requirement.

All students have four opportunities during their first two years at Brandeis to exempt themselves from all or part of the physical education requirement by taking a battery of tests that measure muscular strength and endurance, flexibility, cardiovascular endurance, and body composition. A student unable to pass the fitness test should enroll in a course in the Personal Fitness Group.

A grade of 70–79 percent on the fitness test will exempt you from one physical education class or half of the requirement. A grade of 80 percent or better will exempt a student from two physical education classes or all of the requirement. Physical education classes meet the first day of regular classes and attendance is mandatory. A maximum of two absences is allowed in a class that meets once per week and a maximum of four absences is allowed in a class that meets twice per week.

## Courses of Instruction

### (1–99) Primarily for Undergraduate Students

#### PE 1a Beginner's Swimming

[ pe-sc ]

Designed to teach the nonswimmer the basic skills of floating, treading water, and the crawl stroke. Usually offered in the fall semester.

Staff

#### PE 2a Swim Fitness

[ pe-sc ]

Designed to improve overall fitness levels through lap swimming. Emphasis is on using the heart rate to improve cardiovascular endurance level. The instruction is geared more to understanding and implementing swimming as a vehicle to fitness and less toward teaching individual swimming stroke mechanics. Usually offered every semester.

Mr. Zotz

#### PE 2b Water Aerobics

[ pe-sc ]

Designed to improve overall fitness levels through water exercise. Emphasis is on improving cardiovascular endurance through a cross-section of exercises done in the water. Usually offered every semester.

Mr. Zotz

#### PE 5a First Aid and Community CPR

[ pe-1 ]

An instruction in the American Red Cross standard First Aid and Cardiopulmonary Resuscitation and AED (automated external defibrillator). Upon course completion, certificates will be given to students who successfully complete the skills test and pass the written test with scores of 80 percent or better. Usually offered every semester.

Ms. Johnson and Ms. Rybko

#### PE 6a Sports Medicine

[ pe-1 ]

An introduction to sports medicine. A basic understanding of human anatomy and sports is required. The course looks at many facets of sports medicine, including weight training, nutrition, drug education, flexibility, and rehabilitation. Each of the major joints of the body is examined anatomically, based on injuries sustained. Class also looks briefly at surgical repair of certain joints. Usually offered every spring semester.

Staff

#### PE 9a Volleyball

[ pe-1 ]

An introduction to the fundamentals of volleyball—scoring, rotation, rules, and the basic skills of passing, serving, hitting, and setting. Methodology includes lectures, demonstrations, drills, but mostly play. Course is intended to be fun through active participation. Usually offered every fall.

Staff

#### PE 10a Basketball

[ pe-1 ]

Structured to meet needs of students with an overview of offensive and defensive skills. Methods used are lecture, demonstrations, drills, and play. Usually offered every semester.

Staff

#### PE 11a Nautilus/Free Weights

[ pe-1 ]

Instruction of proper use of Nautilus, Body Master, and free-weight training. Classes also include aerobic activity such as use of Lifecycles and Tru-Climb 450. Usually offered every semester.

Mr. Coven

#### PE 12a Power Step

[ pe-1 ]

This class is based on step aerobics, with the addition of weights and/or cords to increase the intensity of the class and increase the upper body workout. Usually offered every semester.

Ms. DeNicola

#### PE 14a Yoga

[ pe-1 ]

Hatha yoga is physical in nature and is based on proper body alignment and is distinctive in its use of props such as belts, walls, and blankets. Classes start with gentle stretches and work toward more challenging poses. Usually offered every semester.

Ms. Dallamora

#### PE 16a Golf

[ pe-1 ]

A beginning golf group instructional course. Techniques such as grip, set-up, swing, chipping, pitching, and putting are covered. Some discussion on golf rules and etiquette is introduced. Usually offered every semester.

Mr. Varney

#### PE 17a Beginner's Fencing

[ pe-1 ]

Covers basic mobility, offensive and defensive strategy, and tactics. Competitive bouts is done, with a class tournament scheduled for the end of the semester. Usually offered every semester.

Mr. Shipman

#### PE 18b Intermediate Fencing

[ pe-1 ]

*Prerequisite: PE 17a.*

Basic mobility and blade actions are reviewed, with advanced attacks and tactics, strategy, and more bouts included. Introduction to saber and epee. Usually offered every spring semester.

Mr. Shipman

#### PE 20a Intermediate Tennis

[ pe-1 ]

*Prerequisite: prior tennis experience.*

Designed for the student who already possesses the fundamental tennis skills and knows how to play the game. Emphasis is on match play tactics and the integration of footwork, conditioning, and shot selection into a complete game. Usually offered every semester.

Mr. Lamanna

**PE 21a Tennis**

[ pe-1 ]

*Students must provide their own racquet.*  
An overview of grips, ground strokes, serve, return of serve, and net play. Basic singles and doubles strategy, rules, and scoring of the game are introduced. Usually offered every semester.

Mr. Lamanna

**PE 22a Squash**

[ pe-1 ]

*Students must provide their own racquet and protective eyewear.*

Covers rules for squash. The serve, return of serve, grip, forehand, backhand, and other basic strokes are introduced. Strategy and play will be emphasized. Usually offered every semester.

Mr. Lamanna and Mr. Varney

**PE 24a Beginner's Karate**

[ pe-1 ]

The first three Kata of Uechi-Ryu are taught. Application to kanshiwa and kanshu is explored. Students begin slow speed, focused free-fighting, with emphasis on technique from Uechi-Ryu Kata. Usually offered every semester.

Mr. Christiano

**PE 25a Intermediate Karate**

[ pe-1 ]

*Prerequisite: PE 24a.*

Advanced Kotekitae and body conditioning, especially shin and toe development, is practiced. Study of self-defense focuses on multiple, unarmed attackers. Usually offered every spring semester.

Mr. Christiano

**PE 26a Beginning Social Dance**

[ pe-1 ]

Learn the basic skills and steps in the American style of waltz, cha-cha, swing, rumba, and mambo. Usually offered every semester.

Ms. Evans-Baer

**PE 26b Beginning Social Dance, Part II**

[ pe-1 ]

*Prerequisite: PE 26a or comparable dance experience.*

A continuation of PE 26a. Previous knowledge of waltz, cha-cha, swing, rumba, and mambo is helpful, but not necessary. Usually offered every spring semester.

Ms. Evans-Baer

**PE 27a Keeping Stress in Check**

[ pe-1 ]

Designed to help students achieve wellness through exercise, nutrition, and health education. Students are taught to recognize components of their lifestyles that are detrimental to their health while developing a personal fitness program. Usually offered every semester.

Mr. Zotz

**PE 31a Ballet**

[ pe-1 ]

Students begin with warm-up exercises (barre work); balance, control, stretch, and arm movements will be incorporated. When dancers become strong enough, class will proceed to center work, including balancing exercises, turns, and jumps. Dancers will learn stretching and cool-down exercises. Usually offered every semester.

Ms. Margosian

**PE 31b Intermediate Ballet**

[ pe-1 ]

Students need to have two to three years of recent ballet training to participate. Same material as beginning ballet is covered at an accelerated pace. Russian-style ballet and the Legat technique are taught. Usually offered every semester.

Ms. Margosian

**PE 32a Modern Dance**

[ pe-1 ]

A beginning course in modern dance technique, based on Martha Graham and Jose Limon style. The course will offer stretching and alignment to dance sequences. Usually offered every semester.

Staff

**PE 33a Walking for Fitness**

[ pe-1 ]

Designed to improve your overall fitness level through walking. Emphasis is on improving cardiovascular endurance level. Instruction is given on how to develop a personal fitness program. Usually offered every semester.

Staff

**PE 35a Power Walking**

[ pe-1 ]

Designed to help increase the fitness level of students through a high-intensity, low-impact workout. The workout consists of walking with hand-held weights. Usually offered every semester.

Mr. Tabb

**PE 38a Indoor Soccer**

[ pe-1 ]

An introduction to the fundamentals of soccer—skill development, dribbling, passing, shooting, offense, and defense. Intended to be fun through participation in elementary games and exercises. Usually offered every semester.

Mr. Reytblat

**PE 40a Personal Safety/Self-Defense**

[ pe-1 ]

Teaches students to assert themselves and deal with the natural excitement and fear that can cause a person to freeze up when faced with an aggressor. Students are led through simple but effective drills and scenarios designed to help them overcome the uncomfortable feelings and fear that can mark a person as an easy target for an attack. Usually offered every semester.

Mr. True

**PE 41a Pilates**

[ pe-1 ]

A series of exercises designed to strengthen the abdominals and back muscles. These core exercises are combined with some yoga stretches to enhance flexibility and well-being. Usually offered every semester.

Ms. Cotter or Mr. Zotz

**PE 42a Tae Kwon Do**

[ pe-1 ]

A series of physical exercises designed to build strength, flexibility, and endurance. Through physical training, students build a strong mind and spirit. Usually offered every semester.

Mr. Theodat

**PE 43a Dance Dance Revolution**

[ pe-1 ]

Students play a video game that requires them to use their feet instead of their thumbs. Following the lighted arrows with their feet, Dance Dance Revolution is aerobic in nature and can burn as many calories as a Stairmaster or jogging. Usually offered every semester.

Mr. Evans

**PE 44a The First-Year Experience: Spirit, Mind, and Body**

[ pe-1 ]

*Open only to first-year students.*

Students will develop and utilize their interpersonal skills through experiential and community engaged learning. They are exposed to core values including: citizenship, integrity, respect, civility, lifelong learning and embracing diversity. Topics covered in the course include: values clarification, health and safety, time and stress management, skills for academic success including approaching faculty. Usually offered every semester.

Mr. Adams or Ms. O'Malley

**PE 45a Stability Ball Class**

The stability ball, a large round ball which provides an unstable surface, is used to strengthen the body as a unit. A combination of exercises with the ball builds core strength, as well as enhances balance, power, and flexibility. Usually offered every year.

Ms. Dallamora

**PE 46a Body Sculpture**

[ pe-1 ]

Full body workout using free weights for muscular endurance, stability ball for core strength, and the step to tone the body. Usually offered every semester.

Ms. Miller

**PE 47a Total Body Training**

[ pe-1 ]

*Open to all abilities.*

Do you want to be a better athlete?

Athleticism is a combination of strength, power, coordination, flexibility, balance, agility, and reaction. Includes dynamic stretching, plyometrics, core workout, and confidence-building exercises in a fast-paced hour. Usually offered every semester.  
Mr. Lamanna

**PE 48a Cardio Workout**

[ pe-1 ]

Offers instruction of proper use of cardio equipment including elliptical machines, treadmills, rowers, and stationary bikes. Usually offered every semester.  
Mr. Tabb

**PE 49a Tennis and Squash**

[ pe-1 ]

Covers tennis over the first half of the semester and squash for the second half. Usually offered every semester.  
Mr. Lamanna

**Courses of Related Interest**

These count as activity courses toward the physical education requirement.

**THA 9a**

Movement for the Stage I

**THA 9b**

Movement for the Stage II

**THA 10b**

Stage Combat

**THA 11a**

Movement for the Performer

**THA 110a**

Moving Women/Women Moving

**THA 110b**

Modern Dance and Movement

**THA 120a**

Dance in Time

**THA 120b**

Movement and Dance Theater Composition

**THA 130a**

Suzuki

Department of

**Physics**

Courses of Study:  
Minor  
Major (BA/BS)  
Combined BA/MS  
Master of Science  
Doctor of Philosophy

**Objectives****Undergraduate Major**

A typical scenario for a physical explanation of a given situation is this: a small collection of basic physical principles relevant to the situation is used to create a mathematical model of it; computations are carried out using the model, leading to predictions that are checked experimentally; if there is agreement, the physical situation is deemed to have been explained. The objective of the program in physics is to make it possible for students to execute such a scenario for a wide range of physical situations. To that end, students are required to attain a firm grasp of the basic principles of classical physics and familiarity with those of quantum physics, to learn how to decide which principles are relevant to a given situation and how to construct the appropriate mathematical model, to develop the mathematical skills necessary to carry out the computations that generate predictions, and to strengthen the experimental skills used in exploring new phenomena and in carrying out the verification step of the typical scenario.

The ability to execute the typical scenario of physical explanation is useful not only to research physicists, but also to scientists in many other fields, especially interdisciplinary ones, such as biophysics and environmental science; it is also useful to engineers, to members of the medical profession, and to architects. For that reason, the physics program has made special arrangements to integrate a physics major with study preparing for a career in any of the areas mentioned above. Students interested in combining biology and physics should see the interdepartmental program in biological physics elsewhere in this *Bulletin*.

**Graduate Program in Physics**

The graduate program in physics is designed to equip students with a broad understanding of major fields of physics and to train them to carry out independent, original research. This objective is to be attained by formal course work and supervised research projects. As the number of students who are accepted is limited, a close contact between students and faculty is maintained, permitting close supervision and guidance of each student.

Advanced degrees will be granted upon evidence of the student's knowledge, understanding, and proficiency in classical and modern physics. The satisfactory completion of advanced courses will constitute partial fulfillment of these requirements. Research upon which theses may be based, with residence at Brandeis, may be carried out in the following areas:

**1. Theoretical Physics**

Quantum theory of fields; relativity; supergravity; string theory; condensed matter theory; statistical mechanics; biological physics.

**2. Experimental Physics**

High-energy experimental physics; condensed matter physics; radio astronomy; and biological physics.

Every graduate teaching fellow (TF) is supervised by a member of the faculty, who serves as a mentor to improve the quality of the TF's teaching. In recognition of this objective, each year the physics department awards the David Falkoff Prize to an outstanding teaching fellow. An additional goal of the department is to enable graduate students to be able to present their research findings in a clear and effective manner. Each spring the department organizes the Stephan Berko Symposium, where students give short presentations of their research. These talks are prepared with the assistance of faculty research advisers. The best graduate student research project and the best undergraduate research project are recognized with Stephan Berko Prizes.

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## How to Become a Major

Because the sequence in which physics courses should be taken is tightly structured, and in most cases requires at least three years to complete, students contemplating a major in physics should consult the physics undergraduate advising head at the first opportunity. For most students, such consultation should take place before enrolling in courses at the beginning of the first year. PHYS 11a or 15a and 19a should normally be part of the first-semester program. Midyear students entering Brandeis in January need to consult the physics undergraduate advising head the summer before they enroll at Brandeis.

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## How to Be Admitted to the Graduate Program

The general requirements for admission to the Graduate School, given in an earlier section of this *Bulletin*, apply to candidates for admission to the graduate area in physics. Admission to advanced courses in physics will be granted following a conference with the student at entrance.

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### Faculty

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#### Bulbul Chakraborty, Chair

Theoretical condensed matter physics.

#### James Bensinger

Experimental high-energy physics.

#### Craig Blocker, Graduate Advising Head (on leave fall 2008)

Experimental high-energy physics.

#### Zvonimir Dogic

Soft condensed matter physics. Biological physics.

#### Richard Fell

Theoretical quantum electrodynamics.

#### Seth Fraden

Physics of liquid crystals. Colloids. Macromolecules. Microfluidics.

#### Michael Hagan

Computation and theory in biological physics.

#### Matthew Headrick

String theory, quantum field theory, and geometry.

#### Lawrence Kirsch

Experimental high-energy physics.

#### Jané Kondev

Theoretical condensed matter physics. Biological physics.

#### Albion Lawrence

String theory and its applications to particle physics and cosmology.

#### Robert Meyer

Physics of liquid crystals, colloids, and polymer gels.

#### David Roberts, Undergraduate Advising Head (fall semester) (on leave spring 2009)

Theoretical astrophysics. Radio astronomy.

#### Azadeh Samadani

Experimental biological physics. Soft condensed matter physics.

#### Howard Schnitzer

Quantum theory of fields. String theory.

#### Geoffrey Svacha

Nonlinear optics and nanoscale physics.

#### John Wardle, Undergraduate Advising Head (spring semester)

Radio astronomy. Cosmology.

#### Hermann Wellenstein (on leave spring 2009)

Experimental high-energy physics.

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## Requirements for the Minor

Six semester courses in physics at the level of PHYS 10 or above. Note that PHYS 18a and 18b and PHYS 19a and 19b count as one semester course.

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## Requirements for the Majors

### Degree of Bachelor of Arts

The requirement for the major in physics leading to the degree of Bachelor of Arts is the equivalent of eleven semester courses in physics and two semester courses in mathematics. There must be the equivalent of at least three semesters in laboratory courses (PHYS 19a and 19b together count as one semester, as do PHYS 18a and 18b). One must also take PHYS 31a. Mathematics and physics courses numbered under 10 may not be used to fulfill the requirement for the major in physics. A student not intending to pursue graduate study in physics may be permitted to substitute two advanced courses in other fields to meet the requirements for the major in physics, subject to the approval of the advising coordinator. A student with a major in physics and an interest in biophysics may want to take courses in biophysics, biology, biochemistry, chemistry, or neuroscience. With departmental approval, a student may use such courses to satisfy part of the requirements for the major in physics. No course with a grade of below C- can be used to satisfy the requirements of the major.

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### Degree of Bachelor of Science

To satisfy the requirements for the major in physics leading to the degree of Bachelor of Science, students must successfully complete the eleven physics courses required for the BA in physics and six additional courses. Two of the additional six courses should be chosen from the following: PHYS 25b, 31b, 32b, 39a, 40a, 100a, 102a, 104a, 105a, 107b, 110a. Another two courses must be selected from the following: NPHY 115a, NBIO 136b, CHEM 41b, any MATH course numbered 27 or higher (excluding courses used to fulfill the math requirement below), any COSI course numbered 21 or higher, or any other course approved by the physics department that is either listed or cross-listed in other departments within the School of Science. The final two courses must be chosen from one of the following pairs of courses: MATH 15a and MATH 20a or any two MATH courses numbered higher than 21. No course with a grade of below C- can be used to satisfy the requirements of the major.

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### Combined BA/MS Program

A student may be admitted to a special four-year BA/MS program upon recommendation of the department and the Graduate School by May 1 preceding the senior year. The student must successfully complete at least thirty-eight courses. All the regular requirements for the MA degree in physics must be met: successful completion of six graduate courses in physics numbered 160 or above, and satisfactory performance on the qualifying examination. No more than two of the graduate-level courses may be counted toward major requirements. Grades of B- or better are required in the six courses numbered 160 or above. The qualifying examination includes the final examinations in PHYS 161a, 161b, 162a and 162b, 163a and two oral examinations on all of physics through the first-year graduate level. The department will recommend admission to this program only if the student's record indicates that the student can successfully complete the requirements. Consultation with the physics advising coordinator before March 1 of the sophomore year is highly recommended for a student contemplating this program.

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### Special Notes Relating to Undergraduates

There are several natural tracks through the undergraduate physics courses. The first is: Year 1—PHYS 11a,b or 15a,b, PHYS 19a,b, MATH 10a,b; Year 2—PHYS 20a, PHYS 40a, PHYS 29a,b, MATH 15a and 20a or MATH 22a,b; Year 3—PHYS 30a, 31a (formerly 30b), PHYS 39a; Year 4—PHYS 31b, 100a.

The second, a premedical track, is: Year 1—PHYS 11a,b or 15a,b, PHYS 19a,b, MATH 10a,b; Year 2—PHYS 20a, PHYS 29a,b, PHYS 40a, CHEM 11a,b, 18a,b; Year 3—BIOL 22a (formerly BIBC 22a), BIOL 22b, BIOL 18a,b, CHEM 25a,b, 29a,b; Year 4—PHYS 30a, 31a (formerly 30b).

Students are encouraged to construct other tracks that might better suit their needs in consultation with their advisers.

Students considering a career in engineering should consult the description of the Columbia University School of Engineering Combined Degree Program in the special academic opportunities section of this *Bulletin*.

A student intending to pursue graduate work in physics will normally add to the tracks above courses selected from PHYS 25b, 32b, 39a, 100a, 102a, 103a, 104a, 105a, and 110a or graduate courses dealing with previously treated subjects at a more advanced level, such as PHYS 161a,b (formerly 101a,b), and 162a,b (formerly 102a,b). Normally only some of the seven courses PHYS 25b, 32b, 100a, 102a, 104a, 105a, and 110a will be offered in a given year; the others will normally be offered in the following year. Undergraduates are not permitted to enroll in physics courses numbered above 160 without the explicit approval of their appropriate major advisers.

A student who has attained a grade of 4 or 5 on the Advanced Placement Examination Physics B may obtain credit for PHYS 10a,b; a student who has attained a grade of 4 or 5 on the Advanced Placement Examination C: Mechanical may obtain credit for PHYS 11a while a grade of 4 or 5 on Advanced Placement Examination Physics C: Electrical may earn credit for PHYS 11b. A student who claims any of these advanced placement credits may not take the same or equivalent courses for credit: PHYS 10a,b, PHYS 11a,b, PHYS 15a,b.

In order to be a candidate for a degree with distinction in physics, one must take a departmentally approved honors program of either PHYS 99d or two semester courses in physics numbered above 160, and one must obtain honor grades. Students should have their honors programs approved by the departmental honors adviser before the beginning of the senior year.

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### Requirements for Advanced Degrees

Normally, first-year graduate students will elect courses from the 100 series, with at least four courses numbered above 160. The normally required first-year courses are PHYS 161a,b, 162a,b, and 163a. A laboratory course, PHYS 169b or QBIO 120b, is normally required in the first or second year. To obtain credit toward residence for a graduate course taken at Brandeis, a student must achieve a final grade of B- or better in that course. Students may obtain credit for advanced courses taken at another institution, provided that their level corresponds to the level of graduate courses at Brandeis and that an honor grade in those courses was obtained. To place out of PHYS 161a or b, 162a or b, or 163a, a student must pass an exemption exam before the end of the second week of the course.

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### Requirements for the Degree of Master of Science

#### Residence Requirement

For those accepted for full-time study, there is a one-year residency requirement. No transfer residence credit will be allowed toward the fulfillment of the master's requirements. Part-time students have no residency requirement.

#### Course Requirements

Six semester courses in physics numbered above 160. A thesis on an approved topic may be accepted in place of a semester course.

#### Language Requirement

There is no foreign language requirement for advanced degrees in physics.

#### Qualifying Examination

Satisfactory performance in the qualifying examination is required. The qualifying examination consists of a written and an oral part and both parts are administered during the first year of the program. The written part of the qualifying examination is the final examinations in PHYS 161a,b, 162a,b, and 163a, unless these courses have been exempted by separate examination, or credit has been given for equivalent courses taken elsewhere. There are two oral exams on general physics; the first at college physics level, the second at the first-year graduate level.

## Requirements for the Degree of Doctor of Philosophy

All of the requirements for the master's degree as well as the following:

### Residence Requirement

The minimum residence requirement is three years. A student may obtain up to one year's residence credit toward the PhD requirements for graduate studies taken at another institution.

### Teaching Requirement

It is required that all PhD candidates participate in undergraduate teaching during the course of their studies.

### Course Requirements

In addition to the normally required first-year courses listed above, one laboratory course is required. After consultation with the graduate adviser, each student must also take two elective advanced physics courses, one of which is outside the student's intended area of research. A total of at least nine semester courses in physics numbered above 160 are required for the doctoral degree.

### Qualifying Examination

PHYS 161a,b, 162a,b and 163a must be passed with grades of B or above, in addition to the requirements listed for the master's degree.

### Advanced Examinations

Advanced examinations are in topics partitioned in the several areas of research interest of the faculty. Faculty members working in each general area function as a committee for this purpose and provide information about their work through informal discussions and seminars. The advanced examination requirement consists of a written paper and an oral examination. Although no original research by the student is required, it is hoped that a proposal for a possible thesis topic will emerge. It is expected that the candidates will take the advanced examination in the field they wish to pursue for the PhD thesis by the middle of the fourth term in order to qualify for continued departmental support beyond the second year.

## Courses of Instruction

### (1-99) Primarily for Undergraduate Students

#### PHSC 2b Introductory Astronomy

[ qr sn ]

*Does not meet requirements for the major in physics.*

Elementary physical ideas will be used to discuss the life and death of stars, the structure of the galaxies, and the large-scale features and evolution of the universe.

Usually offered every year.

Mr. Wardle

#### PHSC 8b Concept and Theories in Physics

[ sn ]

*Does not meet the requirements for the major in physics.*

An introductory study of key ideas in fundamental physical science and the philosophy it has helped to shape. General physics and topics in astronomy, cosmology, and relativity are explored utilizing basic quantitative methods and critical thinking techniques. Usually offered every year.

Mr. Farber

#### PHYS 10a Introduction to Physical Laws and Phenomena I

[ sn qr ]

*Corequisite: MATH 10a or equivalent.*

*Usually taken with PHYS 18a.*

An introduction to Newtonian mechanics, kinetic theory, and thermodynamics.

Usually offered every year.

Mr. Svacha

#### PHYS 10b Introduction to Physical Laws and Phenomena II

[ sn qr ]

*Prerequisite: PHYS 10a. Usually taken with PHYS 18b.*

An introduction to electricity and magnetism, optics, special theory of relativity, and the structure of the atom.

Usually offered every year.

Mr. Svacha

#### PHYS 11a Introductory Physics I

[ qr sn ]

*Corequisite: MATH 10b or the equivalent.*

*Usually taken with PHYS 19a.*

An introduction to Newtonian mechanics with applications to several topics. Usually offered every year.

Mr. Meyer

### Thesis Research

After passing the advanced examination, the student begins work with an adviser, who guides his or her research program. The adviser should be a member of the Brandeis faculty but in special circumstances may be a scientist associated with another research institution. The graduate committee of the physics faculty will appoint a dissertation committee to supervise the student's research. The student's dissertation adviser will be the chair of the dissertation committee.

### Dissertation and Final Oral Examination

The doctoral dissertation must represent research of a standard acceptable to the faculty committee appointed for each PhD candidate. The final oral examination, or defense, is an examination in which the student will be asked questions pertaining to the dissertation research.

## Requirements for the Degree of Doctor of Philosophy in Physics with Specialization in Quantitative Biology

### Program of Study

Students wishing to obtain the specialization must first gain approval of the graduate program chair. This should be done as early as possible, ideally during the first year of graduate studies. In order to receive the PhD in physics with additional specialization in quantitative biology, candidates must complete (a) the requirements for the PhD described above and (b) the course requirements for the quantitative biology specialization that are described in the quantitative biology section of this *Bulletin*.

Any alteration to the quantitative biology course requirements must be approved by the graduate program chair and by the quantitative biology program faculty advisory committee.

**PHYS 11b Introductory Physics II**

[ qr sn ]

*Corequisite: MATH 10b or the equivalent. Usually taken with PHYS 19b. Prerequisite: PHYS 11a or equivalent.*

An introduction to electricity and magnetism and the special theory of relativity. Usually offered every year.  
Mr. Fell

**PHYS 15a Advanced Introductory Physics I**

[ qr sn ]

*Corequisite: MATH 10b or the equivalent. Usually taken with PHYS 19a.*

An advanced version of PHYS 11a for students with advanced preparation in physics and mathematics. An introduction to Newtonian mechanics with special applications to several topics. Usually offered every year.

Mr. Meyer

**PHYS 15b Advanced Introductory Physics II**

[ qr sn ]

*Corequisite: MATH 10b or the equivalent. Prerequisite: PHYS 15a or the equivalent. Usually taken with PHYS 19b.*

An advanced version of PHYS 11b for students with good preparation in physics and mathematics. An introduction to electricity and magnetism and the special theory of relativity for students with advanced preparation. Usually offered every year.

Mr. Fell

**PHYS 18a Introductory Laboratory I**

*Corequisite: PHYS 10a. May yield half-course credit toward rate-of-work and graduation. Two semester-hour credits.*

Laboratory course consisting of basic physics experiments designed to accompany PHYS 10a. One two-and-a-half-hour laboratory per week. One one-hour lecture per week. Usually offered every year.

Mr. Wellenstein

**PHYS 18b Introductory Laboratory II**

*Corequisite: PHYS 10b. May yield half-course credit toward rate-of-work and graduation. Two semester-hour credits.*

Laboratory course consisting of basic physics experiments designed to accompany PHYS 10b. One two-and-a-half-hour laboratory per week. One one-hour lecture per week. Usually offered every year.

Mr. Wellenstein

**PHYS 19a Physics Laboratory I**

*May yield half-course credit toward rate-of-work and graduation. Two semester-hour credits.*

Laboratory course designed to accompany PHYS 11a and PHYS 15a. Introductory statistics and data analysis including use of microcomputers and basic experiments in mechanics. One afternoon or evening of laboratory per week. One one-and-a-half-hour lecture per week. Usually offered every year.

Mr. Fell

**PHYS 19b Physics Laboratory II**

*May yield half-course credit toward rate-of-work and graduation. Two semester-hour credits.*

Laboratory course designed to accompany PHYS 11b and PHYS 15b. Basic experiments in electricity, magnetism, and optics. Basic electrical measurements. Determination of several fundamental physical constants. One afternoon or evening of laboratory per week. One one-and-a-half-hour lecture per week. Usually offered every year.

Mr. Fell

**PHYS 20a Modern Physics I**

[ sn ]

*Prerequisites: PHYS 11a, PHYS 11b, or equivalent.*

A survey of phenomena, ideas, and mathematics underlying modern physics—special relativity, waves and oscillations, and foundations of wave mechanics. Usually offered every year.

Mr. Bensinger

**PHYS 22a The Science in Science Teaching and Learning**

[ sn ]

*Does not meet requirements for the major in physics.*

General science concepts and scientific inquiry will be studied in depth using direct instruction, student projects, and discovery learning. This laboratory-based course is especially relevant to future elementary school teachers. Usually offered every year.

Mr. Svacha

**PHYS 25b Astrophysics**

[ sn ]

*Prerequisites: PHYS 10a and b or PHYS 15a and b, and MATH 10a and b.*

Application of basic physical principles to the study of stars, galaxies, quasars, and the large-scale structure of the universe. Usually offered every second year.

Mr. Roberts or Mr. Wardle

**PHYS 29a Electronics Laboratory I**

[ sn ]

*Prerequisites: PHYS 10a and b or PHYS 15a and b, and PHYS 18a and b or PHYS 19a and b.*

Introductory laboratory in analog electronics. Topics to be covered are DC circuits, AC circuits, complex impedance analysis, diodes, transistors, and amplifiers. Usually offered every year.

Mr. Kirsch

**PHYS 29b Electronics Laboratory II**

[ sn ]

*Prerequisite: PHYS 29a.*

Introductory laboratory in digital electronics. Topics to be covered are Boolean algebra, combinational logic, sequential logic, state machines, digital-analog conversion, and microprocessors. The last part of the semester is spent on individual design projects. Usually offered every year.

Mr. Bensinger

**PHYS 30a Electromagnetism**

[ sn ]

*Prerequisite: PHYS 20a or permission of the instructor.*

The fundamentals of electromagnetic theory. Includes electrostatics, magnetostatics, electric and magnetic circuits, and Maxwell's equations. Usually offered every year.

Ms. Samadani

**PHYS 31a Quantum Theory I**

[ sn ]

*Prerequisites: PHYS 15a and b and PHYS 20a or permission of the instructor. This course may not be repeated for credit by students who have taken PHYS 30b in previous years.*

Introduction to quantum mechanics: atomic models, Schrödinger equation, angular momentum, and hydrogen atom.

Multielectron atoms and interaction of atoms with the electromagnetic field. Usually offered every year.

Mr. Headrick

**PHYS 31b Quantum Theory II**

[ sn ]

*Prerequisite: PHYS 31a (formerly PHYS 30b).*

A continuation of PHYS 31a (formerly PHYS 30b). Topics include dependent perturbation theory, identical particles with applications to atomic, nuclear and condensed matter physics, scattering theory, and special topics as time allows. Usually offered every year.

Mr. Fell

**PHYS 32b Microprocessor Laboratory**

[ sn ]

*Prerequisite: PHYS 29a or b.*

Study of microprocessor design and use as controller for other devices. Topics include architecture of microcomputers, interfacing, digital control, analog control, and software development. Usually offered every second year.

Mr. Kirsch

**PHYS 39a Advanced Physics Laboratory**

[ qr sn wi ]

*Prerequisite: PHYS 20a. This course may be repeated once for credit with permission of the instructor. This course is co-taught with PHYS 169b.*

Experiments in a range of topics in physics, possibly including selections from the following: wave optics, light scattering, nuclear magnetic resonance, X-ray diffraction, scanning tunnelling microscopy, numerical simulation and modeling, holography, electro-optics, phase transitions, rubber elasticity, laser tweezers, chaotic dynamics, and optical microscopy. Students work in depth on three or four experiments during the term. Usually offered every year.

Mr. Dogic or Mr. Meyer

**PHYS 40a Introduction to Thermodynamics and Statistical Mechanics**

[ sn ]

Statistical approach to thermal properties of matter. Theoretical tools are developed for studying questions such as: "Why does a rubber band contract upon heating?" or "What is the size of a white dwarf star?" Usually offered every year.

Mr. Dogic

**PHYS 93a Research Internship**

The physics research internship provide students with an opportunity to work in a research setting for one semester, usually on-campus, pursuing a project that has the potential to produce new scientific results. Student and faculty member mutually design a project that supports the research agenda of the group. Students must attend all research group meetings and present their findings in oral and written form at the end of the semester. The project typically includes theoretical, computational, and/or laboratory research, and may involve collaboration with other group members. In some cases, credit toward the physics laboratory requirement may be given. Course requires signature of the instructor, is subject to the availability of undergraduate research positions, and is typically open only to juniors and seniors. Staff

**PHYS 97a Tutorial in Physics**

Tutorial for students studying advanced material not covered in regular courses. Usually offered every year. Staff

**PHYS 97b Tutorial in Physics**

Tutorial for students studying advanced material not covered in regular courses. Usually offered every year. Staff

**PHYS 98a Readings in Physics**

Open to exceptional students who wish to study an area of physics not covered in the standard curriculum. Usually offered every year. Staff

**PHYS 98b Readings in Physics**

Open to exceptional students who wish to study an area of physics not covered in the standard curriculum. Usually offered every year. Staff

**PHYS 99d Senior Research**

*Permission of the advising coordinator required.*

Research assignments and preparation of a report under the direction of an instructor. Usually offered every year. Staff

**(100–199) For Both Undergraduate and Graduate Students****PHYS 100a Classical Mechanics**

[ sn ]

*Prerequisites: PHYS 20a or permission of the instructor.*

Lagrangian dynamics, Hamiltonian mechanics, planetary motion, general theory of small vibrations. Introduction to continuum mechanics. Usually offered every second year.

Mr. Fell

**PHYS 102a General Relativity**

[ sn ]

*Prerequisites: PHYS 10a and b, PHYS 15a and b, and PHYS 20a, or permission of the instructor.*

An introduction to the basic principles of general relativity. Topics include a review of special relativity, tensor analysis in curved space-times, the principle of equivalence, the Einstein equations, the Schwarzschild solution, and experimental tests of general relativity. Usually offered every second year.

Mr. Fell

**PHYS 104a Soft Condensed Matter**

[ sn ]

Mechanical, thermal, and electronic properties of matter including fluids, solids, liquid crystals, and polymers. Simple models of matter are developed and used to discuss recent experimental findings. Usually offered every second year.

Mr. Fraden

**PHYS 105a Biological Physics**

[ sn ]

Physical forces in living matter are studied from the perspective offered by statistical mechanics, elasticity theory, and fluid dynamics. Quantitative models for biological structure and function are developed and used to discuss recent experiments in single-molecule biology. Usually offered every second year.

Ms. Samadani

**PHYS 107b Particle Physics**

[ sn ]

*Prerequisite: PHYS 30a or permission of the instructor. Corequisite: PHYS 31a (formerly PHYS 30b) or permission of the instructor.*

The phenomenology of elementary particles and the strong, weak, and electromagnetic interactions are studied. Properties of particles, quarks, neutrinos, vector bosons, Higgs particles, supersymmetry, symmetries, and conservation laws are covered. This course is co-taught with the graduate course PHYS 167b, and the workload will be appropriate to each group. Usually offered every second year.

Mr. Blocker

**PHYS 110a Mathematical Physics**

[ sn ]

*Prerequisite: PHYS 30a, PHYS 31a (formerly PHYS 30b), or permission of the instructor.*

A selection of mathematical concepts and techniques useful for formulating and analyzing physical theories. Topics may include: complex analysis, Fourier and other integral transforms, special functions, ordinary and partial differential equations (including their theory and methods for solving them), group and representation theory, and differential geometry. Usually offered every year.

Mr. Headrick

**NPHY 115a Dynamical Systems, Chaos, and Fractals**

[ sn ]

*Prerequisites: PHYS 10a or 15a, or instructor's permission for approved equivalents.*

Advanced introduction to the theory of nonlinear dynamical systems, bifurcations, chaotic behaviors, and fractal patterns. Concepts and analysis are illustrated by examples from physics, chemistry, and biology. The course will be complemented by a significant number of computer labs. Usually offered every second year.

Staff

**PHYS 161a Electromagnetic Theory I**

[ sn ]

Electrostatics, magnetostatics, boundary value problems. Usually offered every year.

Mr. Schnitzer

**PHYS 161b Electromagnetic Theory II**

[ sn ]

Maxwell's equations. Quasi-stationary phenomena. Radiation. Usually offered every year.

Mr. Schnitzer

**PHYS 162a Quantum Mechanics I**

[ sn ]

Nonrelativistic quantum theory and its application to simple systems; spin systems and the harmonic oscillator. Feynman diagram visualization of time-dependent perturbation theory. Usually offered every year.

Mr. Lawrence

**PHYS 162b Quantum Mechanics II**

[ sn ]

Path integral formulation of quantum mechanics. Quantum treatment of identical particles. Approximate methods: variational, WKB, and perturbation theory. Applications to atoms, molecules, and solids. Usually offered every year.

Mr. Lawrence

**PHYS 163a Statistical Physics and Thermodynamics**

[ sn ]

The thermal properties of matter. Derivation of thermodynamics from statistical physics. Statistical theory of fluctuations. Usually offered every year.  
Mr. Kondev

**PHYS 167b Particle Phenomenology**

[ sn ]

The phenomenology of elementary particles and the strong, weak, and electromagnetic interactions. Properties of particles, kinematics of scattering and decay, phase space, quark model, unitary symmetries, and conservation laws. This course is co-taught with PHYS 107b, and the workload will be appropriate to each group. Usually offered every second year.  
Mr. Blocker

**PHYS 168b Introduction to Astrophysics**

[ sn ]

Bremsstrahlung, synchrotron radiation, inverse Compton scattering. Extended and compact radio sources, jets, superluminal motion. Quasars and active galactic nuclei, IR to X-ray continua, spectral line formation. Black holes and accretion disks. Usually offered irregularly as demand requires; consult department.  
Mr. Wardle

**PHYS 169b Advanced Laboratory**

[ sn ]

Experiments in a range of topics in physics, possibly including selections from the following: wave optics, light scattering, nuclear magnetic resonance, X-ray diffraction, scanning tunneling microscopy, numerical simulation and modeling, holography, electro-optics, phase transitions, rubber elasticity, laser tweezers, chaotic dynamics, and optical microscopy. Students work in depth on three or four experiments during the term. This course is co-taught with PHYS 39a. Usually offered every year.  
Mr. Dogic or Mr. Meyer

**(200 and above) Primarily for Graduate Students****PHYS 202a Quantum Field Theory**

Methods of statistical and quantum field theory, including path integrals, second quantization, Feynman diagrams, renormalization group, epsilon expansions, effective field theory. Applications ranging from phase transitions and critical phenomena to gauge theories of particle physics. Usually offered every year.  
Mr. Lawrence

**PHYS 204a Condensed Matter II**

Modern techniques such as effective field theory, scaling, and the renormalization group are introduced and used to study solids, magnets, liquid crystals, and macromolecules. Most of the theory is developed on simple models and applied experiments. Usually offered every second year.  
Ms. Chakraborty

**PHYS 210a High Energy Physics Seminar I**

Analysis of important recent developments in particle physics. Usually offered every fourth year.  
Mr. Lawrence

**PHYS 213a Advanced Examination Tutorial I**

Supervised preparation for the advanced examination. Specific sections for individual faculty members as requested. Usually offered every year.  
Staff

**PHYS 213b Advanced Examination Tutorial II**

Supervised preparation for the advanced examination. Specific sections for individual faculty members as requested. Usually offered every year.  
Staff

**PHYS 280a Advanced Readings and Research**

Specific sections for individual faculty members as requested. Usually offered every year.  
Staff

**PHYS 280b Advanced Readings and Research**

Specific sections for individual faculty members as requested. Usually offered every year.  
Staff

**PHYS 304a Condensed Matter Seminar I**

Seminars in advanced topics in condensed matter physics. Usually offered every year.  
Staff

**PHYS 304b Condensed Matter Seminar II**

A continuation of PHYS 304a. Usually offered every year.  
Staff

**PHYS 401a Dissertation Research**

Independent research for the PhD. Specific sections for individual faculty members as requested. Usually offered every semester.  
Staff

**PHYS 401b Dissertation Research**

Independent research for the PhD. Specific sections for individual faculty members as requested. Usually offered every semester.  
Staff

**Cross-Listed Courses****Q BIO 110a**

Numerical Modeling of Biological Systems

**Q BIO 120b**

Quantitative Biology Instrumentation Laboratory

**BIOP 200b**

Reading in Macromolecular Structure-Function Analysis