An interdepartmental program

Peace, Conflict, and Coexistence Studies

Objectives

Since the end of World War II, peace, conflict, and coexistence studies has emerged as an interdisciplinary area of inquiry drawing on social science, the humanities, the creative arts, and science in efforts to understand reasons for war and possible ways of resolving conflicts without resorting to violence. In the last few years, for many people the primary focus of inquiry is shifting from the Cold War and the nuclear threat to conflict resolution in small and large contexts. Along with the larger goal of ending war altogether, the Brandeis program reflects this tendency.

This is a time to examine the many meanings of "security," to investigate the nature of power and political participation and to develop ideas and ways of addressing conflicts that honor the integrity of all parties involved. This is a time, in other words, to learn alternatives to violence and a time to learn the ways of disarmament and ending of war.

How to Become a Minor

Students who wish to take peace, conflict, and coexistence studies (PAX) as a minor in addition to their major can construct an individually tailored minor in consultation with program advisors on the peace, conflict, and coexistence studies committee.

Committee

Gordon Fellman, Chair
(Sociology)

Seyom Brown
(Politics)

Steven Burg
(Politics)

Cynthia Cohen
(International Center for Ethics, Justice and Public Life)

David Cunningham
(Sociology)

Judith Eissenberg
(Music)

Reuven Kimelman
(Near Eastern and Judaic Studies)

Robert Lange
(Physics)

Richard Parmentier
(Anthropology)

John Schrecker
(History)

Andreas Teuber
(Philosophy)

Daniel Terris
(American Studies)

Dessima Williams
(Sociology)

Requirements for the Minor

Students are to take six required courses, configured this way:

A. Two **core requirements** (comprehensive course or project).

1. SOC 119a (War and Possibilities of Peace).

2. *Either* PAX 92a/b (Internship in Peace, Conflict, and Coexistence Studies) *or* a senior honors thesis.

The internship consists of at least 10 hours a week in a social change organization in the greater Boston area or, if the student is abroad, an appropriate equivalent. The intern is supervised by a PAX professor or staff person, keeps a daily journal, presents and does the reading of a bibliography on the topic of the internship and its larger framework, and writes a paper of 15-20 pages at the end of the internship. The student is expected to meet weekly or biweekly with the supervisor and to email weekly or biweekly if doing the work abroad. Internships are organized around but not limited to those we find through the Hiatt Career Center.

The senior thesis is undertaken in the student's major, on a topic central to peace, conflict, and coexistence studies. With the department's permission, a member of the PAX Faculty Committee will serve on and represent the PAX Program on the thesis committee.

B. Two or more **core electives**: At least two courses (and up to four) from this list. Core electives must be taken in at least two different departments.

Core electives include courses that offer critical analyses of violence and non-violence and that consider information, ideas, and examples of productive ways of resisting violence and working toward peace and justice (what in the peace studies field is called "positive peace," as distinct from "negative peace," which is the absence of war but not of conditions that appear to lead to war). These courses offer perspectives on major institutions and possible alternatives, explore some strategies for change, and encourage students to envision and work toward a world based more on positive peace than on negative peace or war.

C. Maximum of two **related electives**: No more than two courses from this list can count to meet requirements for the minor, and they must be taken in different departments.

These courses relate directly or indirectly to international, domestic, organizational, intergroup, interpersonal, or personal conflict and also include consideration of perspectives that promote understanding, reconciliation, and transformation. They need not focus on violence and non-violence, positive peace, or encouraging students to envision positive peace. Students may apply courses from the "core electives" list that they have not taken to fulfill core requirements, to this requirement.

D. Students are urged to take at least one course from a school other than social science to fulfill their PAX requirements.

E. Students may petition the PAX Committee for special consideration of courses not listed here that the student wishes to propose as appropriate for her/his PAX minor.

Courses of Instruction

PAX 92a Internship in Peace, Conflict, and Coexistence Studies
Usually offered every year.
Staff

PAX 92b Internship in Peace, Conflict, and Coexistence Studies
Usually offered every year.
Staff

PAX 110a International Nonviolent Initiatives
[ss]
Explores the potential of nonviolent struggle and related efforts to reduce violence worldwide. The sociological mechanisms and ethical outlooks of forms of "nonviolence" are studied, as well as the workings of "people power" on five continents.
Staff

PAX 186a Introduction to Intercommunal Coexistence
[ss]
Required for students selected as Ethics and Coexistence Fellows.
Investigates the emerging field of intercommunal coexistence, partly through case studies, and by analyzing "coexistence," "tolerance," "reconciliation," and related concepts. Investigates methods of intercommunal work, including encounter, dialogue, activism, and the arts. Considers tensions between coexistence and values of equity and justice. Usually offered every spring.
Ms. Cohen

Core Courses

PAX 92a
Internship in Peace, Conflict, and Coexistence Studies

PAX 92b
Internship in Peace, Conflict, and Coexistence Studies

SOC 119a
War and Possibilities of Peace

Core Electives

LGLS 130a
Conflict Analysis and Intervention

PAX 110a
International Nonviolent Initiatives

PAX 186a
Introduction to Intercommunal Coexistence

PHIL 19a
Human Rights

PHIL 111a
What is Justice?

POL 127b
Seminar: Managing Ethnic Conflict

POL 161b
Causes and Prevention of War

POL 163a
Seminar: Human Rights and International Relations

SOC 112b
Social Class and Social Change

SOC 153a
The Sociology of Empowerment

WMNS 5a
Women in Culture and Society: A Multidisciplinary Perspective

Related Electives

AAAS 60a
Economics of Third World Hunger

AAAS 80a
Economy and Society in Africa

AAAS 123a
Third World Ideologies

AAAS 126b
Political Economy of the Third World

AMST 175a
Violence (and Non-Violence) in American Culture

ANTH 139b
Language, Ethnicity, and Nationalism

BIOL 17b
Conservation Biology

BISC 2a
Human Reproduction, Population Explosion, Global Consequences

BUS 70a
Business in the Global Economy

ECON 57a
Environmental Economics

HIST 139b
Fascism East and West

HIST 186b
War in Vietnam

LGLS 120a
Sex Discrimination and the Law

LGLS 124b
International Law and Development

LGLS 125b
International Law, Organizations, and Conflict Resolution

NEJS 189a
The Arab-Israeli Conflict

PHIL 20a
Social and Political Philosophy: Democracy and Disobedience

POL 15a
Introduction to International Relations

POL 127a
Ending Deadly Conflict

POL 144a
Latin American Politics I

POL 144b
Latin American Politics II

POL 178a
Seminar: International Politics of the Pacific

SOC 107a
Global Apartheid and Global Social Movements

SOC 157a
Sociology of the Israeli-Palestinian Confrontation

Department of
Philosophy

Courses of Study:
Minor
Major (B.A.)

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 that is 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.

How to Become a Major

To become a major in philosophy, students must complete nine required courses: five must be taught by faculty of the Department of Philosophy; at least one must be in the history of philosophy; at least one must be in logic; and 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.

Faculty

Jerry Samet, Chair
Philosophy of mind. Philosophy of psychology and cognitive science. History of philosophy.

Alan Berger
Logic. Philosophy of science. Philosophy of language.

Tracy Edwards, Allen-Berenson Visiting Assistant Professor in Philosophy and Women's Studies
Philosophy of law. Social and political philosophy. Philosophy of race and gender.

Robert Greenberg
Metaphysics. History of philosophy. Kant.

Eli Hirsch, Undergraduate Advising Head
Metaphysics. Epistemology. Medical ethics.

Marion Smiley
Moral, social, and political philosophy.

Andreas Teuber, Advisor to Minors
Political philosophy. Moral philosophy. Aesthetics. Modern social theory. History of political thought.

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

Requirements for the Major

A. All Philosophy majors must satisfactorily complete at least nine (9) semester courses from among philosophy and cross-listed courses.

B. At least five (5) semester courses counted toward the major must be taught by faculty of the Department of Philosophy.

C. At least four (4) courses must be upper-level (99 and above), distributed as follows:

1. At least one (1) must be an upper-level course in Moral, Social, and Political Philosophy (PHIL 110a-116a)

2. At least two (2) must be upper-level courses in Metaphysics & Epistemology (PHIL 135a-147b)

D. At least one (1) course must be in the History of Philosophy (PHIL 161a-180b)

E. At least one (1) course must be in Logic (PHIL 6a, 106b)

F. A maximum of one (1) semester of 98a,b or 99d can be counted towards the major (5PE94A 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 (4) 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.

Requirements for the Minor

A. All philosophy minors must complete satisfactorily at least five (5) semester courses from among philosophy and cross-listed courses.

B. At least three (3) semester courses counted toward the minor must be taught by faculty of the Department of Philosophy.

C. At least one (1) course must be upper-level (100 and above)

D. A maximum of one (1) semester of 98a,b can be counted towards the minor (5PE94A does not count)

E. No course with a grade below a C will count toward meeting the requirement of five courses for the minor; student 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 major.

G. With the approval of the department minors advisor, transfer students and those taking a year's study abroad may apply up to two (2) 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 advisor, transfer and cross-listed courses will count as lower-level electives.

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.
Messrs. Berger, Greenberg, Hirsch, Samet, Teuber, and Yourgrau; Ms. Smiley

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 12b Philosophy and Literature
[hum]
A philosophical exploration of major literary texts by Shakespeare, Milton, Swift, Austen, Bronte, Eliot, Hardy, among others. Usually offered every second year.
Staff

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 19a Human Rights
[hum]
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 second year.
Mr. Teuber

PHIL 20a Social and Political Philosophy: Democracy and Disobedience
[hum]
Focuses on the relation of the individual to the state and, in particular, on the theory and practice of non-violent 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, disobedience in China and Northern Ireland and at abortion clinics. Usually offered every second year.
Mr. Teuber

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 second year.
Mr. Teuber

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. The existence of God, "God-talk," evil and suffering, mystical experiences, life after death, free will and determinism, the relation of religion to morality. Usually offered every year.
Mr. Hirsch

PHIL 28a Western Philosophical Tradition: Feminist Perspectives
[hum]
Examines the place of gender in the history of western philosophy and goes on to ask a series of philosophical questions that are informed by contemporary feminism, including "Is there a woman's voice?" and "What is gender equality and is it valuable?" Usually offered every year.
Ms. Smiley

PHIL 35a Philosophy of Science
[hum]
Philosophers in the 20th 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 second year.
Mr. Berger or Mr. Hirsch

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.
Messrs. Berger, Hirsch, or 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 third year.
Messrs. Berger or Yourgrau

PHIL 39b Philosophy of Mind
[hum]
Topics include the mind-body relation and consciousness, 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 20th 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. Usually offered every year.
Messrs. Berger or Greenberg

PHIL 67b Contemporary Continental Philosophy: The Traditions and Feminist Engagements
[hum]
Covers the major movements and figures in 20th century continental philosophy and feminist engagements with and in this tradition. Examines phenomenology, hermeneutics, critical theory, structuralism, and deconstruction along with feminist concerns about how philosophy has denigrated or denied women's subjectivity. Usually offered every fourth year.
Ms. McAfee

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 20th 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]
An analysis of existential philosophy with special attention to the works of Kierkegaard and Nietzsche. Other existential philosophers are also studied. Usually offered every fourth year.
Staff

PHIL 98a Readings in Philosophy
Readings, reports, and discussions on assigned topics. Usually offered every semester.
Staff

PHIL 98b Readings in Philosophy
Readings, reports, and discussions on assigned topics. Usually offered every semester.
Staff

PHIL 99d Senior Research
The course is normally a two-semester sequence. It is open to seniors who are candidates for degrees with honors in philosophy and involves the preparation and writing of a 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.
Mr. Berger

PHIL 110a The Good Life or How Should I Live?
[hum]
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 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 wi]
Prerequisite: Two courses in philosophy or politics (or one course in each subject) 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 second year.
Ms. Smiley

PHIL 112b Philosophy and Public Policy
[hum]
Prerequisite: 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 examples, the arguments for and against public funding of the arts, fire departments, patents, zoning laws, and national health care. Usually offered every third year.
Mr. Teuber

PHIL 113b Aesthetics: Painting, Photography, and Film
[ca hum]
Prerequisite: Two courses in philosophy or fine arts (or one course in each subject) and one of the following courses: AMST 120b, ENG 27b, 101a, 147a, 177a, or FILM 100a, or permission of the instructor.
Explores representation in painting, photography, and film by studying painters Rembrandt, Velasquez, 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 second year.
Mr. Teuber

PHIL 114b Topics in Ethical Theory
[hum]
Prerequisite: Phil 1a or one course numbered PHIL 17a-23b or PHIL 110a-121a.
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? The course will address such questions. Usually offered every second year.
Ms. Smiley

PHIL 116a Topics in Political Philosophy
[hum]
Prerequisite: PHIL 1a, 17a, or POL 10a.
Normative justifications of the state. Examines how western philosophers have used constructs such as the state of nature, the social contract, and the general will to justify state powers. Usually offered every second year.
Ms. Smiley

PHIL 117b Topics in the Philosophy of Law: Judicial Philosophies
[hum]
Prerequisite: Two courses in philosophy or legal studies, or one course in each, or one in either subject and one of the following: POL 115a,b, 116a, or permission of the instructor. Topics vary from year to year. Course may be repeated once for credit.
Examines the philosophical assumptions at work in the judicial process as it has developed in both ancient and modern times, from Cicero to Louis Brandeis to Sandra Day O'Connor. Looks closely at a variety of judicial philosophies, the views of judges of what the law is and what it should do and the role such views play in the course of judicial review and how a given judicial philosophy may dictate particular outcomes in specific cases. Students also evaluate the philosophical arguments to be made for and against judicial activism and judicial restraint. Topics include the nature of the civil and common law traditions, natural law, legal realism, legal proceduralism, the pragmatism of the Process School and contemporary currents such as Critical Legal Studies (CLS) and Law and Economics (Richard Posner, et al), as well as the characteristic styles of such major Justices as Richard Coke, Joseph Jefferson Mansfield, Thurgood Marshall, Oliver Wendell Holmes, and Louis Brandeis. Readings include John Hart Ely's Democracy and Distrust and Morton Horwitz's The Transformation of American Law.
Mr. Breen

PHIL 119b Chinese Philosophy
[hum nw]
Prerequisite: PHIL 1a.
Focuses on the ancient philosophies of Confucianism, Taoism, and Ch'an (Zen) Buddhism. The aim will be to identify the concerns and ways of thinking that are distinctive of each philosophy. Usually offered every third year.
Staff

PHIL 120b Gender and Moral Philosophy
[hum]
Prerequisite: PHIL 1a or one course numbered PHIL 17a-23b or PHIL 110a-121a
Provides an overview of moral philosophy (including Aristotle and Kant) and examines how gender norms have shaped its development. Addresses whether traditionally "male" concerns with disinterested principles of reason have a higher moral value than "feminine" concerns with context and care. Usually offered every fourth year.
Ms. McAfee

PHIL 121a Politics, Philosophy, and the Legal Regulation of Sexuality
[hum]
Prerequisite: PHIL 1a or 66b, or one course numbered PHIL 35a-39b.
Treating the sexual exchange as a proper subject for politics, students read traditional philosophers like Tocqueville and Mill, as well as laws and court opinions in an effort to understand how sex is regulated in America as a political matter. Usually offered every fourth year.
Staff

PHIL 135a Theory of Knowledge
[hum]
Prerequisite: PHIL 1a or 66b, or one course numbered PHIL 35a-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. Hirsch

PHIL 136a Personal Identity
[hum]
Prerequisite: PHIL 1a or 66b, or one course numbered PHIL 35a-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 Innateness
[hum]
Prerequisite: PHIL 1a or 66b, or one course numbered PHIL 35a-39b.
How much of what we are—what we believe and know, what we think and feel, how we act—is due to our environment and training and how much is a function of our inherent nature? Analyzes the contemporary debate as well as the main positions in the history of philosophy on this question. Also considers recent research in linguistics and the cognitive sciences. Usually offered every third year.
Mr. Samet

PHIL 138a Metaphysics
[hum]
Prerequisite: PHIL 1a or 66b, or one course numbered PHIL 35a-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.
Messrs. Berger, Hirsch, or Yourgrau

PHIL 139b Topics in Logic
[hum]
Prerequisite: PHIL 6a or 106b.
Topics may vary from year to year and the course may be repeated for credit. Topics in the past 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, 6a, or 106a, 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 and modal 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 39b or permission of the instructor.
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 second year.
Mr. Samet

PHIL 142b The Subjective Point of View
[hum]
Prerequisite: PHIL 1a or permission of the instructor.
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 second year.
Mr. Greenberg

PHIL 143a Consciousness and Self
[hum]
Prerequisite: PHIL 1a.
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 permission of the instructor.
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 second year.
Messrs. Berger, Hirsch, and Yourgrau

PHIL 145b Topics in the Philosophy of Language
[hum]
Prerequisite: PHIL 1a.
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 second year.
Mr. Berger or Mr.Hirsch

PHIL 146a Idea of God
[hum]
Prerequisite: PHIL 1a or permission of the instructor.
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 147b Topics in the Philosophy of Space and Time
[hum]
Prerequisite: A course in logic.
Examines the notions of space and time in the theories of Aristotle, Gallileo, and Einstein. Examines which concepts no longer make sense when we go from one space time to the other. Students will learn how to read Gallilean and Minkowski space time diagrams. Usually offered every third year.
Mr. Berger

PHIL 148b Philosophy of the Humanities
[hum]
Prerequisite: One course in philosophy or history.
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 second year.
Mr. Levisohn

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 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 second 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: PHIL 1a or 39b, or permission of the instructor.
A close reading of Descartes' Meditations, one of the cornerstones of modern philosophy. Considers responses of Descartes' contemporaries to this work and Descartes's replies, and contemporary discussions and interpretations. Topics include knowledge and skepticism, the mind-body problem, the relation of perception and knowledge, the existence of God, the nature of the self, and the distinction between our ideas of primary and secondary qualities. Usually offered every fourth year.
Mr. Samet

PHIL 171b Problems of A Priori Knowledge
[hum]
Prerequisite: One course in philosophy or permission of the instructor.
Examines some of the main problems of a priori knowledge as seen from a Kantian point of view. Usually offered every second year.
Mr. Greenberg

PHIL 174a Special Topics in the History of Philosophy: Hume's First Enquiry
[hum]
Prerequisite: PHIL 1a or permission of the instructor.
A close reading of Hume's short classic Enquiry Concerning Human Understanding, which attempts to distill the key elements of Hume's Empiricism and make his philosophy accessible to a general audience. Topics include the nature of thought, skepticism and the possibility of knowledge, free will, the credibility of miracles, and the prospects for a life hereafter. Usually offered every fourth year.
Mr. Samet

PHIL 178b Major Figures in the Christian Faith: Simone Weil
[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 180b British Empiricism
[hum]
Prerequisite: One course in philosophy or permission of the instructor.
Examines the metaphysical and epistemological doctrines of John Locke, Bishop Berkeley, and David Hume, the central figures of 17th- and 18th-century British Empiricism. Also explores the influence of Empiricism on contemporary philosophy. Usually offered every third year.
Mr. Samet

Cross-Listed Courses

ED 159b
Philosophy of Education

HIST 133b
Rights & Revolutions: History of Natural Rights

LING 130a
Semantics: The Structure of Concepts

NEJS 159a
Major Trends in Modern Jewish Philosophy

POL 186b
Classical Political Thought

WMNS 105b
Feminist Theories in Historical and Cross-Cultural Perspective

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

Denise Dallamora, Chair
Fitness — yoga.

Kathleen Anderson
Fitness — pilates.

Carol Ann Baer
Dance.

Vincent Christiano
Karate.

Michael Coven
Fitness — weight training. Team sports.

Lisa DeNicola
Fitness — aerobics.

Susan Dibble
Dance.

John Evans
Fitness — D.D.R.

Michael Gray
Athletic training.

John Jarvis
Racquet sports.

Zabelle Margosian
Dance.

Brian Meehan
Team sports — basketball.

Mark Reytblat
Fitness. Team sports.

William Shipman
Fencing. Racquet sports. Golf.

Carol Simon
Team sports. Racquet sports.

Mary Sullivan
Aquatics. First aid. CPR.

Jean-Robert Theodat
Fitness — Tad Kwon Do.

James True
Personal safety.

Richard Varney
Team sports. Racquet sports.

James Zotz
Aquatics. 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 by 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.

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 will exempt you from one physical education class or half of your requirement. A grade of 80 percent or better will exempt you from two physical education classes or all of your 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** for a class that meets twice per week.

Courses of Instruction

(1-99) Primarily for Undergraduate Students

PE 1a Beginner's Swimming
Designed to teach the non-swimmer the basic skills of floating, treading water, and the crawl stroke. Usually offered in the fall semester.
Ms. Sullivan

PE 2a Swim Fitness
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
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
An instruction in the American Red Cross standard First Aid and Cardiopulmonary Resuscitation. 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.
Mr. Burr and Ms. Sullivan

PE 6a Sports Medicine
Introduction to sports medicine and a basic understanding of human anatomy and sports is required. The course will look at many facets of sports medicine including weight training, nutrition, drug education, flexibility, and rehabilitation. Each of the major joints of the body will be examined anatomically, based on injuries sustained. Class will also look briefly at surgical repair of certain joints. Usually offered every spring semester.
Mr. Burr

PE 9a Volleyball
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
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.
Mr. Ford

PE 11a Nautilus/Free Weights
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.
Staff

PE 12a Step Aerobics
Step aerobics is a program that includes stepping up and down on an adjustable platform while performing upper-body movements to music. Unlike aerobics, it is low impact and can be moderated to any fitness level. Usually offered every semester.
Ms. DeNicola

PE 14a Yoga
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
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.
Staff

PE 17a Beginner's Fencing
Covers basic mobility, offensive and defensive strategy, and tactics. Competitive bouting is done, with a class tournament scheduled for the end of the semester. Usually offered every semester.
Mr. Shipman

PE 20a Intermediate Tennis
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. Jarvis

PE 21a Tennis
Students must provide their own racquet.
An overview of grips, groundstrokes, serve, return of serve, and net play. Basic singles and doubles strategy, rules, and scoring of the game are introduced. Usually offered every semester.
Staff

PE 22a Squash
Students must provide their own racquet and protective eye wear.
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.
Staff

PE 24a Beginner's Karate
The first three Kata of Uechi-Ryu is 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
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 Ballroom Dance
Latin dances are covered: introduction to cha-cha, rumba, tango, and mambo. Also, swing, waltz, and fox-trot. Usually offered every semester.
Ms. Evans-Baer

PE 26b Intermediate Ballroom Dance
Prerequisite: PE 26a or comparable dance experience.
A follow-up to PE 26a. Learn new steps in cha-cha, rumba, tango, and waltz. Usually offered every spring semester.
Ms. Evans-Baer

PE 27a Keeping Stress in Check
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
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
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 is taught. Usually offered every semester.
Ms. Margosian

PE 32a Modern Dance
A beginning course in modern dance technique, based on Martha Graham and Jose Lemon style. The course will offer stretching and alignment to dance sequences. Usually offered every semester.
Ms. Dibble

PE 33a Walking for Fitness
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
Designed to help increase the fitness level of the students through a high-intensity, low-impact workout. The workout consists of walking with hand-held weights. Usually offered every semester.
Staff

PE 38a Indoor Soccer
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.
Mr. Coven and Mr. Reytblat

PE 40a Personal Safety/Self Defense
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.
Staff

PE 41a Pilates
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. Cann

PE 42a Tae Kwon Do
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
Students play a video game which 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.
Staff

Courses of Related Interest

These courses count as activity courses towards the physical education requirement.

THA 9a
Movement for the Stage I

THA 9b
Movement for the Stage II

THA 10b
Stage Combat

THA 110b
Modern Dance and Movement

THA 120b
Movement and Dance Theater Composition

Department of

Physics

Courses of Study:
Minor
Major (B.A./B.S.)
Combined B.A./M.S.
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 physics; statistical mechanics; quantum theory of the solid state; critical phenomena and phase transitions; computational neuroscience.

2. *Experimental Physics*
High-energy experimental physics; condensed matter physics; radio astronomy; and biophysics.

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 their faculty research advisors. The best graduate student research project and the best undergraduate research project are recognized with Stephan Berko Prizes.

How to Become an Undergraduate Major

Since 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 advising coordinator at the first opportunity. For most students either such consultation should take place before enrolling in courses at the beginning of the first year, or PHYS 11a and 19a should be part of the first semester program.

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.

Faculty

Robert Meyer, Chair
Physics of liquid crystals, colloids, and polymer gels.

James Bensinger
Experimental high-energy physics.

Craig Blocker
Experimental high-energy physics.

Karl Canter
Experimental biophysics.

Bulbul Chakraborty
Theoretical condensed matter physics.

Stanley Deser
Quantum theory of fields. Gravitation. Supergravity. Strings.

Richard Fell
Theoretical quantum electrodynamics.

Seth Fraden
Physics of liquid crystals, colloids, and macromolecules.

Lawrence Kirsch
Experimental high-energy physics.

Jané Kondev
Theoretical condensed matter physics.

Robert Lange
K-12 science and environmental education, teacher training, and curriculum research.

Albion Lawrence
String theory and its applications to particle physics and cosmology.

David Roberts
Theoretical astrophysics. Radio astronomy.

Howard Schnitzer
Quantum theory of fields. String theory.

Xiao-Jing Wang (Volen National Center for Complex Systems)
Computational neuroscience.

John Wardle
Radio astronomy. Cosmology.

Hermann Wellenstein
Experimental high-energy physics.

Requirements for the Undergraduate 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 11 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 30b. 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.

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 11 physics courses required for the B.A. in physics and six additional courses. Two of the additional six courses should be chosen from the following: PHYS 25b, 32b, 39a, 40a, 100a, 104a, 105a, 110a. Another two courses must be selected from the following: NPHY 115a, NBIO 136b, CHEM 41a, 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 MATH 21a and MATH 21b, or any two MATH courses numbered higher than 21.

Combined B.A./M.S. Program

A student may be admitted to a special four-year B.A./M.S. program upon recommendation of the department and the Graduate School by May 1 preceding the senior year. The student must successfully complete **at least** 38 courses. All the regular requirements for the M.S. 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 towards 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.

Requirements for the Undergraduate Minor

Six semester courses in physics at the level of PHYS 10 or above. Note that PHYS 18a,b and PHYS 19a,b count as 1 semester course.

Special Notes Relating to Undergraduates

There are several natural tracks through the undergraduate physics courses. The first is: Year 1—PHYS 11a,b, 19a,b, MATH 10a,b; Year 2—PHYS 20a,b, 29a,b, MATH 21a,b or PHYS 110a; Year 3—PHYS 30a,b; Year 4—PHYS 40a, 100a.

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

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

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 PHYS 25b, 39a, 100a, 104a, and 105a 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 two or three of the six courses PHYS 25b, 32b, 100a, 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 advisors.

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: PHSC 9b, PHYS 10a,b, PHYS 11a,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 advisor before the beginning of the senior year.

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 113a,b, 161a, 162a,b, 163a, and 169b. 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 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, 162a or b, or 163a, a student must pass an exemption exam before the end of the second week of the course.

Requirements for the Degree of Master of Science

Residence Requirement
One year in residence as a full-time student. No transfer residence credit will be allowed toward the fulfillment of the master's requirements.

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, 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 and the following:

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

Teaching Requirement
It is required that all Ph.D. candidates participate in undergraduate teaching during the course of their studies.

Course Requirements
In addition to the normally required first-year courses listed above, at least two graduate courses in the following list must be taken during the first four terms: PHYS 161b, 167b, 168b, 200a, 202a, 204a. Note, however, that not all of the above courses will necessarily be given each year. PHYS 161b and 202a are normally required for all students. A total of at least nine semester courses in physics numbered above 160 are required for the doctoral degree.

Qualifying Examination
PHYS 161a, 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. While 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 Ph.D. thesis by the middle of the fourth term, in order to qualify for continued departmental support beyond the second year.

Thesis Research
After passing the advanced examination, the student begins work with an advisor who guides his or her research program. The advisor 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 advisor 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 Ph.D. candidate. The final oral examination, or defense, is an examination in which the student will be asked questions pertaining to the dissertation research.

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 4a Science and Development
[qr sn]
Does not meet requirements for the major in physics.
Focuses on specific scientific and technological issues encountered in economic development. The scientific material needed to understand different approaches will be analyzed using simple mathematics as an essential tool. Usually offered every second year.
Mr. Lange

PHSC 7b Technology and the Management of Public Risk
[qr sn]
Does not meet requirements for the major in physics.
Analyzes some of the public safety issues involved in assessing risk and making technological decisions. The case history method will be used. Usually offered every fourth year.
Staff

PHSC 9b Introduction to Physics
[qr sn]
Does not meet requirements for the major in physics.
Introduces students to the laws, concepts, and phenomena of physics. Lecture and laboratory are well integrated to explore selected topics of general interest. Usually offered every year.
Mr. Wellenstein

PHYS 10a Physics for the Life Sciences I
[qr sn]
Corequisite: MATH 10a or equivalent.
Introduces students in the life sciences to the laws and concepts of mechanics and thermodynamics. Usually offered every year.
Mr. Lange

PHYS 10b Physics for the Life Sciences II
[qr sn]
Prerequisite: PHYS 10a.
Introduces students in the life sciences to the phenomena and concepts of acoustics, electricity and magnetism, optics, and modern physics. Usually offered every year.
Mr. Fraden

PHYS 11a Basic Physics I
[qr sn]
Corequisite: MATH 10a,b or the equivalent.
Classical mechanics, plus topics from kinetic theory and thermodynamics. Usually offered every year.
Mr. Roberts

PHYS 11b Basic Physics II
[qr sn]
Prerequisite: PHYS 11a.
Elementary electromagnetism presented from a modern point of view, plus topics in special relativity. Usually offered every year.
Mr. Roberts

PHYS 15a Honors Basic Physics I
[qr sn]
Prerequisite: MATH 10a,b or the equivalent. Corequisite: PHYS 19a
Advanced version of PHYS 11a for students with good preparation in physics and mathematics. Newtonian mechanics. Kinetic theory and thermodynamics. Usually offered every year.
Staff

PHYS 15b Honors Basic Physics II
[qr sn]
Prerequisite: MATH 10a,b or the equivalent. PHYS 11a or 15a or the equivalent. Corequisite: PHYS 19b
Advanced version of PHYS 11b for students with good preparation in physics and mathematics. Elementary electromagnetism presented from a modern point of view. Special relativity. Usually offered every year.
Staff

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. Canter

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. 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. 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, 11b, or equivalent.
A survey of phenomena, ideas, and mathematics underlying modern physics—special relativity, waves and oscillations, optics, thermal and statistical physics, and introductory quantum mechanics, as well as a selection of topics such as nuclear physics and radioactivity, elementary particles, cosmology, and electronic properties of crystals, semiconductors, and metals. Usually offered every year.
Mr. Fell

PHYS 20b Modern Physics II
[sn]
Prerequisite: PHYS 20a.
Continuation of PHYS 20a. Usually offered every year.
Mr. Wardle

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, especially relevant to future elementary school teachers, will be co-taught with schoolteachers and enlivened by children's visits. Usually offered every year.
Mr. Lange

PHYS 25b Astrophysics
[sn]
Prerequisites: PHYS 10a, 10b or 11a, 11b, and Math 10a, 10b.
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

PHYS 29a Electronics Laboratory I
[sn]
Prerequisites: PHYS 10a, 10b or 11a, 11b; and 18a, 18b or 19a, 19b.
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]
Prerequsite: 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. Blocker

PHYS 30a Electromagnetism
[sn]
Prerequisite: PHYS 20b 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. Chakraborty

PHYS 30b Quantum Theory
[sn]
Prerequisites: PHYS 11a,b and PHYS 20a,b; or permission of the instructor.
Introduction to quantum mechanics: atomic models, Schrodinger equation, angular momentum, and hydrogen atom. Multielectron atoms and interaction of atoms with the electromagnetic field. Usually offered every year.
Mr. Deser

PHYS 32b Microprocessor Laboratory
[sn]
Prerequisite: PHYS 29a or 29b.
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]
Prerequisite: PHYS 20a. This course may be repeated once for credit with permission of the instructor.
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 semester.
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. Fraden

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 and 20b, 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.
Staff

PHYS 104a Condensed Matter I
[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.
Staff

PHYS 105a Biological Physics
[sn]
May not be taken for credit by students who took Phys 104a in the Fall of 2002.
Physical forces in living matter are studied from the perspective offered by statisitcal 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.
Mr. Kondev

PHYS 107b Particle Physics
[sn]
Prerequisite: PHYS 30a or permission of the instructor. Corerequisite: 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 work load will be appropriate to each group. Usually offered every second year.
Staff

PHYS 110a Mathematical Physics
[sn]
Complex variables; Fourier and Laplace transforms; special functions; partial differential equations. Usually offered every year.
Staff

PHYS 113a First Year Tutorial I
[sn]
A review of physics from the most elementary topics to those treated in other first-year graduate courses. The environment of an oral qualifying examination is reproduced in the tutorial. Usually offered every year.
Staff

PHYS 113b First Year Tutorial II
[sn]
Continuation of PHYS 113a. Usually offered every year.
Staff

NPHY 115a Dynamical Systems, Chaos, and Fractals
[sn]
Prerequisite: PHYS 10a or 11a, MATH 21a, MATH 36a, or approved equivalents. This course may not be repeated for credit by students who have taken PHYS 115a in previous years.
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.
Mr. Wang

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. Deser

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. Kondev

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.
Ms. Chakraborty

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. Usually offered every second year.
Staff

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.
Staff

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 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 semester.
Mr. Meyer

(200 and above) Primarily for Graduate Students

PHYS 200a General Relativity
Introduction to current research and problems in gravitational physics. Physical and mathematical background are provided as needed, but emphasis is on recent literature. Usually offered every second year.
Mr. Deser

PHYS 202a 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.
Staff

PHYS 210a High Energy Theoretical Physics Seminar I
Analysis of important recent developments in particle physics. Usually offered every year.
Mr. Lawrence

PHYS 210b High Energy Theoretical Physics Seminar II
A continuation of PHYS 210a. Usually offered every year.
Mr. Lawrence

PHYS 213a Advanced Examination Tutorial I
Supervised preparation for the advanced examination. Usually offered every year.
Staff

PHYS 213b Advanced Examination Tutorial II
Supervised preparation for the advanced examination. Usually offered every year.
Staff

PHYS 301a Astrophysics Seminar I
Advanced topics and current research in astrophysics are discussed. Usually offered every year.
Mr. Roberts

PHYS 301b Astrophysics Seminar II
A continuation of PHYS 301a. Usually offered every year.
Mr. Wardle

PHYS 302a Particle Seminar I
Seminar covers latest advances in elementary particle physics. Includes student presentations and invited speakers. Usually offered every year.
Mr. Kirsch

PHYS 302b Particle Seminar II
A continuation of PHYS 302a. Usually offered every year.
Mr. Blocker

PHYS 304a Condensed Matter Seminar I
Analysis and discussion of recent important developments in solid-state physics. Usually offered every year.
Ms. Chakraborty

PHYS 304b Condensed Matter Seminar II
A continuation of PHYS 304a. Usually offered every year.
Mr. Kondev

PHYS 305a Liquid Crystals I
Recent advances in the physics of liquid crystals and related systems such as microemulsions, colloidal suspensions, and polymer solutions. Usually offered every year.
Mr. Meyer

PHYS 305b Liquid Crystals II
A continuation of PHYS 305a. Usually offered every year.
Mr. Fraden

NPHY 341b Neural Computation
An advanced graduate seminar course on current theoretical issues dealing with the dynamics and information processing of neural systems. Usually offered every year.
Mr. Wang

PHYS 349a Readings in Condensed Matter
Usually offered every year.
Ms. Chakraborty

PHYS 405d Experimental Elementary Particle Physics
Specific sections for individual faculty members as requested.
Staff

PHYS 408d Computational Neuroscience
Specific sections for individual faculty members as requested.
Staff

PHYS 409d Theoretical High Energy Physics
Specific sections for individual faculty members as requested.
Staff

PHYS 417d Theoretical Condensed Matter Physics
Ms. Chakraborty and Mr. Kondev

PHYS 421d Relativity
Mr. Deser

PHYS 426d Astrophysics
Specific sections for individual faculty members as requested.
Staff

PHYS 430d Experimental Solid-State Physics
Specific sections for individual faculty members as requested.
Staff

PHYS 431d Experimental Condensed-Matter Physics
Specific sections for individual faculty members as requested.
Staff

PHYS 436d Biophysics
Staff

Cross-Listed Courses

BIOP 200b
Biophysics and Structural Biology Graduate Seminar