

PHL 466 Aristotle 3

Subcategory Name: Value Theory Rule:

Criterion: C- Number of Credits

Course Listing

PHL 412 Ethics and Public Affairs 3  
PHL 422 Environmental Philosophy 3  
PHL 427 Topics in Philosophy of Art 1 To 4  
PHL 429 Philosophy in Literature 3  
PHL 449 Hist Moral and Political Phil 3  
PHL 455 Phil of Society and Culture 3

Subcategory Name: Continental Philosophy Rule:

Criterion: C- Number of Credits

Course Listing

PHL 467 19th Century Continental Phil 3  
PHL 468 20th Century Continental Phil 3

Subcategory Name: Analytic Philosophy Rule:

Criterion: C- Number of Credits

Course Listing

PHL 405 20th Century Analytic Phil 3  
PHL 406 Contemp Issues Analytic Phil 3  
PHL 445 Central Issues Phil of Science 3

Commentary: Special Topics courses taught at the 400-level (PHL 491 [PHIL 495]) may count as upper-division core courses provided that they have a suitable content (consult the department advisor).

Degree Commentary

Students must complete a minimum of 18 credits in philosophy; at least 6 credits must be in courses numbered 300 and higher.

## Department Faculty

### Professors

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- Albert Borgmann, Regents Professor Emeritus of Philosophy
- Christopher Preston, Professor of Philosophy
- David Sherman, Professor of Philosophy
- Deborah Slicer, Professor of Philosophy, Graduate Advisor

### Associate Professors

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- Bridget Clarke, Associate Professor of Philosophy
- Armond Duwell, Associate Professor of Philosophy
- Soazig Le Bihan, Associate Professor of Philosophy
- Paul Muench, Associate Professor of Philosophy
- Matthew Strohl, Associate Professor of Philosophy, Department Chair

## Adjunct Faculty

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- Patrick Burke, Adjunct Instructor of Philosophy
- David Clark, Adjunct Assistant Professor of Philosophy
- Daniel Congdon

## Emeritus Professors

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- Thomas Huff, Adjunct Professor / Professor of Philosophy, Emeritus
- Fred McGlynn, Professor Emeritus

## Course Descriptions

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### Philosophy

#### PHL 101Y - Introduction to Philosophy

Credits: 3. (R-12) Offered yearly. An introduction to philosophy through examination of the thought of selected great philosophers or of traditional positions on classical philosophical problems. Course Attributes: American and European

#### PHL 102Y - Topical Intro to Philosophy

Credits: 1 TO 4. (R-9) Offered yearly. An introduction to philosophy through examination of a selected topic (such as existentialism, philosophy of film, technology and the good life, science and society, philosophy of religion). Course Attributes: American and European

#### PHL 110E - Introduction to Ethics

Credits: 3. Offered every term. An examination of the Western vision of morality through the careful study of selected writings from Aristotle, Kant and Mill. Additional works in ethics may supplement primary readings. Course Attributes: Ethical & Human Values Course

#### PHL 112E - Intro Ethics and Environment

Credits: 3. Offered intermittently. An introductory-level ethics course with a special interest in the natural environment. The course will (a) introduce students to the three classical traditions in ethics - virtue, Kantianism, and utilitarianism, (b) ground these theories in questions about the moral status of non-humans and our moral duties to non-humans, (c) include an applied section of the course that will cover animal welfare, biotechnology, and other current topics. Course Attributes: Ethical & Human Values Course

#### PHL 114E - Intro to Political Ethics

Credits: 3. Offered intermittently. An examination of the issues of political ethics through the careful study of selected writings from the three great Western political traditions: classical natural law theory, modern individualism, and contemporary distributive justice. Course Attributes: Ethical & Human Values Course

#### PHL 191 - Special Topics

Credits: 1 TO 6. (R-6) Offered intermittently. Experimental offerings of visiting professors, experimental offerings of new courses, or one-time offerings of current topics.

#### PHL 198 - Internship

Credits: 1 TO 6. (R-6) Offered intermittently. Prereq., consent of faculty supervisor and the Internship Services Office. Extended classroom experience which provides practical application of classroom learning during placements off campus. A maximum of 6 credits of Internship (198, 298, 398, 498) may count toward graduation. Course Attributes: Internships/Practicums

#### PHL 210E - Moral Philosophy

Credits: 3. Offered autumn and spring. Prereq., philosophy major or minor, or consent of instr. An examination of leading approaches to moral philosophy through a careful reading of classical texts in the Western tradition. A more thorough treatment of the material offered in PHL 110E. Intended primarily for philosophy majors and minors. Course Attributes: Ethical & Human Values Course Writing Course-Intermediate

PHL 233 - Intro to Logic: Deduction

Credits: 3. Offered autumn and spring. Understanding general principles of reasoning and the habits of clear and correct thinking. Emphasis on the analysis of the logical structure of claims in natural language and the skills of elementary deductive inference.

PHL 235 - Intro to Logic: Induction

Credits: 3. Offered intermittently. Prereq., PHL 233 or equivalent, or consent of instr. A study of the formal principles of reasoning from evidence.

PHL 241N - Hist & Philosophy of Science

Credits: 3. Offered intermittently. The epistemological and metaphysical developments of natural philosophy or science. The origins of science in ancient Greece, and its subsequent developments during the scientific revolution. Developments in biology, especially Darwinism and genetics, and developments in physics. Course Attributes: Historical & Cultural Course Natural Science Course

PHL 261Y - History of Ancient Philosophy

Credits: 3. Offered autumn. Introduction to the central works of Plato and Aristotle, with an overview of Presocratic and Hellenistic philosophy. Course Attributes: American and European

PHL 262Y - History of Modern Philosophy

Credits: 3. Offered spring. A survey of the history of philosophy from Descartes to Kant, which includes other continental rationalists and the British Empiricists. Course Attributes: American and European

PHL 291 - Special Topics

Credits: 1 TO 6. (R-6) Offered intermittently. Experimental offerings of visiting professors, experimental offerings of new courses, or one-time offerings of current topics.

PHL 292 - Independent Study

Credits: 1 TO 6. (R-6) Offered intermittently. Course material appropriate to the needs and objectives of the individual student.

PHL 298 - Internship

Credits: 1 TO 6. (R-9) Offered intermittently. Prereq., consent of faculty supervisor and the Internship Services office. Extended classroom experience which provides practical application of classroom learning during placements off campus. A maximum of 6 credits of Internship (198, 298, 398, 498) may count toward graduation. Course Attributes: Internships/Practicums

PHL 301 - Knowledge and Reality

Credits: 3. (R-9) Offered intermittently. Prereq., upper-division standing or consent of instr. Selected topics in one or more of the following areas: epistemology (the study of knowledge), philosophy of science, metaphysics. Intended primarily for non-majors.

PHL 311 - The Good, Right, Beautiful

Credits: 3. (R-9) Offered intermittently. Prereq., upper-division standing or consent of instr. Selected topics in one or more of the following areas: ethics, philosophy of mind/action, aesthetics. Intended primarily for non-majors.

PHL 316 - Historical Figures in Phil

Credits: 3. (R-9) Offered intermittently. Prereq., upper-division standing or consent of instr. Study of one or more historically significant philosophers. Intended primarily for non-majors.

PHL 321E - Philosophy & Biomedical Ethics

Credits: 3. Offered intermittently. Prereq., upper-division standing or consent of instr. An examination of ethical problems raised by the practice of medicine and by recent developments in medically-related biological sciences. Course Attributes: Ethical & Human Values Course

PHL 323 - Ethics of Climate Change

Credits: 3. This course will examine some of the fundamental issues raised by global climate change and consider how environmental ethics might help to address these issues. Students will become acquainted with the essential elements of climate change science and be provided with an introduction to contemporary approaches to environmental ethics that have developed out of the primary ethical traditions of western thought: deontological (Kantian) ethics, utilitarian ethics, and virtue ethics. In addition, the course will examine alternative understandings of the appropriate relationship between humans and the natural world including: "Deep Ecology" and Native American perspectives.

PHL 351 - Philosophy and Feminism

Credits: 3. Offered intermittently. Prereq., upper-division standing or consent of instr. Study of what distinguishes feminist from traditional approaches to ethics. May also examine other relevant areas of philosophy, including epistemology, political theory, philosophy of science and environment.

PHL 363 - Ancient Greek and Roman Phil

Credits: 3. Offered intermittently. Examination of the thought of the philosophers of Greece and Rome as expressed in original works read in English translation. Ancient philosophy studied within its historical, linguistic and cultural setting. Cannot receive credit for both PHL 363 and MCLG 362H.

PHL 370 - Philosophy of Religion

Credits: 3. Offered intermittently. Prereq., upper-division standing or consent of instr. An examination of one or more of the classic problems of Western philosophy of religion, such as the traditional arguments for and against the existence of God, the relationship of faith and reason, the status of religious experience, the problem of evil, and the problem of reconciling divine omniscience with human freedom.

PHL 390 - Research

Credits: 1 TO 9. (R-9) Offered intermittently. Prereq., consent of instr. Directed individual research and study appropriate to the background and objectives of the student. Course Attributes: Research & Creative Schlrshp

PHL 391 - Special Topics

Credits: 1 TO 9. (R-9) Offered intermittently. Experimental offerings of visiting professors, experimental offerings of new courses, or one-time offerings of current topics.

PHL 392 - Independent Study

Credits: 1 TO 9. (R-9) Offered intermittently. Prereq., consent of instr. Course material appropriate to the needs and objectives of the individual student.

PHL 394 - Seminar

Credits: 1 TO 9. (R-9) Offered intermittently. Prereq., consent of instr. A review and discussion of current research. Topics vary.

PHL 398 - Internship

Credits: 1 TO 6. (R-6) Offered intermittently. Prereq., consent of faculty supervisor and the Internship Services office. Extended classroom experience which provides practical application of classroom learning during placements off campus. A maximum of 6 credits of Internship (198, 298, 398, 498) may count toward graduation. Course Attributes: Internships/Practicums

PHL 405 - 20th Century Analytic Phil

Credits: 3. (R-9) Offered intermittently. Prereq., upper-division standing, PHL 210E, PHL 233, and PHL 262Y, or consent of instr. Intensive study of the work of one or more philosophers (such as Frege, Russell, Wittgenstein) or historical introduction to the major issues and figures of 20th century philosophy in the analytic tradition (with readings from Frege, Russell, Wittgenstein, Quine and others).

PHL 406 - Contemp Issues Analytic Phil

Credits: 3. (R-6) Offered intermittently. Prereq., upper-division standing, PHL 210E, PHL 233, and PHL 262Y, or consent of instr. Examination of contemporary issues in analytic philosophy focusing on one or more of the following topics: philosophy of language, epistemology, metaphysics, philosophy of mind.

PHL 412 - Ethics and Public Affairs

Credits: 3. Offered intermittently. Prereq., upper-division standing and PHL 210E, or consent of instr. Examination of morally relevant issues in government, journalism, education and other social institutions. Issues considered may include just war theory, deception, confidentiality, conflict of interest, privacy, paternalism responsibilities in conflict with other institutions, and responsibilities across national boundaries, among others.

PHL 422 - Environmental Philosophy

Credits: 3. Offered intermittently. Prereq., upper-division standing and PHL 210E, or consent of instr. Critical exploration of selected philosophical and literary texts pertinent to the ethics of human relationships with the natural environment.

PHL 427 - Topics in Philosophy of Art

Credits: 1 TO 4. (R-9) Offered intermittently. Prereq., upper-division standing and PHL 210E, or consent of instr. Examination of philosophical problems related to particular arts and discussion of the nature of the arts. Topics considered may include music, visual arts, literature, and film.

PHL 429 - Philosophy in Literature

Credits: 3. Offered intermittently. Prereq., upper-division standing and PHL 210E, or consent of instr. Philosophical thought in selected works of literature.

PHL 445 - Central Issues Phil of Science

Credits: 3. Offered intermittently. Prereq., upper-division standing and PHL 210E, or consent of instr. A consideration of philosophical issues relating to the nature of modern physical science: method, explanation, theory, progress, space/time, causality, relation of science to philosophy.

PHL 449 - Hist Moral and Political Phil

Credits: 3. Offered intermittently. Prereq., upper-division standing and PHL 210E, or consent of instr. Reading and interpretation of selected writings in the history of moral philosophy and/or political philosophy.

PHL 450 - Contemp Moral/Political Theory

Credits: 3. Offered intermittently. Prereq., upper-division standing and PHL 210E, or consent of instr. Recent theories in ethics and their implications; recent work in political theory, emphasizing contemporary liberalism and its critics.

PHL 455 - Phil of Society and Culture

Credits: 3. Offered intermittently. Prereq., upper-division standing and PHL 210E, or consent of instr. A philosophical examination of cultural forces shaping modern society, forces such as science, technology, or domesticity.

PHL 462 - Early Modern Philosophy

Credits: 3. (R-6) Offered intermittently. Prereq., upper-division standing, PHL 210E, and PHL 262Y, or consent of instr. Intensive study of the work of one or more of the major philosophers from the early modern period (Descartes, Spinoza, Leibniz, Locke, Berkeley, Hume).

PHL 464 - Kant

Credits: 3. Offered intermittently. Prereq., upper-division standing, PHL 210E, and PHL 262Y, or consent of instr. Reading and interpretation of selected works.

PHL 465 - Plato

Credits: 3. Offered intermittently. Prereq., upper-division standing, PHL 210E, and PHL 261Y, or consent of instr. Reading and interpretation of selected works.

PHL 466 - Aristotle

Credits: 3. Offered intermittently. Prereq., upper-division standing, PHL 210E, and PHL 261Y, or consent of instr. Reading and interpretation of selected works.

PHL 467 - 19th Century Continental Phil

Credits: 3. (R-6) Offered intermittently. Prereq., upper-division standing, PHL 210E, and PHL 262Y, or consent of instr. Intensive study of the work of one or more 19th century continental philosophers (such as Hegel, Schopenhauer, Kierkegaard, Marx, Nietzsche).

PHL 468 - 20th Century Continental Phil

Credits: 3. (R-9) Offered intermittently. Prereq., upper-division standing, PHL 210E, and PHL 262Y, or consent of instr. Intensive study of the work of one or more 20th century continental philosophers (such as Heidegger, Husserl, Sartre, Merleau-Ponty, Ricoeur, Derrida) or several texts representing a major movement in 20th century continental thought (such as Phenomenology, Existentialism, Hermeneutics, Post-structuralism).

PHL 490 - Research

Credits: 1 TO 9. (R-9) Offered intermittently. Prereq., consent of instr. Directed individual research and study appropriate to the background and objectives of the student. Course Attributes: Research & Creative Schlrshp

PHL 491 - Special Topics

Credits: 1 TO 9. (R-9) Offered intermittently. Prereq., consent of instr. Experimental offerings of visiting professors, experimental offerings of new courses, or one-time offerings of current topics.

PHL 492 - Independent Study

Credits: 1 TO 9. (R-9) Offered intermittently. Prereq., consent of instr. Course material appropriate to the needs and objectives of the individual student.

PHL 494 - Seminar

Credits: 1 TO 9. (R-9) Offered intermittently. Prereq., consent of instr. A review and discussion of current research. Topics vary.

PHL 498 - Internship

Credits: 1 TO 6. (R-6) Offered intermittently. Prereq., consent of faculty supervisor and the Internship Services office. Extended classroom experience which provides practical application of classroom learning during placements off campus. A maximum of 6 credits of Internship (198, 298, 398, 498) may count toward graduation. Course Attributes: Internships/Practicums

PHL 499 - Senior Seminar

Credits: 3. (R-9) Offered spring. Prereq., senior standing and philosophy major or philosophy minor, or consent of instr. Research in problems in philosophy. Course Attributes: Writing Course-Advanced

PHL 501 - Episto/Technol/Science

Credits: 3. (R-6) Offered yearly. Reading and interpretation of selected writings that address one of three topics: epistemology (theory of knowledge), philosophy of technology, or philosophy of science (focus will be foundations of ecology). Level: Graduate

PHL 502 - Topics in Value Theory

Credits: 3. (R-6) Offered yearly. Reading and interpretation of selected writings in value theory. Level: Graduate

PHL 504 - Topics in Environ Philosophy

Credits: 3. (R-9) Offered yearly. Same as ENST 504. Critical study/discussion of current (as well as benchmark) texts and issues in environmental ethics, environmental politics, and the philosophy of ecology. Interdisciplinary; open to interested students from all disciplines. Level: Graduate

PHL 505 - Topics in Contemp Phil

Credits: 3. (R-6) Offered intermittently. Reading and interpretation of selected writings in contemporary philosophy. Level: Graduate

PHL 510 - Phil Forum Colloquium

Credits: 1. (R-3) Offered autumn and spring. Prereq., graduate standing. Discussion and further exploration of issues presented at the weekly Philosophy Forum. Level: Graduate

PHL 521 - Theory & Skills for Ethics

Credits: 3. Offered intermittently. Exploration and critical reflection of concepts and significant issues in the teaching of practical ethics in classroom and corporate settings. Level: Graduate

PHL 581 - Thesis Proposal Prep

Credits: 1 TO 2. (R-2) Offered every semester. Preparation of a thesis or manuscript based on research for presentation and/or publication. Level: Graduate

PHL 590 - Research

Credits: 1 TO 9. (R-9) Offered intermittently. Prereq., consent of instr. Directed individual research and study appropriate to the background and objectives of the student. Level: Graduate Course Attributes: Research & Creative Schlrshp

PHL 591 - Special Topics

Credits: 1 TO 9. (R-9) Offered intermittently. Experimental offerings of visiting professors, experimental offerings of new courses, or one-time offerings of current topics. Level: Graduate

PHL 592 - Independent Study

Credits: 1 TO 9. (R-9) Offered intermittently. Prereq., consent of instr. Course material appropriate to the needs and objectives of the individual student. Level: Graduate

PHL 593 - Professional Paper

Credits: 1 TO 9. (R-9) Offered intermittently. Prereq., consent of instr. Course material appropriate to the needs and objectives of the individual student. Level: Graduate Course Attributes: Faculty-Led Study Abroad

PHL 594 - Seminar

Credits: 1 TO 9. (R-9) Offered intermittently. A review and discussion of current research. Topics vary. Level: Graduate

PHL 598 - Internship

Credits: 1 TO 12. (R-12) Offered intermittently. Prereq., consent of faculty supervisor and the Internship Services office. Extended classroom experience which provides practical application of classroom learning during placements off campus. Level: Graduate Course Attributes: Internships/Practicums

PHL 599 - Thesis

Credits: 1 TO 6. (R-9) Offered every semester. Prereq., approval of a thesis proposal by the student's thesis committee. Level: Graduate

# Physics and Astronomy Department

**Andrew S. Ware, Chair**

Physics is considered to be the most fundamental of all disciplines in the natural sciences. In physics we try to describe and understand a myriad of physical phenomena ranging from subatomic to cosmological scales by quantifying the relationships among different physical quantities. Not only does physics have its own merit as a challenging but exciting scientific endeavor, it provides the basis for understanding underlying processes in astronomy, biology, chemistry, geology, computer science, engineering, and even in behavioral sciences. Applications of physics are virtually unlimited: computers, communications, energy production, medical technology, and space flight, to name just a few. The Department of Physics and Astronomy offers a range of physics courses from introductory to advanced undergraduate level in both experimental and theoretical physics with computational methods in mind. In addition, we offer introductory to advanced astronomy and astrophysics courses in which astronomical applications of physics are emphasized. These courses deal with the Universe, from the solar system to clusters of galaxies, both theoretically and observationally. The Department of Physics and Astronomy offers the Bachelor of Arts degree with a major in physics. Graduates with this degree are prepared for further study in physics or related fields at the masters or Ph.D. level, as well as a wide variety of technical positions in industry.

In addition, the department offers three options that combine a solid background in the study of physics with in-depth study in other fields. These options allow for specialization in related fields and provide appropriate background for certain employment opportunities and for continued graduate or professional study. For more details, see the related sections of this catalog.

- Astronomy
- Computational Physics
- Teaching Broadfield Science

## **College Humanities & Sciences Catalog Year: 2015-2016**

Degree Type: Bachelor of Arts Level: **Major** Subject: **Physics**

Total Credits: 61 Cumulative GPA Required: 2.0

Lower Division Core

Category Name: Lower Division Physics

Rule: Must complete all of the courses in one of the two options:

Criterion: C- Number of Credits 10

Course Listing

Commentary: The Physics with Calculus series (PHSX 215N - 218N) is strongly recommended.

Subcategory Name: College Physics

Rule: May complete all of the following courses

Criterion: C- Number of Credits 10

Course Listing

PHSX 205N	College Physics I	4
PHSX 206N	College Physics I Laboratory	1
PHSX 207N	College Physics II	4
PHSX 208N	College Physics II Laboratory	1

Subcategory Name: Physics with Calculus Rule: May complete all of the following courses

Criterion: C- Number of Credits 10

Course Listing

PHSX 215N	Fund of Physics w/Calc I	4
PHSX 216N	Physics Laboratory I w/Calc	1
PHSX 217N	Fund of Physics w/Calc II	4
PHSX 218N	Physics Laboratory II w/Calc	1

Commentary: Calculus-based Physics sequence is strongly recommended.

Upper Division Core

Category Name: Upper Division Physics Rule: Complete the following courses

Criterion: C- Number of Credits 27

Course Listing

PHSX 301	Intro Theoretical Physics	3
PHSX 311	Oscillations and Waves	2
PHSX 320	Classical Mechanics	3
PHSX 323	Intermediate Physics Lab	3
PHSX 327	Optics	3
PHSX 343	Modern Physics	3
PHSX 423	Electricity & Magnetism I	3
PHSX 444	Advanced Physics Lab	3
PHSX 461	Quantum Mechanics I	3
PHSX 499	Senior Capstone Seminar	1

Commentary: Major Electives

Category Name: Physics Electives

Rule: Choose any 2 courses designated with PHSX prefix, for 6 total credits

Criterion: C-

Course Listing Number of Credits 6

PHSX 141N	Einstein's Relativity	3
PHSX 330	Communicating Physics	3
PHSX 333	Computational Physics	3
PHSX 425	Electricity & Magnetism II	3
PHSX 446	Thermodyn & Stat Mech	3
PHSX 462	Quantum Mechanics II	3

Commentary: PHSX 425 and PHSX 462 are strongly recommended

Commentary: Cognates



Category Name: Math Requirements

Rule: Complete all of the following courses

Criterion: C- Number of Credits 15

Course Listing

M 171 Calculus I 4

M 172 Calculus II 4

M 273 Multivariable Calculus 4

M 311 Ordinary Diff Equations/System 3

Commentary: M 317, M 412, and M 418 are recommended as well

Cognates

Category Name: Computer Science Requirements Rule: Choose 1 of the following

Criterion: C- Number of Credits 3

Course Listing

CSCI 100 Intro to Programming 3

CSCI 135 Fund of Computer Science I 3

CSCI 250 Computer Mdlng/Science Majors 3

PHSX 333 Computational Physics 3

Commentary: PHSX 333 or CSCI 250 is strongly recommended

Commentary: Additional Requirements

Category Name: Foreign Language

Commentary: Students must also complete a 2 semester language sequence or have equivalent placement.

Degree Commentary

## **College Humanities & Sciences Catalog Year: 2015-2016**

Degree Type: Bachelor of Arts Level: Major Subject: **Physics** Option: **Astronomy**

Total Credits: 65 Cumulative GPA Required: 2.0

The astronomy option provides a thorough study of astronomy and astrophysics as well as a solid background in physics and mathematics. Graduates from this program have gone on to graduate programs in astronomy and astrophysics while others have found career opportunities at national astronomical observatories.

Lower Division Core

Category Name: Lower Division Physics Core

Rule: Must complete all of the courses in one of the two options:

Criterion: Number of Credits 10

Course Listing

Commentary: The Physics with Calculus series (PHSX 215N - 218N) is strongly recommended.

Subcategory Name: College Physics

Rule: May complete all of the following courses

Criterion: C- Number of Credits 10

Course Listing

PHSX 205N College Physics I 4

PHSX 206N College Physics I Laboratory 1

PHSX 207N College Physics II 4

PHSX 208N College Physics II Laboratory 1

Subcategory Name: Physics with Calculus

Rule: May complete all of the following courses:

Criterion: C- Number of Credits 10

Course Listing

PHSX 215N Fund of Physics w/Calc I 4

PHSX 216N Physics Laboratory I w/Calc 1

PHSX 217N Fund of Physics w/Calc II 4

PHSX 218N Physics Laboratory II w/Calc 1

Commentary: Calculus-based physics sequence is strongly recommended.

Lower Division Core

Category Name: Lower Division Astronomy Core

Rule: Must complete all of the courses in one of the two options:

Criterion: Number of Credits 4

Course Listing Commentary:

Subcategory Name: Astronomy Core: Option 1 Rule: May complete all of the following courses

Criterion: C- Number of Credits 4

Course Listing

ASTR 132N Elementary Astronomy II 3

ASTR 135N Elementary Astronomy Lab II 1

Subcategory Name: Astronomy Core: Option 2 Rule: May complete the following course

Criterion: C- Number of Credits 4

Course Listing

ASTR 142N The Evolving Universe 4

Commentary: Upper Division Core

Category Name: Upper Division Physics Core Rule: Must complete the following courses

Criterion: C- Number of Credits 12

Course Listing

PHSX 301 Intro Theoretical Physics 3

PHSX 311 Oscillations and Waves 2

PHSX 343 Modern Physics 3

PHSX 461 Quantum Mechanics I 3

PHSX 499 Senior Capstone Seminar 1

Commentary: Upper Division Core

Category Name: Upper Division Astronomy Core Rule: Must complete the following courses

Criterion: C- Number of Credits 9

Course Listing

ASTR 353 Galactic Astrophysics 3

ASTR 363 Stellar Astr & Astrophys I 3

ASTR 365 Stellar Ast & Astrophys II 3

Commentary: ASTR 351 and ASTR 362 are recommended as well

Commentary: Major Electives

Category Name: Major Electives

Rule: Complete the following subcategories of courses

Criterion: Number of Credits 12

Course Listing Commentary:

Subcategory Name: Physics Electives Rule: Choose 3 of the following courses

Criterion: C- Number of Credits 9

Course Listing

PHSX 320 Classical Mechanics 3  
PHSX 327 Optics 3  
PHSX 423 Electricity & Magnetism I 3  
PHSX 425 Electricity & Magnetism II 3  
PHSX 446 Thermodyn & Stat Mech 3  
PHSX 462 Quantum Mechanics II 3

Subcategory Name: Physics Laboratory Electives Rule: Choose 1 of the following laboratory courses

Criterion: C- Number of Credits 3

Course Listing

ASTR 362 Observational Astronomy 3  
PHSX 323 Intermediate Physics Lab 3  
PHSX 444 Advanced Physics Lab 3

Commentary: Cognates

Category Name: Math Requirements Rule: Complete the following courses

Criterion: C- Number of Credits 15

Course Listing

M 171 Calculus I 4  
M 172 Calculus II 4  
M 273 Multivariable Calculus 4  
M 311 Ordinary Diff Equations/System 3

Commentary: M 317, M 412, and M 418 are recommended as well

Commentary: Cognates

Category Name: Computer Science Electives Rule: Choose 1 of the following courses

Criterion: C- Number of Credits 3

Course Listing

CSCI 100 Intro to Programming 3  
CSCI 135 Fund of Computer Science I 3  
CSCI 250 Computer Mdlng/Science Majors 3  
PHSX 333 Computational Physics 3

Commentary: PHSX 333 or CSCI 250 is strongly recommended.

Commentary: Additional Requirements

Category Name: Foreign Language

Commentary: Students must also complete a 2 semester language sequence or have equivalent placement Degree

## College Humanities & Sciences Catalog Year: 20152016

Degree Type: Bachelor of Arts Level: Major Subject: **Physics** Option: **Teaching Broadfield Science**

Total Credits: 79 Cumulative GPA Required: 2.0

Individuals interested in teaching in K-12 schools must complete a degree in the content area they want to teach plus the teacher preparation program through the Department of Curriculum and Instruction. Individuals must complete the teaching major/teaching track within that degree program, which may contain different course requirements than the academic major since the sequence of courses is designed to meet state standards. Upon completion of the degree program with the teaching track and the secondary licensure program, one will be eligible for a standard Montana teaching license in this content area.

Lower Division Core

Category Name: Physics Requirements

Rule: Must complete all of the following subcategories

Criterion: C

Number of Credits 24

Course Listing

Subcategory Name: Required Physics Courses

Rule: All courses are required

PHSX 215N Fund of Physics w/Calc I 4

PHSX 216N Physics Laboratory I w/Calc 1

PHSX 217N Fund of Physics w/Calc II 4

PHSX 218N Physics Laboratory II w/Calc 1

PHSX 301 Intro Theoretical Physics 3

PHSX 311 Oscillations and Waves 2

PHSX 330 Communicating Physics 3

PHSX 343 Modern Physics 3

Commentary:

Subcategory Name: Physics Elective

Rule: Must complete 1 additional upper division Physics course

Criterion: C

Number of Credits 3

Course Listing

Commentary:

Commentary:

Lower Division Core

Category Name: Math Requirements

Rule: All courses are required

Criterion: C

Number of Credits 15

Course Listing

M 171 Calculus I 4

M 172 Calculus II 4

M 273 Multivariable Calculus 4

M 311 Ordinary Diff Equations/System 3

Lower Division Core

Category Name: Statistics Requirements

Rule: Must complete 1 of the following courses

Criterion: C

Number of Credits 34

Course Listing

STAT 216 Introduction to Statistics 4

STAT 341 Intro to Probability and Stat 3

Commentary:

Lower Division Core

Category Name: Astronomy Requirements

Rule: All courses are required

Criterion: C

Number of Credits 4

Course Listing

ASTR 131N Elementary Astronomy I 3

ASTR 134N Elementary Astronomy Lab I 1

Lower Division Core

Category Name: Geology Requirements

Rule: Must complete the following subcategories

Criterion: Number of Credits 7

Course Listing

Commentary:

Subcategory Name: Required Geology Courses

Rule: All courses are required

Criterion: C

Number of Credits 4

Course Listing

GEO 101N Intro to Physical Geology 3

GEO 102N Intro to Physical Geology Lab 1

Commentary:

Subcategory Name: Geology Electives

Rule: Must complete 1 of the following courses

Criterion: C

Number of Credits 3

Course Listing

ASTR 351 Planetary Science 3

GEO 105N Oceanography 3

GEO 108N Climate Change 3

GEO 200 Historical Geology 2

Commentary:

Rule: Must complete all of the following courses

Criterion: C

Number of Credits 12

Course Listing

BIOB 160N Principles of Living Systems 4

BIOB 260 Cellular and Molecular Biology 4

BIOB 272 Genetics and Evolution 4

Commentary:

Lower Division Core

Category Name: Chemistry Requirements

Rule: Must complete all of the following courses

Criterion: CNumber

of Credits 11

Course Listing

CHMY 141N College Chemistry I 5

CHMY 143N College Chemistry II 5

CHMY 485 Laboratory Safety 1

Commentary:

Track Requirements

Category Name: Teaching Methods Requirement

Rule: Complete the following course.

Criterion: C

Number of Credits 3

Course Listing

EDU 497 Teaching and Assessing 0 To 4 F

Commentary: The EDU 497 course number is used for multiple courses. Students should register for EDU 497

Methods: 512 Science.

Degree Commentary: Students must be formally admitted to the Teacher Education Program and complete all of the professional education licensure requirements. See the Department of Curriculum & Instruction in the College of Education and Human Sciences for more information. A major GPA of 2.75 is required to be eligible for student teaching.

## **College Humanities & Sciences Catalog Year: 2015-2016**

Degree Type: Bachelor of Arts Level: Major Subject: **Physics** Option: **Computational Physics**

Total Credits: 72 Cumulative GPA Required: 2.0

The computational physics option provides a thorough study of computer science and computational physics as well as a solid background in physics and mathematics. Graduates from this program have gone on to graduate programs in physics and computer science while others have found career opportunities in technical fields.

Lower Division Core

Category Name: Lower Division Physics Core

Rule: Must complete all of the courses in one of the two options:

Criterion: Number of Credits 10

Course Listing

Commentary: The Physics with Calculus series (PHSX 215N - 218N) is strongly recommended.

Subcategory Name: College Physics

Rule: may complete all of the following courses

Criterion: C- Number of Credits 10

Course Listing

PHSX 205N	College Physics I	4
PHSX 206N	College Physics I Laboratory	1
PHSX 207N	College Physics II	4
PHSX 208N	College Physics II Laboratory	1

Subcategory Name: Physics with Calculus Rule: May complete all of the following courses

Criterion: C- Number of Credits 10

Course Listing

PHSX 215N	Fund of Physics w/Calc I	4
PHSX 216N	Physics Laboratory I w/Calc	1
PHSX 217N	Fund of Physics w/Calc II	4
PHSX 218N	Physics Laboratory II w/Calc	1

Commentary: Upper Division Core

Category Name: Upper Division Physics Rule: Complete the following courses

Criterion: C- Number of Credits 18

Course Listing

PHSX 301	Intro Theoretical Physics	3
PHSX 311	Oscillations and Waves	2
PHSX 320	Classical Mechanics	3
PHSX 333	Computational Physics3	
PHSX 343	Modern Physics	3
PHSX 423	Electricity & Magnetism I	3
PHSX 499	Senior Capstone Seminar	1

Commentary: Major Electives

Category Name: Physics Elective

Rule: Choose 1 of the following courses

Criterion: C- Number of Credits 3

Course Listing

PHSX 141N	Einstein's Relativity	3
PHSX 323	Intermediate Physics Lab	3
PHSX 327	Optics	3
PHSX 330	Communicating Physics	3
PHSX 425	Electricity & Magnetism II	3
PHSX 444	Advanced Physics Lab 3	
PHSX 446	Thermodyn & Stat Mech	3
PHSX 461	Quantum Mechanics I	3
PHSX 462	Quantum Mechanics II	3

Commentary: PHSX 322, 425, and 461 are strongly recommended

Commentary: Cognates

Category Name: Math Requirements Rule: Complete the following courses

Criterion: Number of Credits 21

Course Listing

M 171	Calculus I	4
M 172	Calculus II	4

M 225 Intro to Discrete Mathematics 3

M 273 Multivariable Calculus 4

M 311 Ordinary Diff Equations/System 3

M 325 Discrete Mathematics 3

Commentary: M 307, STAT 341, and STAT 458 are recommended as well

Cognates

Category Name: Computer Science Requirements Rule: Complete the following subcategories of courses

Criterion: Number of Credits 20

Course Listing Commentary:

Subcategory Name: Computer Science Core Courses Rule: Must complete all of the following courses

Criterion: C- Number of Credits 13

Course Listing

CSCI 135 Fund of Computer Science I 3

CSCI 136 Fund of Computer Science II 3

CSCI 232 Data Structures and Algorithms 4

CSCI 332 Design/Analysis of Algorithms 3

Subcategory Name: Computer Science Electives

Rule: Choose an additional 7 credits from any CSCI courses number 200 and above

Criterion: C- Number of Credits 7

Course Listing

Commentary: CSCI 205, 250, 361, 415, and 477 are recommended

Commentary: Additional Requirements

Category Name: Foreign Language

Commentary: Students must also complete a 2 semester language sequence or have equivalent placement.

## College Humanities & Sciences Catalog Year: 2015-2016

Degree Type: Minor Level: Minor Subject: **Physics (Minor)**

Total Credits: 24 Cumulative GPA Required: 2.0

Lower Division Core

Category Name: Required Lower Division Courses

Rule: Must complete all of the following courses in one of the two options: Criterion: Number of Credits 10

Course Listing

Commentary: The Physics with Calculus series (PHSX 215N - 218N) is strongly recommended.

Subcategory Name: College Physics

Rule: May complete all of the following courses:

Criterion: C- Number of Credits 10

Course Listing

PHSX 206N College Physics I Laboratory 1

PHSX 207N College Physics II 4

PHSX 208N College Physics II Laboratory 1

Subcategory Name: Physics with Calculus

Rule: May complete all of the following courses:

Criterion: C- Number of Credits 10



#### Course Listing

PHSX 215N	Fund of Physics w/Calc I	4
PHSX 216N	Physics Laboratory I w/Calc	1
PHSX 217N	Fund of Physics w/Calc II	4
PHSX 218N	Physics Laboratory II w/Calc	1

Commentary: Upper Division Core

Category Name: Upper Division Core Course Rule: Must complete the following course:

Criterion: C- Number of Credits 3

#### Course Listing

PHSX 301	Intro Theoretical Physics	3
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Commentary: Other Courses

Category Name: Elective Courses

Rule: Must complete 11 credits from the following courses

Criterion: C- Number of Credits 11

#### Course Listing

PHSX 141N	Einstein's Relativity	3
PHSX 291	Special Topics 1 To 9	
PHSX 311	Oscillations and Waves	2
PHSX 320	Classical Mechanics	3
PHSX 323	Intermediate Physics Lab	3
PHSX 327	Optics	3
PHSX 330	Communicating Physics	3
PHSX 343	Modern Physics	3
PHSX 423	Electricity & Magnetism I	3
PHSX 444	Advanced Physics Lab 3	
PHSX 446	Thermodyn & Stat Mech	3
PHSX 461	Quantum Mechanics I	3
PHSX 462	Quantum Mechanics II	3

Commentary: Eight of the eleven required credits must be upper division courses.

Degree Commentary: Mathematics prerequisites for the physics minor are M 171, 172, 273, and 311

### **College Humanities & Sciences Catalog Year: 2015-2016**

Degree Type: Minor Level: Minor Subject: **Astronomy (Minor)**

Total Credits: 25 Cumulative GPA Required: 2.0

Lower Division Core

Category Name: Lower Division Physics Courses

Rule: Must complete all of the courses in one of the two options:

Criterion: Number of Credits 10

#### Course Listing

Commentary: The Physics with Calculus series (PHSX 215N - 218N) is strongly recommended.

Subcategory Name: College Physics

Rule: May complete all of the following courses:

PHSX 205N	College Physics I	4
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PHSX 206N College Physics I Laboratory 1

PHSX 207N College Physics II 4

PHSX 208N College Physics II Laboratory 1

Subcategory Name: Physics with Calculus

Rule: May complete all of the following courses:

Criterion: C- Number of Credits 10

Course Listing

PHSX 215N Fund of Physics w/Calc I 4

PHSX 216N Physics Laboratory I w/Calc 1

PHSX 217N Fund of Physics w/Calc II 4

PHSX 218N Physics Laboratory II w/Calc 1

Commentary: Lower Division Core

Category Name: Lower Division Astronomy Courses Rule: Complete the following subcategories of courses

Criterion: Number of Credits 6-7

Course Listing Commentary:

Subcategory Name: Core Course

Rule: Complete all of the following courses

Criterion: C- Number of Credits 3

Course Listing

ASTR 131N Elementary Astronomy I 3

Subcategory Name: Core Elective

Rule: Choose 1 of the following courses

Criterion: C- Number of Credits 3-4

Course Listing

ASTR 132N Elementary Astronomy II 3

ASTR 142N The Evolving Universe 4

Major Electives

Category Name: Electives

Rule: Must complete 3 of the following courses

Criterion: C- Number of Credits 9

Course Listing

ASTR 351 Planetary Science 3

ASTR 353 Galactic Astrophysics 3

ASTR 362 Observational Astronomy 3

ASTR 363 Stellar Astr & Astrophys I 3

Degree Commentary: Mathematics prerequisites for the Astronomy minor are M 171, M 172, and M 273

## Department Faculty

### Professors

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- Daniel Reisenfeld, Chair, Professor of Physics & Astronomy
- Eijiro Uchimoto, Professor

- Andrew Ware, Professor

## Associate Professors

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- Nate McCrady, Associate Professor

## Assistant Professors

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- Paul Janzen, Assistant Professor
- David Macaluso, Assistant Professor

## Adjunct Faculty

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- Benjamin Grossmann, Adjunct Assistant Professor
- Brad Halfpap, Adjunct Associate Professor

## Lecturers

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- Alex Bulmahn, Lecturer
- Diane Friend, Lecturer

## Research Faculty

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- Vladimir Kovalev, Assistant Research Professor
- Phong Tran, Assistant Research Professor

## Course Descriptions

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### Astronomy

#### ASTR 131N - Planetary Astronomy

Credits: 3. Offered autumn. Prereq., high school algebra and geometry. An introduction to observational, historical, and planetary astronomy. Students will have a chance to visit UM's state-of-the-art planetarium and observe with our 0.4 meter telescope. Course Attributes: Natural Science Course

#### ASTR 132N - Stars, Galaxies, and the Universe

Credits: 3. Offered spring. Prereq., high school algebra and geometry. An introduction to stars, stellar evolution, galaxies, and cosmology. Students will have a chance to visit UM's state-of-the-art planetarium and observe with our 0.4 meter telescope. Course Attributes: Natural Science Course

#### ASTR 134N - Planetary Astronomy Lab

Credits: 1. Offered autumn. Prereq. or coreq., ASTR 131N Laboratory exercises in observational and planetary astronomy. Students will have a chance to visit UM's state-of-the-art planetarium and observe with our 0.4 meter telescope. Course Attributes: Natural Science Lab Course Natural Science Course

#### ASTR 135N - Stars, Galaxies, and the Universe Lab

Credits: 1. Offered spring. Prereq. or coreq., ASTR 132N. Laboratory exercises in observational, stellar, and galactic astronomy. Students will have a chance to visit UM's state-of-the-art planetarium and observe with our 0.4 meter telescope. Course Attributes: Natural Science Lab Course

#### ASTR 142N - The Evolving Universe

Credits: 4. Offered spring. Prereq., M 151 or equiv. Overview of recent developments in planetary system formation, stars, galaxies, and cosmology. Some astronomical observing required outside of normal class hours. Course Attributes: Natural Science Lab Course

#### ASTR 191 - Special Topics

Credits: 1 TO 6. (R-6) Offered intermittently. Experimental offerings of visiting professors, experimental offerings of new courses or one-time offerings of current topics.

#### ASTR 198 - Internship

Credits: 1 TO 6. (R-6) Offered intermittently. Prereq., consent of department. Extended classroom experience which provides practical application of classroom learning during placements off campus. Prior approval must be obtained from the faculty supervisor and the Internship Services office. A maximum of 6 credits of Internship (198, 298, 398, 498) may count toward graduation. Course Attributes: Internship graduation limit 6

#### ASTR 292 - Independent Study

Credits: 1 TO 6. Course material appropriate to the needs and objectives of the individual student.

#### ASTR 351 - Planetary Science

Credits: 3. Offered autumn even-numbered years. Prereq., PHSX 215N-216N or 205N-206N and M 162 or 171. Same as GEO 317. Physical and geological characteristics of planets, satellites, asteroids, comets, and meteoroids, with an emphasis on comparative planetology.

#### ASTR 353 - Galactic Astrophysics

Credits: 3. Offered spring odd-numbered years. Prereq., ASTR 132N, PHSX 217N-218N, M 273. The nature of the Milky Way galaxy and other galaxies, galactic evolution, the large scale structure of the universe, active galaxies and quasars, and cosmology, including the early universe.

#### ASTR 362 - Observational Astronomy

Credits: 3. Offered autumn even-numbered years. Prereq., ASTR 132N or 142N, PHXS 217N-218N. Laboratory study of the probabilistic behavior of light, data acquisition with telescopes, digital imaging and spectroscopy. Emphasis on fundamental statistical tools, scientific computer programming, and written and oral presentation of scientific results.

#### ASTR 363 - Stellar Astr & Astrophys I

Credits: 3. Offered autumn odd-numbered years. Prereq., ASTR 132N, M 273, and PHSX 217N-218N; PHSX 343 recommended. Detailed application of physical laws to determine the nature of the stars; analysis of stellar spectra and atmospheres; solar astrophysics; structure of stars and their evolution.

#### ASTR 365 - Stellar Ast & Astrophys II

Credits: 3. Offered spring even-numbered years. Prereq., ASTR 363. Continuation of ASTR 363.

#### ASTR 391 - Special Topics

Credits: 1 TO 9. (R-6) Offered intermittently. Experimental offerings of visiting professors, experimental offerings of new courses, or one-time offerings of current topics.

#### ASTR 392 - Independent Study

Credits: 1 TO 6. Course material appropriate to the needs and objectives of the individual student.

#### ASTR 398 - Internship

Credits: 1 TO 6. (R-6) Offered intermittently. Prereq., consent of department. Extended classroom experience which provides practical application of classroom learning during placements off campus. Prior approval must be obtained from the faculty supervisor and the Internship Services office. A maximum of 6 credits of Internship (198, 298, 398, 498) may count toward graduation. Course Attributes: Internships/Practicums

#### ASTR 494 - Senior Capstone Seminar

Credits: 1. Offered autumn. Prereq., junior or senior standing in physics. Each student will present a seminar on research performed prior to or during their senior year.

#### ASTR 499 - Seminar/Workshop

Credits: 1. Offered autumn. Prereq., junior or senior standing in physics. Each student will present a seminar on research performed prior to or during their senior year.

### General engineering Core

#### EGEN 101 - Intro to Eng Cal & Prob Solv

Credits: 3. Offered autumn. Prereq. or coreq., M 151 or equivalent. An introduction to engineering calculations, problem solving, and design. Students are taught to solve and present engineering problems on computers using

spreadsheet and graphic software (AutoCAD). In addition, there will be discussions on engineering failures and engineering ethics.

## Physics

### PHSX 101 - Freshman Physics Experience

Credits: 1. Offered autumn. Prereq., freshman standing (fewer than 30-credits towards degree) or consent of instructor. This course is intended for all incoming students either majoring in physics or considering majoring in physics. This seminar course presents an overview of the undergraduate experience as a physics major. Seminars on recent developments in physics and astronomy and opportunities for undergraduate involvement in research and instruction are included.

### PHSX 141N - Einstein's Relativity

Credits: 3. Offered spring. Prereq., working knowledge of high school physics and high school calculus, or consent of instr. Modern theoretical study of space, time, the principle of relativity, and its implications. Analysis of apparent paradoxes, and applications to particle physics. Course Attributes: Natural Science Course

### PHSX 191 - Special Topics

Credits: 1 TO 6. (R-6) Offered intermittently. Experimental offerings of visiting professors, experimental offerings of new courses, or one-time offerings of current topics.

### PHSX 198 - Internship

Credits: 1 TO 9. (R-6) Offered intermittently. Prereq., consent of department. Extended classroom experience which provides practical application of classroom learning during placements off campus. Prior approval must be obtained from the faculty supervisor and the Internship Services office. A maximum of 6 credits of Internship (198, 298, 398, 498) may count toward graduation. Course Attributes: Internships/Practicums

### PHSX 205N - College Physics I

Credits: 4. Offered autumn and spring. Prereq., M 122 or 151 or equivalent, and prereq. or coreq. PHSX 206N. Mechanics, sound, and heat. For non-physical science majors. This course satisfies the lecture portion of medical school requirements in general physics. Credit not allowed for both PHSX 205N-207N and 215N-217N. Course Attributes: Natural Science Course

### PHSX 206N - College Physics I Laboratory

Credits: 1. Offered autumn and spring. Prereq. or coreq., PHSX 205N. Mechanics, sound, and heat. For non-physical science majors. This course satisfies the laboratory portion of medical school requirements in general physics. Credit not allowed for both PHSX 206N-208N and 216N-218N. Course Attributes: Natural Science Lab Course

### PHSX 207N - College Physics II

Credits: 4. Offered autumn and spring. Prereq. PHSX 205N and prereq. or coreq., PHSX 208N. Electricity, magnetism, light, and modern physics. For non-physical science majors. This course satisfies the lecture portion of medical school requirements in general physics. Credit not allowed for both PHSX 205N-207N and 215N-217N. Course Attributes: Natural Science Course

### PHSX 208N - College Physics II Laboratory

Credits: 1. Offered autumn and spring. Prereq., PHSX 206N, prereq. or coreq., PHSX 207N. Electricity, magnetism, light and modern physics. For non-physical science majors. This course satisfies the laboratory portion of medical school requirements in general physics. Credit not allowed for both PHSX 206N-208N and 216N-218N. Course Attributes: Natural Science Lab Course

### PHSX 215N - Fund of Physics w/Calc I

Credits: 4. Offered autumn. Prereq. or coreq., PHSX 216N and M 171 or equiv. This course satisfies the lecture portion of medical and technical school requirements in general physics. Mechanics, fluids, waves and sound. Credit not allowed for both PHSX 215N-216N-217N-218N and 205N-206N-207N-208N. Course Attributes: Natural Science Course

### PHSX 216N - Physics Laboratory I w/Calc

Credits: 1. Offered autumn. Coreq., PHSX 215N. This course satisfies the laboratory portion of medical and technical school requirements in general physics. Mechanics, fluids, waves, and sound. Credit not allowed for both

PHSX 215N-216N-217N-218N and 205N-206N-207N-208N. Course Attributes: Natural Science Lab Course Natural Science Course

PHSX 217N - Fund of Physics w/Calc II

Credits: 4. Offered spring. Prereq., PHSX 215N, and prereq. or coreq. PHSX 218, and prereq. or coreq., M 172 or equivalent. This course satisfies the lecture portion of medical and technical school requirements in general physics. Heat, electricity, magnetism, and light. Credit not allowed for both PHSX 215N-216N-217N-218N and 205N-206N-207N-208N. Course Attributes: Natural Science Course

PHSX 218N - Physics Laboratory II w/Calc

Credits: 1. Offered spring. Prereq., PHSX 215N, coreq., PHSX 217N. This course satisfies the laboratory portion of medical and technical school requirements in general physics. Heat, electricity, magnetism, and light. Credit not allowed for both PHSX 215N-216N-217N-218N and 205N-206N-207N-208N. Course Attributes: Natural Science Lab Course

PHSX 225N - Gen Science: Phys & Chem Sci

Credits: 5. Offered autumn. Prereq., M 095 or equiv. Integrated lectures, discussions, laboratory exercises, and demonstrations on topics in chemical and physical science for prospective elementary school teachers and the non-scientist. A two-hour laboratory session is required each week. Course Attributes: Natural Science Lab Course

PHSX 291 - Special Topics

Credits: 1 TO 9. (R-6) Offered intermittently. Experimental offerings of visiting professors, experimental offerings of new courses, or one-time offerings of current topics.

PHSX 292 - Independent Study

Credits: 1 TO 9. (R-9) Course material appropriate to the needs and objectives of the individual student. Course Attributes: Omnibus Course

PHSX 301 - Intro Theoretical Physics

Credits: 3. Offered spring. Prereq., M 273; coreq., PHSX 217N-218N. Selected topics from applied linear algebra, ordinary and partial differential equations, vector analysis, complex variables, and Fourier series. Applications to classical mechanics, electromagnetism, and quantum mechanics.

PHSX 311 - Oscillations and Waves

Credits: 2. Offered autumn. Prereq., PHSX 217N-218N or 207N-208N; Prereq. or coreq. M 273. Detailed study of oscillations and waves at the intermediate level, to develop physical intuition and mathematical skills needed for analyzing a wide range of periodic phenomena encountered in physics.

PHSX 320 - Classical Mechanics

Credits: 3. Offered autumn. Prereq., PHSX 301, M 311. Topics in classical mechanics at the intermediate level, emphasizing Lagrangian and Hamiltonian dynamics.

PHSX 323 - Intermediate Physics Lab

Credits: 3. Offered spring. Prereq., PHSX 217N-218N or PHSX 207N-208N and PHSX 311. Laboratory course in the application of analog and digital electronics to experimental physics, with additional emphasis on data analysis techniques.

PHSX 327 - Optics

Credits: 3. Offered spring. Prereq., PHSX 311. Intermediate level study of light and optics, including geometrical optics, wave optics, optical instruments, coherence, polarization, and special topics.

PHSX 330 - Communicating Physics

Credits: 3. Offered spring even-numbered years. Prereq., PHSX 217N-218N or PHSX 207N-208N. Oral and written communication skills in physics, to include teaching high school and college physics, presenting seminars, and writing technical and non-technical physics articles. Course Attributes: Writing Course-Advanced

PHSX 333 - Computational Physics

Credits: 3. Offered spring odd-numbered years. Prereq., PHSX 217N-218N; coreq., any upper-division PHXS course. Solution of advanced problems in physics using computational methods. Students will learn a variety of numerical methods, including FORTRAN programming techniques.

PHSX 343 - Modern Physics

Credits: 3. Offered autumn. Prereq., one year of college physics; coreq., M 273. Includes historical background for development of modern physics and an introduction to quantum mechanics, atomic and nuclear physics. Credit not allowed for graduate degree in physics.

#### PHSX 391 - Special Topics

Credits: 1 TO 12. (R-9) Offered intermittently. Experimental offerings of visiting professors, experimental offerings of new courses, or one-time offerings of current topics.

#### PHSX 392 - Honors Physics

Credits: 1 TO 6. (R-6) Offered intermittently. Prereq., consent of instr. Independent research in topics of current interest in physics.

#### PHSX 423 - Electricity & Magnetism I

Credits: 3. Offered autumn. Prereq, PHSx 301. Electricity and magnetism at the intermediate level.

#### PHSX 425 - Electricity & Magnetism II

Credits: 3. Offered spring. Prereq., PHSX 423. Continuation of PHSX 423. Electricity and magnetism at the intermediate level.

#### PHSX 444 - Advanced Physics Lab

Credits: 3. Offered autumn. Prereq., PHSX 343 or equiv., PHSX 327 or equiv.; PHSX 322 suggested but not required. Advanced experiments in classical and modern physics, including optics, spectroscopy, laser science, atomic, nuclear, and particle physics, Data analysis techniques for experimental scientists. Recommended for students entering graduate school in any experimental science.

#### PHSX 446 - Thermodyn & Stat Mech

Credits: 3. Offered spring even-numbered years. Prereq., PHSX 343; coreq., M 311. Topics in thermodynamics and statistical mechanics.

#### PHSX 461 - Quantum Mechanics I

Credits: 3. Offered autumn. Prereq., PHSX 311, PHSX 343; prereq. or coreq., M 311. Introduction to quantum mechanics. Topics include Schrodinger equation, piecewise constant potential, harmonic oscillator, hydrogen atom, angular momentum theory, electron spin.

#### PHSX 462 - Quantum Mechanics II

Credits: 3. Offered spring. Prereq., PHSX 461 or consent of instr. Advanced topics in quantum mechanics including linear vector spaces and Dirac notation, quantum dynamics, time-dependent perturbation theory, and scattering theory.

#### PHSX 491 - Special Topics

Credits: 3. (R-6) Offered intermittently. Prereq., PHSX 461 or consent of instr. Studies of a topic in advanced modern physics including nuclear physics, solid state physics, and quantum optics. The topic chosen will vary according to instructor.

#### PHSX 492 - Independent Study

Credits: 1 TO 9. (R-9) Offered intermittently. University omnibus option for independent work. Course Attributes: Omnibus Course

#### PHSX 499 - Senior Capstone Seminar

Credits: 1. Offered autumn. Prereq., junior or senior standing in physics. Each student will present a seminar on research performed prior to or during their senior year.

#### PHSX 595 - Special Topics

Credits: 1 TO 9. (R-9) Offered intermittently. Experimental offerings of visiting professors, experimental offerings of new courses, or one-time offerings of current topics. Level: Graduate Course Attributes: Internships/Practicums

#### PHSX 597 - Research

Credits: 1 TO 6. (R-9) Offered intermittently. Prereq., consent of instr. Research in selected physics topics. Level: Graduate

#### PHSX 598 - Internship

Credits: 1 TO 9. (R-9) Offered intermittently. Prereq., consent of department. Extended classroom experience which provides practical application of classroom learning during placements off campus. Prior approval must be obtained from the faculty supervisor and the Internship Services office. Level: Graduate Course Attributes:

Internships/Practicums

# Political Science Department

**Ramona Grey, Chair**

Political Science is the systematic study of politics. Politics influence how people and institutions exercise and resist power. Political Science, therefore, is concerned with how nations and communities are governed and who governs them. The departmental faculty members have as their mission the engagement and enlightenment of their students, professional colleagues, and fellow citizens about the nature of politics.

The department offers a varied undergraduate curriculum covering domestic, foreign, and international politics. By meeting the requirements outlined below, a student may earn a bachelor's degree in political science or in political science-history; a minor in political science or global public health; or a bachelor's degree in political science with an option in one of the following: American politics, international relations and comparative politics, public administration, non-profit administration, international development studies, or public law. A Master of Arts degree in political science and a Master of Public Administration degree are also offered.

The scope of the faculty's interest and research is wide. They bring special insights gained through study and residence in Europe, Russia, Africa, Central Asia, India, the Far East and Latin America, as well as in Montana and Washington, D.C.

Courses offered in the department are designed to: (1) assist students to secure a broad liberal education and to equip them with the foundations for American citizenship; (2) provide undergraduate preparation for those students who propose to continue study at the graduate level with the ultimate goal of college teaching and research; (3) offer a broad program of training for those students who plan careers in government or politics; (4) assist in preparing students for careers in teaching at both the elementary and secondary levels; (5) provide a sound background for those students who intend to enroll in law and other professional schools.

The major fields of political science are (1) American government and politics with national, state and local government, and public law as sub-fields; (2) public administration; (3) political theory; (4) comparative government; (5) international relations, organization and law. Majors are eligible for membership in Pi Sigma Alpha, the national political science honorary and are active in student political activities. The Department of Political Science secures a number of legislative and administrative internships in state and local government each year. Internships and other learning opportunities in Washington, D.C., are also available.

## **College Humanities & Sciences Catalog Year: 2015-2016**

Degree Type: Bachelor of Arts      Level: Major      Subject: **Political Science**

Option: American Politics

Total Credits: 40      Cumulative GPA Required: 2.0

Lower Division Core

Category Name: Required Lower Division Courses Rule: Must complete all of the following courses:

Criterion: C-      Number of Credits 12

Course Listing

PSCI 230X      Intro to International Rel      3

PSCI 250E      Intro to Political Theory3



Commentary: Upper Division Core

Category Name: Required Upper Division Courses Rule: Must complete the following course:

Criterion: C- Number of Credits 1

Course Listing

PSCI 400 Adv Writing in Pol Science 1

Commentary: Major Electives

Category Name: Degree Electives

Rule: Must complete 5 of the following courses

Criterion: C- Number of Credits 15

Course Listing

PSCI 340 Exp Offering: American Govt 1 To 6

PSCI 341 Political Parties and Election 3

PSCI 342 Media, Public Opinion, Polling 3

PSCI 344 State and Local Government 3

PSCI 346 American Presidency 3

PSCI 347 U.S. Congress 3

PSCI 348 US Multicultural Politics 3

PSCI 352 American Political Thought 3

PSCI 365 Pub Policy Issues and Analysis 3

PSCI 370 Courts and Judicial Politics 3

PSCI 440 Exp Offering: American Govt 1 To 9

PSCI 443 Politics of Social Movements 3

PSCI 444 Am Political Participation 3

PSCI 445 Political Psychology 3

PSCI 468 Public Policy Cycle 3

Other Courses

Category Name: Required Upper Division Field Courses

Rule: Must complete 1 upper division course in 4 of the 5 fields:

Criterion: C- Number of Credits 12

Course Listing

Commentary: Any field course can also be counted toward a Political science option. Student must take an additional four courses from the following options.

Subcategory Name: Public Administration Rule: May select one of the following courses:

Criterion: C- Number of Credits 0-3

Course Listing

PSCI 344 State and Local Government 3

PSCI 360 Exp Offering: Public Admin 1 To 6

PSCI 361 Public Administration 3

PSCI 365 Pub Policy Issues and Analysis 3

PSCI 391 Special Topics 1 To 9

PSCI 448 Health Care Policy 3

PSCI 449 Environmental Health Policy 3

PSCI 461 Administrative Law 3