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PHYSICS PROGRAM

Physics is the study of nature at its most fundamental. Its scope covers everything from the tiniest particles of matter – such as atoms, electrons, and quarks -- to the structure of the entire universe, encompassing innumerable galaxies and stars.

Physicists seek to understand complex phenomena in terms of simple, unifying principles. Their queries have ranged from the seemingly innocuous, like "What causes an object to fall?", to the more elemental, like "What is the true nature of light?". Such questions led to the discovery of the gravitational force, which governs the motion of planets and stars, as well as to the biggest breakthrough of the twentieth century – quantum mechanics – which governs the very small. Answers to physicists' questions have revolutionized society, not only altering our basic understanding of the universe, but also profoundly affecting our day-to-day lives, laying the foundation for numerous technological innovations such as the laser, computer, and cellular phone. And Physics continues to evolve and excite us, with unanswered questions from a multitude of active and emerging fields of research, such as Quantum Computation, Superconductivity, Chaos, Biophysics, and String Theory, to name a few.

The physics program at UC Merced provides a strong foundation in the fundamentals of theoretical and applied physics, while also emphasizing the increasingly interdisciplinary role played by physicists in the scientific and technological community. This is reflected in the "core plus emphasis track" model of the major. The core is a rigorous grounding in fundamental physical principles, including electricity and magnetism, quantum and classical mechanics, and thermodynamics. The emphasis tracks consist of flexible specialization options which students design with the assistance of their faculty advisor. Possible emphases include Atomic, Molecular , and Optical (AMO) Physics; Mathematical Physics; Biophysics; Earth and Environmental Physics; Materials Physics; and Engineering Physics.

Physics students develop excellent quantitative and analytical skills, enabling them to approach new and complex problems that arise in any field. These fundamental skills are essential preparation for a wide range of careers in such fields as aerospace, biotechnology, computers, engineering, medicine, education, law, finance, business, and consulting.

Students majoring in physics must meet the Math/Science general education requirement with the following courses.

Math/Science Preparatory Curricula (10 units):

MATH 21: Calculus of a Single Variable I* (4)
MATH 32: Probability and Statistics (4)
PHYS 8: Introductory Physics I* (4)
CHEM 2: General Chemistry (4)
CSE 20: Introduction to Computing I (2)

*ICP: Integrated Calculus and Physics (8 units) may be taken in place of MATH 21 and PHYS 8.

In **addition** to adhering to the UC Merced and School of Natural Science requirements, the requirements that must be met to receive the B.S. in physics at UC Merced are (57-60 units):

Required additional lower-division Math/Science courses (20 units):

MATH 22: Calculus of a Single Variable II (4)
MATH 23: Vector Calculus (4)
MATH 24: Introduction to Linear Algebra and Differential Equations (4)
PHYS 9: Introductory Physics II (4)
PHYS 10: Introductory Physics III (4)

Required upper-division core physics courses (24 units):

PHYS 105: Analytic Mechanics Core (4)
PHYS 110: Electrodynamics Core (4)
PHYS 112: Statistical Mechanics Core (4)
PHYS 137: Quantum Mechanics Core (4)
PHYS 160: Modern Physics Lab (4)
PHYS 122: Waves Minicourse (2)
One additional minicourse of student's choice (2)

Additional Required Courses (13-16 units):

One breadth science or engineering elective (i.e. not physics or math) (3-4)
Two physics electives (Appropriate nonphysics courses may be substituted as part of an emphasis track) (6-8)
PHYS 195: Undergraduate Research -- Senior Thesis (Research from other programs may be substituted as appropriate) (at least 4 units)

Minicourses

The minicourses are half-semester courses designed to round out a student's core training in physics. Possible minicourses are: Electromagnetic Radiation (Phys 111), Waves (Phys 122), Special Relativity (Phys 126), and Rotational Mechanics (Phys 124). Students are required to take two minicourses, one of which must be the Waves minicourse. For students planning to attend graduate school in physics, all four minicourses are recommended.

Senior Research

All students are required to complete a senior thesis (PHYS 195) consisting of independent research performed under the tutelage of a faculty advisor. Typically, this research is the culmination of a student's emphasis track (see below.) The thesis advisor may be a faculty member in either physics or another discipline, allowing for the possibility of cross-disciplinary research projects.

Emphasis Tracks

Students are encouraged to choose their electives to form an emphasis track in an area of physics or interdisciplinary study. Some examples of tracks are Atomic, Molecular , and Optical (AMO) Physics; Mathematical Physics; Biophysics; Earth and Environmental Physics; Materials Physics; or Engineering Physics. Students have considerable flexibility in proposing and designing their own emphasis tracks, with the assistance of their faculty advisor. A track must consist of at least 12 units. Typically, the track includes the two upper division physics electives and culminates with the student's senior thesis (PHYS 195). Other upper division courses may be substituted for the two physics electives if they are deemed appropriate to the track. All track programs must be approved by the student's faculty advisor. A student may also choose, in consultation with the faculty advisor, not to participate in the track program at all, although the senior thesis and physics electives are still degree requirements.

Examples of Emphasis Tracks

Atomic/Molecular/Optical (AMO) Physics

PHYS 148: Optics (4)
PHYS 144: Modern Atomic and Molecular Physics (4)
PHYS 195: Undergraduate Research (4)

Mathematical Physics

MATH 121: Applied Math Methods I: Boundary-Value Problems and Fourier Analysis (4)
MATH 122: Applied Math Methods II: Complex Variables and Applications (4)
MATH 198: Upper Division Directed Group Study (substituted for PHYS 195) (4)

Biophysics

BIS 100: Molecular Machinery of Life (4)
BIS 104/104L: Biophysics/Biophysics Laboratory (4/1)
BIS 110: The Cell (4)
PHYS 195: Undergraduate Research (4)

Transfer students. Physics will begin accepting junior level and above transfer students beginning in Fall 2008. Transfer students who wish to major in Physics should complete four semesters of calculus, covering the topics of single variable calculus, vector calculus, differential equations and preferably linear algebra. In addition, transfer students should complete one semester of general chemistry with laboratory and three semesters of calculus-based physics with laboratory. Students should consult the Information for Prospective Students link on the School of Natural Sciences website http://naturalsciences.ucmerced.edu for more information.

SAMPLE PLAN OF STUDY FOR PHYSICS DEGREE – ATOMIC, MOLECULAR AND OPTICAL EMPHASIS

Semester 1		Semester 2	
ICP Integrated Calculus and Physics	8	PHYS 9 Introductory Physics II	4
CSE 20 Introduction to Computing I	2	MATH 22 Calculus II	4
Core 1 The World at Home	4	CHEM 2 General Chemistry	4
Freshmen Seminar	1	WRI 10 Reading and Composition	4

Semester Units	**15**	**Semester Units**	**16**

Semester 3		Semester 4	
PHYS 10 Introductory Physics III	4	PHYS 105 Analytic Mechanics	4
MATH 23 Multi-Variable Calculus	4	MATH 24 Lin. Algebra and Diff. Eq.	4
BIS 1 Contemporary Biology	4	GE Elective (Social/Cognitive Sciences)	4
GE Elective (Arts/Humanities)	4	Free Elective	4
Semester Units	**16**	**Semester Units**	**16**

Semester 5		Semester 6	
PHYS 137 Quantum Mechanics	4	PHYS 160 Modern Physics Lab	4
PHYS 110 Electrodynamics	4	PHYS 122 Waves	2
MATH 32 Probability and Statistics	4	PHYS 124 Rotational Mechanics	2
GE Elective (communications)	4	Core 100 The World at Home	4
		Free Elective	4
Semester Units	**16**	**Semester Units**	**16**

Semester 7		Semester 8	
PHYS 112 Statistical Mechanics	4	PHYS 144 Modern Atomic Physics	4
PHYS 148 Optics	4	PHYS 195 Undergraduate Research	3
PHYS 195 Undergraduate Research	3	Free Elective	4
General Education Elective	4	Free Elective	4
Semester Units	**15**	**Semester Units**	**15**

Total Program Units	**125**

The four-year plans presented in this catalog demonstrate the recommended sequencing and timing of the required and elective components within each major. In many cases, a student's academic background will require variations in the timing of the coursework listed in the plan. All students are expected to work with their academic advisor to find their best pathway through the degree requirements of their chosen program.

SAMPLE PLAN OF STUDY FOR PHYSICS DEGREE - APPLIED MATH EMPHASIS

Semester 1		Semester 2	
ICP Integrated Calculus and Physics	8	PHYS 9 Introductory Physics II	4
CSE 20 Introduction to Computing I	2	MATH 22 Calculus II	4
Core 1 The World at Home	4	CHEM 2 General Chemistry	4
Freshmen Seminar	1	WRI 10 Reading and Composition	4
Semester Units	**15**	**Semester Units**	**16**

Semester 3		Semester 4	
PHYS 10 Introductory Physics III	4	PHYS 105 Analytic Mechanics	4
MATH 23 Multi-Variable Calculus	4	MATH 24 Lin. Algebra and Diff. Eq.	4
BIS 1 Contemporary Biology	4	GE Elective (Social/Cognitive Sciences)	4
GE Elective (Arts/Humanities)	4	Free Elective	4
Semester Units	**16**	**Semester Units**	**16**

Semester 5		Semester 6	
PHYS 137 Quantum Mechanics	4	PHYS 160 Modern Physics Lab	4
PHYS 110 Electrodynamics	4	PHYS 122 Waves	2
MATH 32 Probability and Statistics	4	PHYS 111 Electromagnetic Radiation	2
GE Elective (communications)	4	Core 100 The World at Home	4
		Free Elective	4
Semester Units	**16**	**Semester Units**	**16**

Semester 7		Semester 8	
PHYS 112 Statistical Mechanics	4	MATH 122 Applied Math Methods II	4
MATH 121 Applied Math Methods I	4	MATH 198 Directed Group Study	2
MATH 198 Directed Group Study	2	Free Elective	4
General Education Elective	4	Free Elective	4
Semester Units	**14**	**Semester Units**	**14**

Total Program Units	**123**

The four-year plans presented in this catalog demonstrate the recommended sequencing and timing of the required and elective components within each major. In many cases, a student's academic background will require variations in the timing of the coursework listed in the plan. All students are expected to work with their academic advisor to find their best pathway through the degree requirements of their chosen program.

SAMPLE PLAN OF STUDY FOR PHYSICS DEGREE – BIOPHYSICS EMPHASIS

Semester 1		Semester 2	
ICP Integrated Calculus and Physics	8	PHYS 9 Introductory Physics II	4
CSE 20 Introduction to Computing I	2	MATH 22 Calculus II	4
Core 1 The World at Home	4	CHEM 2 General Chemistry	4
Freshmen Seminar	1	WRI 10 Reading and Composition	4
Semester Units	**15**	**Semester Units**	**16**

Semester 3	Semester 4

PHYS 10 Introductory Physics III	4	PHYS 105 Analytic Mechanics	4
MATH 23 Multi-Variable Calculus	4	MATH 24 Lin. Algebra and Diff. Eq.	4
BIS 1 Contemporary Biology	4	CHEM 8 Organic Chemistry	4
GE Elective (Arts/Humanities)	4	GE Elective (Social/Cognitive Sciences)	4
Semester Units	**16**	**Semester Units**	**16**

Semester 5		Semester 6	
PHYS 137 Quantum Mechanics	4	PHYS 160 Modern Physics Lab	4
PHYS 110 Electrodynamics	4	MATH 32 Probability and Statistics	4
BIS 100 Molecular Machinery of Life	4	BIS 110 The Cell	4
GE Elective (communications)	4	Core 100 The World at Home	4
Semester Units	**16**	**Semester Units**	**16**

Semester 7		Semester 8	
PHYS 112 Statistical Mechanics	4	PHYS 122 Waves	2
PHYS 195 Undergraduate Research	3	PHYS 124 Rotational Mechanics	2
BIS 104 Biophysics	4	PHYS 195 Undergraduate Research	3
BIS 104L Biophysics Lab	1	General Education Elective	4
Free Elective	4	Free Elective	4
Semester Units	**16**	**Semester Units**	**15**

Total Program Units	**126**

The four-year plans presented in this catalog demonstrate the recommended sequencing and timing of the required and elective components within each major. In many cases, a student's academic background will require variations in the timing of the coursework listed in the plan. All students are expected to work with their academic advisor to find their best pathway through the degree requirements of their chosen program.