

## DU Physics and Astronomy BS Degree Requirements (updated May 2014)

### 1. DU Common Curriculum (44 credits)

- First-Year Seminar (4 credits)
- Writing and Rhetoric (8 credits)
- Foreign Language (12 credits or demonstrated proficiency)
- Ways of Knowing (16 credits), including
  - Analytical Inquiry: Society and Culture (AI-S; 8 credits)
  - Scientific Inquiry: Society and Culture (SI-S; 8 credits)
- Advanced Seminar (4 credits)

### 2. Mathematics (20 credits)

- Calculus I, II, and III (MATH 1951, 1952, 1953; 12 credits)
- Introduction to Differential Equations (MATH 2070; 4 credits)
- Calculus of Several Variables (MATH 2080; 4 credits).

MATH 1951 fulfills the Analytical Inquiry: Natural and Physical World (AI-N) Common Curriculum requirement. Completing all these courses fulfills the requirements for a minor in mathematics for most students. Students transferring in 12 credits of AP or IB Calculus need one more math course for the minor, as DU policy requires 50% of major and minor credit hours to be taken at DU.

### 3. Basic Life Sciences (4 credits)

- General Chemistry I and lab (CHEM 1010 and 1240; 4 credits) **OR**
- Concepts: Physiological Systems and lab (BIOL 1010 and 1020; 4 credits) **OR**
- Concepts: Cellular and Molecular Biology and lab (BIOL 1011 and 1021; 4 credits)

This breadth course should be taken as early as possible, preferably in the student's first year.

### 4. Introductory Physics (17 credits)

- Physics Preparatory (PHYS 1200; 2 credits) **recommended but not required**
- University Physics I, II, III, each with lab (PHYS 1211, 1212, 1213; 15 credits)

PHYS 1200 is intended to be taken in fall of the first year. The PHYS 1211/2/3 sequence fulfills the Scientific Inquiry: Natural and Physical World (SI-N) Common Curriculum requirement.

### 5. Advanced Physics (45+ credits)

BS students must complete at least 45 quarter hours of physics coursework at 2000 level or above. This program must include the following:

- Modern Physics I and II (PHYS 2251, 2252; 4 credits each; yearly)
- Modern Lab (PHYS 2260; 1 credit; yearly)
- Uncertainty and Error Analysis (PHYS 2259; 2 credits; yearly)

*(continued)*

- Intermediate Lab I and II (PHYS 2311, 2312; 2 credits each; yearly)
- Analytical Mechanics I and II (PHYS 3510, 3520; 4 credits each; alternate years)
- Quantum Physics I and II (PHYS 3111, 3112; 4 credits each; alternate years)
- Electromagnetism I and II (PHYS 3611, 3612; 4 credits each; alternate years)
- Thermal Physics (PHYS 3841; 4 credits; alternate years)
- Senior Seminar (PHYS 3100; 2 credits; yearly)

These required courses total 45 credits, so no physics electives are required for the BS. However, we encourage students to take other physics courses as their interests and schedule permit.

Recommended electives include PHYS 2110 *Intro Computational Physics* and PHYS 3711 *Optics* are recommended. PHYS 3991 *Independent Study* and PHYS 3995 *Independent Research* count as physics electives, as do graduate-level courses in physics and biophysics (BIOP) with special permission.

## 6. Minors

BS students must complete two minors, at least one of which is in a BS degree-granting department. Completing the mathematics courses listed in requirement #2 fulfills this second condition.

## Optional concentrations

BS students have the option to pursue a concentration, which offers the opportunity to specialize in an interdisciplinary area. We offer concentrations in biological physics, computational physics, and nanophysics. Each of these requires at least 11 additional credit hours beyond the 45 listed in requirement #5, which may include some courses in other departments. Please see the separate document entitled “Concentrations in the Physics Major” for details. Only one concentration may be officially declared.

## Optional senior thesis

BS students have the option to complete a senior thesis, **due by April 1 of senior year**. This is a scientific document presenting the student’s own undergraduate research, conducted either at DU or elsewhere. A senior thesis is required for distinction in the major.

Students choosing this option must identify a DU research advisor; they will normally enroll in Independent Research (PHYS 3995) while conducting their research. If pursuing a concentration in physics, the student must write a thesis in that area (as approved by the Undergraduate Committee). If pursuing a double major, the student must write a physics-related thesis. Joint thesis projects between physics and other fields will be considered on a case-by-case basis, with the approval of the student’s physics research advisor. The senior thesis should approximate a document that could be submitted for publication to a research journal; suggested length is at least 8500 words. It may include writing completed during the Senior Seminar (PHYS 3100).

## Distinction

A graduating BS student may be awarded distinction in the major if he or she completes a senior thesis and meets other requirements regarding GPA, coursework, research, and outreach. Please see the separate document entitled “Distinction in the Physics Major” for details.

### Junior/senior timeline for students not pursuing a senior thesis

- Fall quarter of junior year: Enroll in Senior Seminar (PHYS 3100, offered each fall) if planning to study abroad in senior fall. This capstone course provides background in research methods and scientific writing.
- Fall quarter of senior year:
  - Enroll in Senior Seminar (PHYS 3100, offered each fall) if you did not take it as a junior. This capstone course provides background in research methods and scientific writing.
  - Apply for spring graduation: <http://www.du.edu/registrar/graduation/graduationapp.html>
- Winter quarter of senior year: If you have conducted research, consider registering to present a poster or talk at the undergraduate Symposium in early May (this is required for completion of a PINS award).

### Junior/senior timeline for students pursuing a senior thesis

- Fall quarter of junior year: Enroll in Senior Seminar (PHYS 3100, offered each fall) if planning to study abroad in senior fall. This capstone course provides background in research methods and scientific writing.
- Winter quarter of junior year: Begin investigating possible research advisors and topics, and consider applying for PinS funding.
- Spring quarter of junior year: Select your research advisor and discuss plans for your senior thesis with your academic advisor during advising week.
- Summer after junior year: Consider doing research in the summer (whether at DU or in an external REU program). Research done outside DU may be used as the basis for a senior thesis, but you must still identify a local research advisor.
- Fall quarter of senior year:
  - Enroll in Senior Seminar (PHYS 3100, offered each fall) if you did not take it as a junior. This capstone course provides background in research methods and scientific writing.
  - Apply for spring graduation: <http://www.du.edu/registrar/graduation/graduationapp.html> .
- Winter break of senior year: Consider using this time to complete your research project so that you can spend winter quarter finalizing your thesis document.
- Winter quarter of senior year: Submit a draft of your thesis to document to both your academic and research advisors during advising week. Consider registering to present a poster or talk at the undergraduate Symposium in early May (this is required for distinction or for completion of a PinS award).
- **By April 1 of senior year:** Finalize your thesis document and post it online (for example, on Portfolio).

## DU Physics and Astronomy BS Sample Degree Planner (updated May 2014)

	<b>Fall</b>	<b>Winter</b>	<b>Spring</b>
<b>Fr</b>	PHYS 1200 <i>Physics Prep</i> (2) MATH 1951 <i>Calculus I</i> (4) FSEM 1111 <i>First Year Seminar</i> (4) CHEM 1010 <i>Gen. Chemistry</i> (3) <sup>1</sup> CHEM 1240 <i>Gen. Chem. Lab</i> (1) <sup>1</sup> <i>Foreign Language</i> (4)  Total Credits _____	PHYS 1211 <i>Univ. Phys. I</i> (5) MATH 1952 <i>Calculus II</i> (4) WRIT 1122 <i>Acad. Writing</i> (4) <i>Foreign Language</i> (4)  Total Credits _____	PHYS 1212 <i>Univ. Phys. II</i> (5) MATH 1953 <i>Calculus III</i> (4) WRIT 1133 <i>Acad. Writing</i> (4) <i>Foreign Language</i> (4)  Total Credits _____
<b>So</b>	PHYS 1213 <i>Univ. Phys. III</i> (5) AI-S (4) <sup>2</sup> SI-S (4) <sup>2</sup> Minor Requirement/Elective (4)  Total Credits _____	PHYS 2251 <i>Mod. Phys. I</i> (4) PHYS 2259 <i>Uncertainty</i> (2) MATH 2070 <i>Diff. Eqns.</i> (4) AI-S (4) <sup>2</sup>  Total Credits _____	PHYS 2252 <i>Mod. Phys. II</i> (4) PHYS 2260 <i>Modern Lab</i> (1) MATH 2080 <i>Multivar.</i> (4) SI-S (4) <sup>2</sup> Minor Requirement/Elective (4)  Total Credits _____
<b>Ju</b>	PHYS 2311 <i>Intermed. Lab I</i> (3) ASEM <i>Advanced Seminar</i> (4) <b>This is the best quarter for                      physics majors to study abroad.</b>  Total Credits _____	PHYS 2312 <i>Intermed. Lab II</i> (3) PHYS 3510 <i>Analyt. Mech. I</i> (4) <sup>3</sup> PHYS 3611 <i>E&amp;M I</i> (4) <sup>3</sup> Minor or concentration requirements as needed  Total Credits _____	PHYS 3520 <i>Analyt. Mech. II</i> (4) <sup>3</sup> PHYS 3612 <i>E&amp;M II</i> (4) <sup>3</sup> PHYS Elective (4) <sup>4</sup> Minor or concentration requirements as needed  Total Credits _____
<b>Se</b>	PHYS 3100 <i>Senior Seminar</i> (2) PHYS 3995 <i>Indep. Research</i> <sup>5</sup> Minor or concentration requirements as needed  Total Credits _____	PHYS 3111 <i>Quantum Physics I</i> (4) <sup>3</sup> PHYS 3995 <i>Indep. Research</i> <sup>5</sup> PHYS Elective (4) <sup>4</sup> Minor or concentration requirements as needed  Total Credits _____	PHYS 3112 <i>Quantum Physics II</i> (4) <sup>3</sup> PHYS 3841 <i>Thermal Physics</i> (4) <sup>3</sup> PHYS 3995 <i>Indep. Research</i> <sup>5</sup> Minor or concentration requirements as needed  Total Credits _____

<sup>1</sup> BIOL 1010 and 1020 (normally offered in fall) or BIOL 1011 and 1021 (normally offered in winter) may be taken instead of CHEM 1010 and 1240.

<sup>2</sup> AI-S and SI-S courses may be taken in any order.

<sup>3</sup> PHYS 3510/3520 *Analytical Mechanics I,II* and PHYS 3611/3612 *Electromagnetism I/II* are offered every other year. PHYS 3111/3112 *Quantum Physics I/II* and PHYS 3841 *Thermal Physics* are offered in the alternating years. Either set of courses may be taken first.

<sup>4</sup> Physics electives are not required, but PHYS 2110 *Intro Computational Physics* and PHYS 3711 *Optics* are strongly recommended. Undergraduates may also enroll in graduate-level courses in physics and biophysics (BIOP) with special permission.

<sup>5</sup> BS students will normally enroll in PHYS 3991 *Independent Study* or PHYS 3995 *Independent Research* as part of their work toward the senior thesis. Credits for these courses are variable.