

Astronomy – Chemistry Double Major/Degree Sample Curricula

The following documents are intended to offer guidance to undergraduates wishing to obtain formal training in both astronomy and chemistry.

Students can obtain a “double major” by following the LAS Chemistry and Astronomy curricula, or a “double degree” by following the Specialized Chemistry curriculum and the Astronomy curriculum. Each of these paths is described in the following documents, for students who have entered before Fall 2009, and for those entering in Fall 2009 and later semesters. [These are separated due to a change in the astronomy curriculum.]

For further guidance, please consult your undergraduate faculty advisor, and/or Debe Williams in the School of Chemical Sciences, and/or Bryan Dunne in the Astronomy department.

SCS Academic Advising Office

168 Noyes

244-8531

Science and Letters Double Major in Chemistry and Astronomy
Catalog Year pre-200908

Below is a sample semester by semester program for a Science and Letters double major in Chemistry and Astronomy for students admitted to the University before Fall 2009. These are the recommended sequences for Chemistry. Individual programs depend upon preparation and goals but students must complete all of the requirements including LAS General Education requirements. Pick up a form from 270 Lincoln Hall to declare a double major.

Fall 1

Math 220 or 221 5 or 4 hrs
Chem 102/103^a 4 hrs

Spring 2

Math 231 3 hrs
Chem 104/105^a 4 hrs
Phys 211 4 hrs

Fall 3

Chem 222/223^a 3 hrs
Math 241 4 hrs
Phys 212 4 hrs
Astr 210 3 hrs

Spring 4

Chem 232/233 5 hrs
Phys 214 & 213 4 hrs
Math 285 or 286 3-4 hrs
Math 225 or 415 2-3 hrs

Fall 5

Chem 442^b 4 hrs
Astr Adv. Hrs^c 3-6 hrs

Spring 6

Chem 444^b 4 hrs
Astr Adv. Hrs^c 3-6 hrs

Fall 7

Chem/Astr 450^{b,d} 4 hrs
Astr 401^e 1 hr
Astr 4--^{c,e} 3 hrs

Spring 8

Chem/Astr 451^{b,d} 4 hrs
Astr Adv. Hrs^c 3-6 hrs

a. Chem 202/203 and 204/205 may be substituted for Chem 102/103, 104/105, and 222/223. Chem 222/223 is a fall only course.

b. A total of 30 hours of Chemistry must be completed with 12 hours in advanced Chemistry (300 level or above).

c. Minimum of 18 hours of 300- and 400-level astronomy and physics courses (excluding PHYS 419), of which at least 10 hours must be astronomy courses (excluding ASTR 401) are required. A minimum of 12 advanced hours not counted towards the Chemistry major must be completed. See an Astronomy advisor for more details.

d. Chem/Astr 450 is planned to be offered fall only in even numbered years starting in 2008 and Chem/Astr 451 is planned to be offered spring only in odd numbered years starting in 2009. If these courses are not offered during your senior year, 4 hours of advanced chemistry outside of physical chemistry and more than 2 hours of other chemistry should be substituted to fulfill degree requirements.

e. Astr 401 must be taken concurrently with one of: Astr 404, 405, 406, 414.

**Semester by Semester Specialized Chemistry-Astronomy Major
Catalog Year Pre-200908**

FIRST YEAR

Hours	FIRST SEMESTER	Hours	SECOND SEMESTER
3	CHEM 202 ¹ Accel. Chemistry I	3	CHEM 204 Accelerate. Chemistry II
2	CHEM 203 Accel. Chem. Lab 1	2	CHEM 205 Accelerate Chem. Lab II
4	MATH 220 or 221 Calculus 1 ²	3	MATH 231 Calculus II
4	RHET 105 Composition	3	CS 101 Intro to Computing for Engineering & Science
5	Elective ^{3, 4, 5}	4	PHYS 211 Univ Phys, Elec & Mag
18	Total	3	Electives^{3, 4, 5}
		18	Total

SECOND YEAR

Hours	FIRST SEMESTER	Hours	SECOND SEMESTER
4	CHEM 236 Fundamental Organic Chemistry I	3	CHEM 436 Fundamental Organic Chemistry II
2	CHEM 237 Struc. and Synthesis	4	PHYS 214/213 Univ Physics, Quantum Physics
4	MATH 241 Calculus of Several Variables	3	MATH 285 ⁵
4	PHYS 212 General Physics (Electricity and Magnetism)	2	MATH 225
3	ASTR 210	3	CHEM 312 Inorganic Chemistry
1	ASTR 199RI	1	CHEM 494 Lab Safety
		2	Electives ^{3, 4, 5}
18	Total	18	Total

THIRD YEAR

Hours	FIRST SEMESTER	Hours	SECOND SEMESTER
4	CHEM 442 Physical Chemistry I	4	CHEM 444 Physical Chemistry II
2	CHEM 315 Instrumental Characterization of Chem. Sys. Lab.	2	CHEM 445 Physical Principles Lab I
2	CHEM 420 Instrumental Characterization of Chem. Sys.	2	CHEM 499
6	Electives ^{3, 4, 5}	3	Electives ^{3, 4, 5}
4	Advanced Hours - ASTR ⁶	6	Advanced Hours - ASTR ⁶
		1	ASTR 496S ⁶
18	Total	18	Total

FOURTH YEAR

Hours	FIRST SEMESTER	Hours	SECOND SEMESTER
4	CHEM/ASTR 450	4	CHEM/ASTR 451
2	CHEM 447 Phys. Principles Lab II	2	CHEM 499 ⁵
2	CHEM 499 ⁵	8	Electives ^{3, 4, 5}
6	Electives ^{3, 4, 5}	4	Advanced Hours - ASTR ⁶
4	ASTR 401/4-- ^{6, 7}		
18	Total	18	Total

This double degree will require a total of 150 semester hours. The above sample semester by semester layout includes 144 hours, the remaining 6 hours can be acquired through AP credit, summer school, additional semesters, or credit hour override.

NOTES:

1. Students may substitute the sequence Chem 102, 103, 104, 105, 222 and 223 for Chem 202, 203, 204, and 205. Chem 222/223 is a fall only course.
2. Math 220 is appropriate for students with little or no background in calculus.
3. General Education Requirements for the Science and Letters Curriculum in the College of Liberal Arts and Sciences must be fulfilled.
4. Four semesters of college credit in one foreign language is required. Four years of high school credit or equivalent in one foreign language are equivalent to four semesters of college credit.
5. Students must complete 14 hours of required technical electives.
 - Required Mathematics- 498, or 225 and 285 or 415 and 285 or 415 and 380 or 225 and 380.
 - Chemistry 499 is strongly recommended (Maximum of 10 semester hours)
 - Computer Science 101 and 110 are strongly recommended
 - Other courses to choose from include: Chemistry (300 or higher), Biochemistry, Chemical Engineering (200 or higher), Life Sciences courses (200 or higher), Mathematics or Computer Science courses above the basic level, Chemistry 199 (3 hours max.) and other courses in physical and biological sciences and engineering.
 - Additional courses can be taken upon the approval of the Chair of the Chemistry Department Advising Committee.
6. Advanced Hours
Chemistry Advanced Hours (at least 11 semester hours)
 - This must include a Biochemistry course for ACS Certification
 - One of the following must be taken: Chemistry 317, 437, or 447
 - Students who will present **less than** 6 semester hours in Chemistry 499 must complete *two* additional courses while those with **at least** 6 semester hours must complete only *one* course chosen from the following list: Chemistry 317, 421, 423, 437, 447, 483; Biochemistry 455.
 - Additional Chemistry/Biochemistry to complete the 11 semester hour requirement include MCB 354 or MCB 450.Astronomy Advanced Hours (at least 18 semester hours)
 - At least 10 hours must be Astronomy courses, the remaining 8 hours can include advanced physics hours (300- level and above)
7. ASTR 401 must be taken concurrently with one of: Astr 404, 405, 406, 414.

The form to declare a double major must be picked up from 270 Lincoln Hall. The double degree requires a total of 150 credit hours. For Departmental Honors in Chemistry you must have at least 6 hours of CHEM 499 and a 3.0 GPA.

SCS Academic Advising Office

168 Noyes

244-8531

Science and Letters Double Major in Chemistry and Astronomy
Catalog Year post-200908

Below is a sample semester by semester program for a Science and Letters double major in Chemistry and Astronomy for students admitted to the University after Fall 2009. These are the recommended sequences for Chemistry. Individual programs depend upon preparation and goals but students must complete all of the requirements including LAS General Education requirements. Pick up a form from 270 Lincoln Hall to declare a double major.

Fall 1

Math 220 or 221 5 or 4 hrs
Chem 102/103^a 4 hrs

Spring 2

Math 231 3 hrs
Chem 104/105^a 4 hrs
Phys 211 4 hrs

Fall 3

Chem 222/223^a 3 hrs
Math 241 4 hrs
Phys 212 4 hrs
Astr 210 3 hrs

Spring 4

Chem 232/233 5 hrs
Phys 214 & 213 4 hrs
Math 285 or 286 3-4 hrs
Math 225 or 415 2-3 hrs

Fall 5

Chem 442^b 4 hrs
Astr 404^{c,e} 3 hrs

Spring 6

Chem 444^b 4 hrs
Astr 405^{c,e} 3 hrs
Astr 401^d 1 hr

Fall 7

Chem/Astr 450^{b,f} 4 hrs
Astr 406^{c,e} 3 hr

Spring 8

Chem/Astr 451^{b,f} 4 hrs
Astr Adv. Hrs^e 4 hrs

- a. Chem 202/203 and 204/205 may be substituted for Chem 102/103, 104/105, and 222/223. Chem 222/223 is a fall only course.
- b. A total of 30 hours of Chemistry must be completed with 12 hours in advanced Chemistry (300 level or above).
- c. Astronomy majors are required to complete 3 of the following 4 courses: Astr 404, 405, 406, 414.
- d. Astr 401 must be taken concurrently with one of: Astr 404, 405, 406, 414.
- e. A minimum of 12 advanced hours of Astronomy courses not counted towards the Chemistry major must be completed. See an Astronomy advisor for more details.
- f. Chem/Astr 450 is planned to be offered fall only in even numbered years starting in 2008 and Chem/Astr 451 is planned to be offered spring only in odd numbered years starting in 2009. If these courses are not offered during your senior year, 4 hours of advanced chemistry outside of physical chemistry and more than 2 hours of other chemistry should be substituted to fulfill degree requirements. In addition, you will need to speak to an astronomy adviser fulfilling Astronomy major requirements.

**Semester by Semester Specialized Chemistry-Astronomy Major
Catalog Year Pre-200908**

FIRST YEAR

Hours	FIRST SEMESTER	Hours	SECOND SEMESTER
3	CHEM 202 ¹ Accel. Chemistry I	3	CHEM 204 Accelerate. Chemistry II
2	CHEM 203 Accel. Chem. Lab 1	2	CHEM 205 Accelerate Chem. Lab II
4	MATH 220 or 221 Calculus 1 ²	3	MATH 231 Calculus II
4	RHET 105 Composition	3	CS 101 Intro to Computing for Engineering & Science
5	Elective ^{3, 4, 5}	4	PHYS 211 Univ Phys, Elec & Mag
18	Total	3	Electives^{3, 4, 5}
		18	Total

SECOND YEAR

Hours	FIRST SEMESTER	Hours	SECOND SEMESTER
4	CHEM 236 Fundamental Organic Chemistry I	3	CHEM 436 Fundamental Organic Chemistry II
2	CHEM 237 Struc. and Synthesis	4	PHYS 214/213 Univ Physics, Quantum Physics
4	MATH 241 Calculus of Several Variables	3	MATH 285 ⁵
4	PHYS 212 General Physics (Electricity and Magnetism)	2	MATH 225
3	ASTR 210	3	CHEM 312 Inorganic Chemistry
1	ASTR 199RI	1	CHEM 494 Lab Safety
		2	Electives ^{3, 4, 5}
18	Total	18	Total

THIRD YEAR

Hours	FIRST SEMESTER	Hours	SECOND SEMESTER
4	CHEM 442 Physical Chemistry I	4	CHEM 444 Physical Chemistry II
2	CHEM 315 Instrumental Characterization of Chem. Sys. Lab.	2	CHEM 445 Physical Principles Lab I
2	CHEM 420 Instrumental Characterization of Chem. Sys.	2	CHEM 499
7	Electives ^{3, 4, 5}	6	Electives ^{3, 4, 5}
3	ASTR 404 ⁶	3	ASTR 405 ⁶
			ASTR 401 ⁶
18	Total	18	Total

FOURTH YEAR

Hours	FIRST SEMESTER	Hours	SECOND SEMESTER
4	CHEM/ASTR 450	4	CHEM/ASTR 451
2	CHEM 447 Phys. Principles Lab II	2	CHEM 499 ⁵
2	CHEM 499 ⁵	8-9	Electives ^{3, 4, 5}
7	Electives ^{3, 4, 5}	3-4	Advanced Hours - ASTR ⁶
3	ASTR 406 ⁶		
18	Total	18	Total

This double degree will require a total of 150 semester hours. The above sample semester by semester layout includes 144 hours, the remaining 6 hours can be acquired through AP credit, summer school, additional semesters, or credit hour override.

NOTES:

1. Students may substitute the sequence Chem 102, 103, 104, 105, 222 and 223 for Chem 202, 203, 204, and 205. Chem 222/223 is a fall only course.
 2. Math 220 is appropriate for students with little or no background in calculus.
 3. General Education Requirements for the Science and Letters Curriculum in the College of Liberal Arts and Sciences must be fulfilled.
 4. Four semesters of college credit in one foreign language is required. Four years of high school credit or equivalent in one foreign language are equivalent to four semesters of college credit.
 5. Students must complete 14 hours of required technical electives.
 - Required Mathematics- 498, or 225 and 285 or 415 and 285 or 415 and 380 or 225 and 380.
 - Chemistry 499 is strongly recommended (Maximum of 10 semester hours)
 - Computer Science 101 and 110 are strongly recommended
 - Other courses to choose from include: Chemistry (300 or higher), Biochemistry, Chemical Engineering (200 or higher), Life Sciences courses (200 or higher), Mathematics or Computer Science courses above the basic level, Chemistry 199 (3 hours max.) and other courses in physical and biological sciences and engineering.
 - Additional courses can be taken upon the approval of the Chair of the Chemistry Department Advising Committee.
 6. Chemistry Advanced Hours (at least 11 semester hours)
 - This must include a Biochemistry course for ACS Certification
 - One of the following must be taken: Chemistry 317, 437, or 447
 - Students who will present **less than** 6 semester hours in Chemistry 499 must complete *two* additional courses while those with **at least** 6 semester hours must complete only *one* course chosen from the following list: Chemistry 317, 421, 423, 437, 447, 483; Biochemistry 455.
 - Additional Chemistry/Biochemistry to complete the 11 semester hour requirement include MCB 354 or MCB 450.
 7. Astronomy Advanced Hours
 - 3 of the 4 following courses: ASTR 404, 405, 406, 414
 - ASTR 401- must be taken concurrently with one of: ASTR 404, 405, 406, 414
 - 12 additional advanced hours in Astronomy or related technical field (e.g. physics, chemistry).
 - A minimum of 12 advanced hours for the Astronomy degree must not be counted for the Chemistry degree
- *The form to declare a double major must be picked up from 270 Lincoln Hall. The double degree requires a total of 150 credit hours.* For Departmental Honors in Chemistry you must have at least 6 hours of CHEM 499 and a 3.0 GPA.