Curriculum Revision Proposal for Chemistry BS Program (Fall 2024)

Committee members:
Analytical – Diep Nguyen
Inorganic – Adam Hock
Organic – Katie Leight
Physical – Ben Zion

<u>Highlights and Rationale for Curriculum Revision</u>

- The revised Chemistry BS curriculum meets the new university policy to reduce the total credit hours from 127 to 120.
- The revised Chemistry BS curriculum also meets all ACS BS Chemistry requirements.
- The revised Chemistry BS curriculum distributes the ACS' required/recommended Macromolecular, Supramolecular, and Nanoscale (MSN) and Green Chemistry topics into the existing courses.
- Reformat Chemistry courses with laboratory components for consistency: Lecture (Lecture: 3; Lab: 0; 3 credit hours) and Laboratory (Lecture: 0; Lab: 4; 1 credit hour): **Principles of Chemistry I** 122 & 123, **Principles of Chemistry II** 126 & 127, **Organic I** 235 & 236, **Organic II** 239 & 240, **Analytical** 247 & 248, **Instrumental** 321 & 322, **Physical** 344 & 345, and **Spec Methods** 434 & 435 (elective).
- Change the MATH requirement for CHEM 344 (Physical Chemistry II) from "both MATH 251 (4 credits) **and** MATH 252 (4 credits)" to "MATH 251 **or** MATH 252". This reduces the required Math credit hours.
- Reduce the credit hours of CHEM 451 (Undergraduate Seminar) from 3 to 2, i.e., "Lecture: 3; Lab: 0; Credits: 3" to "Lecture: 2 Lab: 0 Credits: 2".
- Reduce the times taking CHEM 485 (Chemistry Colloquium, Lecture: 1; Lab: 0; Credits: 1) from 2 to 1.
- Add CHEM 452 (Cheminformatics) OR MATH 425 (Statistical Methods) OR DS 151 (Introduction to Data Science) as required (3 credits) to align with the American Chemical Society (ACS) guidelines and enhance students' data analysis skills.
- Remove Chem 434 (Spectroscopic Methods in Identification and Analysis) as a required course. The material being taught is graduate level. Some of the foundations of spectroscopy will be covered in other courses including CHEM 239, CHEM 240, CHEM 247, CHEM 248, CHEM 321, and CHEM 322. Students can still take Chem 434 as a chemistry elective.
- All chemistry lab courses will satisfy the Communications (C) requirement (See Illinois Tech Core Curriculum, section A) as well as CHEM 451, Undergraduate Seminar, for a total of 12 "C" credit hours in major.

- Convert 3 specialized Chemistry BS programs, i.e., Environmental Chemistry, Forensic Chemistry and Medicinal Chemistry, into 3 Concentrations, i.e., Environmental, Forensic and Medicinal Chemistry, under the current revised Chemistry BS program, under the recent university strategic plan.
- Plan to send proposal to chemistry faculty by January 1st, receive feedback from faculty by January 10th, finalize proposal by January 15th chemistry faculty meeting, have the chemistry faculty vote during or after the faculty meeting, and if it passes, present the proposed curriculum revisions to the University UGSC on **Jan. 28**.
- AP Chemistry score of 5 will earn 8 credits – CHEM 122, CHEM 123, CHEM 126, CHEM 140
- AP Chemistry score of 3 will earn 4 credits – CHEM 122 and CHEM 123

Summary of BS CHEM Curriculum Revision

Credit hour changes:

Key: (Lecture weekly hours, Lab weekly hours, credits)

Course Name	Course #	Credit hours (current)	Credit hours (Proposed)	Credit hour Change (+/-)
Organic Chemistry Laboratory	CHEM 240	2 (1,4,2)	1 (0,4,1)	-1
Analytical Chemistry	CHEM 247	3 (3,3,3)	4 (3,4,4)	+1
Multivariate and Vector Calculus **And** Introduction to Differential Equations	MATH 251 and MATH 252	8 (4,1,4) and (4,0,4)	4 (4,1,4) **or** (4,0,4)	-4
Spectroscopic Methods in Identification and Analysis	CHEM 434	4 (3,4,4)	0	-4
Undergraduate Seminar	CHEM 451	3 (3,0,3)	2 (2,0,2)	-1
Chemistry Colloquium	CHEM 485	2 (0,1,1) and (0,1,1)	1 (1,0,1)	-1
Introductory Statistics, Introduction to Data Science, or Cheminformatics	MATH 225, DS 151, CHEM 452	0	3 (3,0,3) or 3 (3,0,3) or 3 (3,0,3)	+3

Reformatting Courses to be just a Lecture or just a Lab:

Key: (Lecture weekly hours, Lab weekly hours, credits)

CHEM 124 Principles of Chemistry I with Laboratory (3,3,4) ⇒ CHEM 122 Principles of Chemistry I (3,0,3) and CHEM 123 Principles of Chemistry I Laboratory (0,4,1)

CHEM 125 Principles of Chemistry II with Laboratory (3,3,4) ⇒ CHEM 126 Principles of Chemistry II (3,0,3) and CHEM 140 Principles of Chemistry II Laboratory (0,4,1)

CHEM 237 Organic Chemistry I (3,4,4) ⇒ CHEM 235 Organic Chemistry I (3,0,3) and CHEM 236 Organic Chemistry I Laboratory (0,4,1)

CHEM 247 Analytical Chemistry (3,3,3) ⇒ CHEM 247 Analytical Chemistry (3,0,3) and CHEM 248 Analytical Chemistry Laboratory (0,4,1)

CHEM 321 Instrumental Analysis (3,4,4) ⇒ CHEM 321 Instrumental Analysis (3,0,3) and CHEM 322 Instrumental Analysis Laboratory (0,4,1)

CHEM 344 Physical Chemistry II (3,4,4) ⇒ CHEM 344 Physical Chemistry II (3,0,3) and CHEM 345 Physical Chemistry II Laboratory (0,4,1)

CHEM 434 Spectroscopic Methods in Identification and Analysis (3,4,4) ⇒ CHEM 434 Spectroscopic Methods in Identification and Analysis (3,0,3) and CHEM 435 Spectroscopic Methods in Identification and Analysis Laboratory (0,4,1)

Bachelor Science in Chemistry Program Requirements:

Current		Proposed	
Course Number	Credits	Course Number	Credits
Chemistry Requirements	**54**	**Chemistry Requirements**	**48**
CHEM 100	2	CHEM 100	2
CHEM 124	4	CHEM 122	3
		CHEM 123	1
CHEM 125	4	CHEM 126	3
		CHEM 127 (renumbered Chem 140)	1
CHEM 237	4	CHEM 235	3
		CHEM 236	1
CHEM 239	3	CHEM 239	3
CHEM 240	2	CHEM 240	1
CHEM 247	3	CHEM 247	3
		CHEM 248	1
CHEM 321	4	CHEM 321	3
		CHEM 322	1

CHEM 343	3	CHEM 343	3
CHEM 344	4	CHEM 344	3
		CHEM 345	1
CHEM 415	3	CHEM 415	3
CHEM 416	3	CHEM 416	3
CHEM 434	4		
CHEM 451	3	CHEM 451	2
CHEM 485	1	CHEM 485	1
CHEM 485	1		
Select two CHEM electives[1]	6	Select two CHEM electives[1]	6
Biology Requirements	**(6-7)**	**Biology Requirements**	**(6-7)**
BIOL 107	3	BIOL 107	3
or BIOL 115		or BIOL 115	
BIOL 401	(3-4)	BIOL 401	(3-4)
or BIOL 403		or BIOL 403	
Mathematics Requirements	**18**	**Mathematics Requirements**	**17**
MATH 151	5	MATH 151	5
MATH 152	5	MATH 152	5
MATH 251	4	MATH 251	4
MATH 252	4	or MATH 252	
		MATH 225	3
		or DS 151	
		or CHEM 452	
Physics Requirements	**8**	**Physics Requirements**	**8**
PHYS 123	4	PHYS 123	4
PHYS 221	4	PHYS 221	4
Computer Science Requirement	**2**	**Computer Science Requirement**	**2**
CS 105	2	CS 105	2
or CS 110		or CS 110	
Humanities and Social Sciences Requirements	**21**	**Humanities and Social Sciences Requirements**	**21**
See Illinois Tech Core Curriculum, sections B and C	21	See Illinois Tech Core Curriculum, sections B and C	21

Interprofessional Projects (IPRO)	**6**	**Interprofessional Projects (IPRO)**	**6**
See Illinois Tech Core Curriculum, section E	6	See Illinois Tech Core Curriculum, section E	6
Free Electives	**12**	**Free Electives**	**12**
Select 12 credit hours	12	Select 12 credit hours	12
Total Credit Hours	**127-128**	**Total Credit Hours**	**120 - 121**

[1]Students may choose from CHEM 400+ and CHEM 500+ level courses. Students planning take CHEM 487 must complete CHEM 450 in a previous semester and are required to take one semester of CHEM 485.

Bachelor Science in Chemistry Sample Curriculum

YEAR 1			
SEMESTER 1	CREDIT HOURS	SEMESTER 2	CREDIT HOURS
CHEM 100	2	CHEM 126	3
CHEM 122	3	CHEM 140	1
CHEM 123	1	MATH 152	5
CS 105 or 110	2	PHYS 123	4
MATH 151	5	Social Sciences Elective	3
Humanities 200-level Course	3		
	16		16
YEAR 2			
SEMESTER 1	CREDIT HOURS	SEMESTER 2	CREDIT HOURS
CHEM 235	3	CHEM 239	3
CHEM 236	1	CHEM 240	1
CHEM 247	3	BIOL 107 or 115	3
CHEM 248	1	MATH 225, DS 151, or CHEM 452	3
MATH 251 or 252	4	Humanities or Social Sciences Elective	3
PHYS 221	4	Humanities Elective (300+)	3
	16		16
YEAR 3			
SEMESTER 1	CREDIT HOURS	SEMESTER 2	CREDIT HOURS

CHEM 415	3	CHEM 321	3
CHEM 343	3	CHEM 322	1
Chemistry Elective1	3	CHEM 344	3
IPRO Elective I	3	CHEM 345	1
Social Sciences Elective (300+)	3	Humanities Elective (300+)	3
		Free Elective	3
	15		14
YEAR 4			
SEMESTER 1	CREDIT HOURS	SEMESTER 2	CREDIT HOURS
Chemistry Elective1	3	CHEM 416	3
CHEM 485	1	CHEM 451	2
BIOL 401 or 403	(3-4)	IPRO Elective II	3
Free Elective	3	Social Sciences Elective (300+)	3
Free Elective	3	Free Elective	3
	(13-14)		14
Total Credit Hours: 120-121			

Curriculum Revision Proposal for Three Concentrations (Environmental, Forensic and Medicinal Chemistry) under Chemistry BS Program

Highlights and Rationale for Curriculum Revision

- All three concentrations are in compliance with the new university policy with total 120 credit hours required for a BS degree.
- Meets all ACS BS Chemistry requirements (previous specialized majors did not).
- All Chemistry BS requirements are required for each concentration.

The following changes are further made based on the revised 120/121-credit-hour Chemistry BS curriculum described above:

- Add CHEM 463 (Analytical Method Development Laboratory (1,7,3)) to all three concentrations.
- For Environmental Chemistry Concentration: add CHEM 472 (Environmental Chemistry) and CHEM 473 (Environmental Analytical Chemistry).

- For Forensic Chemistry Concentration: add CHEM 475 (Forensic Chemistry) and CHEM 476 (Forensic Chemistry Laboratory).
- For Medicinal Chemistry Concentration: add CHEM 467 (Medicinal Chemistry) and CHEM 456 (Computational Biochemistry and Drug Design).
- The additional requirements for each concentration take up the 6 credits of Chemistry electives and 3 credits of free electives, resulting in 9 hours of free electives.

Bachelor Science in Chemistry with a concentration in Environmental Chemistry Program Requirements:

Current		Proposed	
Course Number	Credits	Course Number	Credits
Chemistry Requirements	**54**	**Chemistry Requirements**	**51**
CHEM 100	2	CHEM 100	2
CHEM 124	4	CHEM 122	3
		CHEM 123	1
CHEM 125	4	CHEM 126	3
		CHEM 127 (renumbered Chem 140)	1
CHEM 237	4	CHEM 235	3
		CHEM 236	1
CHEM 239	3	CHEM 239	3
CHEM 240	2	CHEM 240	1
CHEM 247	3	CHEM 247	3
		CHEM 248	1
CHEM 321	4	CHEM 321	3
		CHEM 322	1
CHEM 343	3	CHEM 343	3
CHEM 344	4	CHEM 344	3
		CHEM 345	1
CHEM 415	3	CHEM 415	3
		CHEM 416	3
CHEM 434	4		
		CHEM 451	2
CHEM 463	3	CHEM 463	3
CHEM 472	3	CHEM 472	3
CHEM 473	3	CHEM 473	3

CHEM 485	1	CHEM 485	1
CHEM 495	1		
Select two ENVIR CHEM electives	6		
Biology Requirements	**(6-7)**	**Biology Requirements**	**(6-7)**
BIOL 107	3	BIOL 107	3
or BIOL 115		or BIOL 115	
BIOL 401	(3-4)	BIOL 401	(3-4)
or BIOL 403		or BIOL 403	
Mathematics Requirements	**18**	**Mathematics Requirements**	**17**
MATH 151	5	MATH 151	5
MATH 152	5	MATH 152	5
MATH 251	4	MATH 251	4
MATH 252	4	or MATH 252	
		MATH 225	3
		or DS 151	
		or CHEM 452	
Physics Requirements	**8**	**Physics Requirements**	**8**
PHYS 123	4	PHYS 123	4
PHYS 221	4	PHYS 221	4
Computer Science Requirement	**2**	**Computer Science Requirement**	**2**
CS 105	2	CS 105	2
or CS 110		or CS 110	
Humanities and Social Sciences Requirements	**21**	**Humanities and Social Sciences Requirements**	**21**
See Illinois Tech Core Curriculum, sections B and C	21	See Illinois Tech Core Curriculum, sections B and C	21
Interprofessional Projects (IPRO)	**6**	**Interprofessional Projects (IPRO)**	**6**
See Illinois Tech Core Curriculum, section E	6	See Illinois Tech Core Curriculum, section E	6
Free Electives	**12**	**Free Electives**	**9**
Select 12 credit hours	12	Select 12 credit hours	9
Total Credit Hours	**127-128**	**Total Credit Hours**	**120 - 121**

Bachelor Science in Chemistry with a concentration in Environmental Chemistry
Sample Curriculum

YEAR 1			
SEMESTER 1	CREDIT HOURS	SEMESTER 2	CREDIT HOURS
CHEM 100	2	CHEM 126	3
CHEM 122	3	CHEM 140	1
CHEM 123	1	MATH 152	5
CS 105 or 110	2	PHYS 123	4
MATH 151	5	Social Sciences Elective	3
Humanities 200-level Course	3		
	16		16
YEAR 2			
SEMESTER 1	CREDIT HOURS	SEMESTER 2	CREDIT HOURS
CHEM 235	3	CHEM 239	3
CHEM 236	1	CHEM 240	1
CHEM 247	3	BIOL 107 or 115	3
CHEM 248	1	MATH 225, DS 151, or CHEM 452	3
MATH 251 or 252	4	Humanities or Social Sciences Elective	3
PHYS 221	4	Humanities Elective (300+)	3
	16		16
YEAR 3			
SEMESTER 1	CREDIT HOURS	SEMESTER 2	CREDIT HOURS
CHEM 415	3	CHEM 321	3
CHEM 343	3	CHEM 322	1
CHEM 472	3	CHEM 344	3
IPRO Elective I	3	CHEM 345	1
Social Sciences Elective (300+)	3	Humanities Elective (300+)	3
		CHEM 473	3
	15		14
YEAR 4			
SEMESTER 1	CREDIT HOURS	SEMESTER 2	CREDIT HOURS
CHEM 463	3	CHEM 416	3
CHEM 485	1	CHEM 451	2
BIOL 401 or 403	(3-4)	IPRO Elective II	3

Free Elective	3	Social Sciences Elective (300+)	3
Free Elective	3	Free Elective	3
	(13-14)		14
Total Credit Hours: 120-121			

Bachelor Science in Chemistry with a concentration in Forensic Chemistry Program Requirements:

Current		Proposed	
Course Number	Credits	Course Number	Credits
Chemistry Requirements	**54**	**Chemistry Requirements**	**51**
CHEM 100	2	CHEM 100	2
CHEM 124	4	CHEM 122	3
		CHEM 123	1
CHEM 125	4	CHEM 126	3
		CHEM 127 (renumbered Chem 140)	1
CHEM 237	4	CHEM 235	3
		CHEM 236	1
CHEM 239	3	CHEM 239	3
CHEM 240	2	CHEM 240	1
CHEM 247	3	CHEM 247	3
		CHEM 248	1
CHEM 321	4	CHEM 321	3
		CHEM 322	1
CHEM 343	3	CHEM 343	3
CHEM 344	4	CHEM 344	3
		CHEM 345	1
CHEM 415	3	CHEM 415	3
		CHEM 416	3
CHEM 434	4		
		CHEM 451	2
CHEM 463	3	CHEM 463	3
CHEM 475	3	CHEM 475	3
CHEM 476	3	CHEM 476	3
CHEM 485	1	CHEM 485	1
CHEM 495	1		

Select two FOREN CHEM electives	6		
Biology Requirements	**(6-7)**	**Biology Requirements**	**(6-7)**
BIOL 107	3	BIOL 107	3
or BIOL 115		or BIOL 115	
BIOL 401	(3-4)	BIOL 401	(3-4)
or BIOL 403		or BIOL 403	
Mathematics Requirements	**18**	**Mathematics Requirements**	**17**
MATH 151	5	MATH 151	5
MATH 152	5	MATH 152	5
MATH 251	4	MATH 251	4
MATH 252	4	or MATH 252	
		MATH 225	3
		or DS 151	
		or CHEM 452	
Physics Requirements	**8**	**Physics Requirements**	**8**
PHYS 123	4	PHYS 123	4
PHYS 221	4	PHYS 221	4
Computer Science Requirement	**2**	**Computer Science Requirement**	**2**
CS 105	2	CS 105	2
or CS 110		or CS 110	
Humanities and Social Sciences Requirements	**21**	**Humanities and Social Sciences Requirements**	**21**
See Illinois Tech Core Curriculum, sections B and C	21	See Illinois Tech Core Curriculum, sections B and C	21
Interprofessional Projects (IPRO)	**6**	**Interprofessional Projects (IPRO)**	**6**
See Illinois Tech Core Curriculum, section E	6	See Illinois Tech Core Curriculum, section E	6
Free Electives	**12**	**Free Electives**	**9**
Select 12 credit hours	12	Select 12 credit hours	9
Total Credit Hours	**127-128**	**Total Credit Hours**	**120 - 121**

Bachelor Science in Chemistry with a concentration in Forensic Chemistry Sample Curriculum

YEAR 1

SEMESTER 1	CREDIT HOURS	SEMESTER 2	CREDIT HOURS
CHEM 100	2	CHEM 126	3
CHEM 122	3	CHEM 140	1
CHEM 123	1	MATH 152	5
CS 105 or 110	2	PHYS 123	4
MATH 151	5	Social Sciences Elective	3
Humanities 200-level Course	3		
	16		16
YEAR 2			
SEMESTER 1	CREDIT HOURS	SEMESTER 2	CREDIT HOURS
CHEM 235	3	CHEM 239	3
CHEM 236	1	CHEM 240	1
CHEM 247	3	BIOL 107 or 115	3
CHEM 248	1	MATH 225, DS 151, or CHEM 452	3
MATH 251 or 252	4	Humanities or Social Sciences Elective	3
PHYS 221	4	Humanities Elective (300+)	3
	16		16
YEAR 3			
SEMESTER 1	CREDIT HOURS	SEMESTER 2	CREDIT HOURS
CHEM 415	3	CHEM 321	3
CHEM 343	3	CHEM 322	1
Free Elective	3	CHEM 344	3
IPRO Elective I	3	CHEM 345	1
Social Sciences Elective (300+)	3	Humanities Elective (300+)	3
		Free Elective	3
	15		14
YEAR 4			
SEMESTER 1	CREDIT HOURS	SEMESTER 2	CREDIT HOURS
CHEM 463	3	CHEM 416	3
CHEM 485	1	CHEM 451	2
BIOL 401 or 403	(3-4)	IPRO Elective II	3
CHEM 475	3	Social Sciences Elective (300+)	3
CHEM 476	3	Free Elective	3
	(13-14)		14

Total Credit Hours: 120-121			

Bachelor Science in Chemistry with a concentration in Medicinal Chemistry Program Requirements:

Current		Proposed	
Course Number	Credits	Course Number	Credits
Chemistry Requirements	**54**	**Chemistry Requirements**	**51**
CHEM 100	2	CHEM 100	2
CHEM 124	4	CHEM 122	3
		CHEM 123	1
CHEM 125	4	CHEM 126	3
		CHEM 127 (renumbered Chem 140)	1
CHEM 237	4	CHEM 235	3
		CHEM 236	1
CHEM 239	3	CHEM 239	3
CHEM 240	2	CHEM 240	1
CHEM 247	3	CHEM 247	3
		CHEM 248	1
CHEM 321	4	CHEM 321	3
		CHEM 322	1
CHEM 343	3	CHEM 343	3
CHEM 344	4	CHEM 344	3
		CHEM 345	1
CHEM 415	3	CHEM 415	3
		CHEM 416	3
CHEM 434	4		
		CHEM 451	2
CHEM 456	3	CHEM 456	3
CHEM 463	3	CHEM 463	3
CHEM 467	3	CHEM 467	3
CHEM 485	1	CHEM 485	1
CHEM 495	1		
Select two MED CHEM electives	6		
Biology Requirements	**(6-7)**	**Biology Requirements**	**(6-7)**
BIOL 107	3	BIOL 107	3

or BIOL 115		or BIOL 115	
BIOL 401	(3-4)	BIOL 401	(3-4)
or BIOL 403		or BIOL 403	
Mathematics Requirements	**18**	**Mathematics Requirements**	**17**
MATH 151	5	MATH 151	5
MATH 152	5	MATH 152	5
MATH 251	4	MATH 251	4
MATH 252	4	or MATH 252	
		MATH 225	3
		or DS 151	
		or CHEM 452	
Physics Requirements	**8**	**Physics Requirements**	**8**
PHYS 123	4	PHYS 123	4
PHYS 221	4	PHYS 221	4
Computer Science Requirement	**2**	**Computer Science Requirement**	**2**
CS 105	2	CS 105	2
or CS 110		or CS 110	
Humanities and Social Sciences Requirements	**21**	**Humanities and Social Sciences Requirements**	**21**
See Illinois Tech Core Curriculum, sections B and C	21	See Illinois Tech Core Curriculum, sections B and C	21
Interprofessional Projects (IPRO)	**6**	**Interprofessional Projects (IPRO)**	**6**
See Illinois Tech Core Curriculum, section E	6	See Illinois Tech Core Curriculum, section E	6
Free Electives	**12**	**Free Electives**	**9**
Select 12 credit hours	12	Select 12 credit hours	9
Total Credit Hours	**127-128**	**Total Credit Hours**	**120 - 121**

Bachelor Science in Chemistry with a concentration in Medicinal Chemistry Sample Curriculum

YEAR 1			
SEMESTER 1	CREDIT HOURS	SEMESTER 2	CREDIT HOURS
CHEM 100	2	CHEM 126	3
CHEM 122	3	CHEM 140	1
CHEM 123	1	MATH 152	5

CS 105 or 110	2	PHYS 123	4
MATH 151	5	Social Sciences Elective	3
Humanities 200-level Course	3		
	16		16
YEAR 2			
SEMESTER 1	CREDIT HOURS	SEMESTER 2	CREDIT HOURS
CHEM 235	3	CHEM 239	3
CHEM 236	1	CHEM 240	1
CHEM 247	3	BIOL 107 or 115	3
CHEM 248	1	MATH 225, DS 151, or CHEM 452	3
MATH 251 or 252	4	Humanities or Social Sciences Elective	3
PHYS 221	4	Humanities Elective (300+)	3
	16		16
YEAR 3			
SEMESTER 1	CREDIT HOURS	SEMESTER 2	CREDIT HOURS
CHEM 415	3	CHEM 321	3
CHEM 343	3	CHEM 322	1
Free Elective	3	CHEM 344	3
IPRO Elective I	3	CHEM 345	1
Social Sciences Elective (300+)	3	Humanities Elective (300+)	3
		Free Elective	3
	15		14
YEAR 4			
SEMESTER 1	CREDIT HOURS	SEMESTER 2	CREDIT HOURS
CHEM 463	3	CHEM 416	3
CHEM 485	1	CHEM 451	2
BIOL 401 or 403	(3-4)	IPRO Elective II	3
CHEM 456	3	Social Sciences Elective (300+)	3
CHEM 467	3	Free Elective	3
	(13-14)		14
Total Credit Hours: 120-121			

Chemistry Undergraduate Course Description

Only courses that are being edited are listed. Changes are highlighted.

CHEM 100

Introduction to the Profession

Introduction to the chemical sciences, scientific method, computing tools, green chemistry, and interrelations of chemical sciences with biology, physics and other professions.

Lecture: 2 Lab: 0 Credits: 2

Satisfies: Communications (C)

CHEM 122

Principles of Chemistry I ~~Without Laboratory~~

An introduction to the foundations of chemistry, including: atoms and molecules; stoichiometry of chemical reactions; thermochemistry; properties of gases; states of matter, chemical solutions; the molecular basis for chemical reactivity; atomic structure; periodicity; and chemical bonding.

Lecture: 3 Lab: 0 Credits: 3

CHEM 123

General Chemistry Laboratory

General chemistry laboratory. The laboratory portion for CHEM 122.

Prerequisite(s): CHEM 122* An asterisk (*) designates a course which may be taken concurrently.

Lecture: 0 Lab: 3 Credits: 1

Satisfies: Communications (C)

(Remove **Chem 124** and **CHEM 125** listing)

CHEM 126

Principles of Chemistry II ~~Without Laboratory~~

~~Same as CHEM 125 except without the laboratory.~~

A continuing introduction to the foundations of chemistry, including: chemical equilibria; the chemistry of acids and bases; solubility and precipitation reactions; kinetics; thermodynamics; electrochemistry; nuclear chemistry; and the basics of organic chemistry.

Prerequisite(s): (CHEM 122 and CHEM 123) ~~or CHEM 124~~

Lecture: 3 Lab: 0 Credits: 3

CHEM 127 ~~140~~

Laboratory portion of CHEM 126 (Principles of Chemistry II) covering Chemical Equilibria, the chemistry of acids and bases, solubility, and precipitation reactions. Introduction to thermodynamics and electrochemistry. Chemistry of selected elements and their compounds.

Prerequisite(s): CHEM 126* An asterisk (*) designates a course which may be taken concurrently.

Lecture: 0 Lab: 4 Credits: 1

Satisfies: Communications (C)

CHEM 235

Organic Chemistry I~~- Lecture~~

The constitution and properties of the different classes of organic compounds with considerable attention to stereochemistry and reaction mechanisms.

Prerequisite(s): ~~CHEM 125 or~~ CHEM 126

Lecture: 3 Lab: 0 Credits: 3

CHEM 236

Organic Chemistry I-Lab

Introduction to the major synthetic and analytical techniques of organic chemistry including the preparation of representative organic compounds from natural sources.

Prerequisite(s): ~~CHEM 125 or CHEM 126~~ CHEM 235* An asterisk (*) designates a course which may be taken concurrently.

Lecture: 0 Lab: 4 Credits: 1

Satisfies: Communications (C)

(Remove **Chem 237** listing)

CHEM 239

Organic Chemistry II

Sequel to Organic Chemistry I with more emphasis on structure and reactivity of several classes of organic compounds including introductory discussion on common spectroscopic techniques.

Prerequisite(s): CHEM ~~237 or (CHEM 236 and CHEM 235)~~ 235

Lecture: 3 Lab: 0 Credits: 3

CHEM 240

Organic Chemistry Laboratory

Basic techniques for advanced organic preparations. Interpretation of scientific results including percent yield, melting point, boiling point, IR, and NMR spectra.

Prerequisite(s): CHEM 239*, An asterisk (*) designates a course which may be taken concurrently.

Lecture: ~~1~~ 0 Lab: 4 Credits: ~~2~~ 1

Satisfies: Communications (C)

CHEM 247

Analytical Chemistry

This course introduces students to the theory and applications of quantitative analytical chemistry. Topics covered include: statistical data analysis; equilibrium constants expressions; acid-base reactions; volumetric analysis; and fundamentals of spectroscopy,

electrochemistry, and of separations science. ~~Laboratory experiments include learning about analytical process, calibration of glassware and equipment, wet chemical analysis, electrochemistry, spectroscopy, and chromatography.~~

Prerequisite(s): CHEM ~~125~~ 126

Lecture: 3 Lab: ~~3~~ 0 Credits: 3

~~Satisfies: Communications (C)~~

CHEM 248

Analytical Chemistry Laboratory

The laboratory portion of CHEM 247. Laboratory experiments include learning about analytical process, calibration of glassware and equipment, wet chemical analysis, electrochemistry, spectroscopy, and chromatography.

Lecture: 0 Lab: 4 Credits: 1

Satisfies: Communications (C)

CHEM 321

Instrumental Analysis

This course introduces students to theory and application of modern instruments in chemical procedures. Standard spectroscopic methods including atomic spectrometry, molecular spectrometry, ultraviolet spectroscopy, molecular luminescence, Fourier transform infrared spectroscopy, and nuclear magnetic resonance spectroscopy. Separation techniques using high pressure liquid chromatography and gas chromatography. Other topics relevant to advanced chemical instrumentation.

Prerequisite(s): CHEM 247

Lecture: 3 Lab: ~~4~~ 0 Credits: ~~4~~ 3

~~Satisfies: Communications (C)~~

CHEM 322

Instrumental Analysis Laboratory

The laboratory portion of CHEM 321.

Prerequisite(s): CHEM 321* An asterisk (*) designates a course which may be taken concurrently.

Lecture: 0 Lab: 4 Credits: 1

Satisfies: Communications (C)

CHEM 343

Physical Chemistry I

Thermodynamic laws and relationships applied to chemical systems. Kinetic theory of gases. Equations of state for ideal and real gases. Calculation of state functions from arbitrary pathways using measurable partial derivatives. Chemical potential and the prediction of phase and reaction equilibria.

Prerequisite(s): (MATH 251 or MATH 252) and CHEM ~~125~~ 126 and CHEM 127

Lecture: 3 Lab: 0 Credits: 3

CHEM 344

Physical Chemistry II

Introduction to quantum mechanics. Applying quantum mechanics to chemical systems. Atomic structure and spectra. Molecular structure and spectroscopy. Statistical mechanics. Chemical kinetics. ~~The laboratory will include experiments dealing with thermochemistry, phase equilibria, chemical kinetics, spectra, molecular structure, and treatment of data.~~

Prerequisite(s): (CHE 202 or CHEM 247 and 248) and CHEM 343 and (MATH 251 or MATH 252)and PHYS 221

Lecture: 3 Lab: ~~4~~ 0 Credits: ~~4~~ 3

~~Satisfies: Communications (C)~~

CHEM 345

The laboratory portion of CHEM 344. The laboratory will include experiments dealing with thermochemistry, phase equilibria, chemical kinetics, spectra, molecular structure, and treatment of data.

Prerequisite(s): CHEM 344* An asterisk (*) designates a course which may be taken concurrently.

Lecture: 0 Lab: 4 Credits: 1

Satisfies: Communications (C)

CHEM 410

Science of Climate Change

This course will focus on the science underlying global warming/climate change. How can we continue to lead the good life while living in harmony with nature? Although obviously important, commercial/political aspects are not considered here. However, any serious debate about climate change issues eventually has to rest on the underlying scientific facts so we need to be informed. Ultimately the sun is our primary source of power. How do we responsibly access that power in the short, intermediate and long terms? Bio-fuels, carbon dioxide, polar ice caps, and solar power are some of the topics to be discussed. Class time will be divided between lectures and recitation. Permission of instructor required.

Prerequisite(s): ~~CHEM 124~~ CHEM 122 and CHEM 123 or PHYS 221

Lecture: 3 Lab: 0 Credits: 3

CHEM 434

Spectroscopic Methods in Identification and Analysis

Characterization and analysis by mass, vibrational, nuclear magnetic resonance, and electronic spectroscopy. Structure-spectra correlations applied to organic and inorganic compounds with examples drawn from diverse areas, e.g., pollutants, toxic materials, polymers, etc. ~~The laboratory work includes characterization of prepared or separated organic compounds by chromatographic, chemical, and spectroscopic methods.~~

Prerequisite(s): CHEM 247 and CHEM 248 and CHEM 240

Lecture: 3 Lab: ~~4~~ 0 Credits: ~~4~~ 3

CHEM 435

Spectroscopic Methods in Identification and Analysis Laboratory

The laboratory portion to CHEM 434. The laboratory work includes characterization of prepared or separated organic compounds by chromatographic, chemical, and spectroscopic methods.

Prerequisite(s): CHEM 434* An asterisk (*) designates a course which may be taken concurrently.

Satisfies: Communications (C)

CHEM 451

Undergraduate Seminar

An overview of a variety of chemical information tools and major scientific databases for navigating primary scientific literature. There will be a focus on the written and oral presentation of scientific research and the critical evaluation of the same types of scientific communication. Professional development with discussions of behavior, ethics, and career paths.

Prerequisite(s): CHEM ~~125~~ 126

Lecture: ~~3~~ 2 Lab: 0 Credits: ~~3~~ 2

Satisfies: Communications (C)

CHEM 452

Cheminformatics

This course provides an introduction to chemical informatics and an overview of computer technology and computational methods for search, visualization, analysis, management, and mining of chemical and biochemical data and information. Potential topics include: representation of 2D and 3D chemical structures and chemical reactions; molecular coding; chemical structure database; chemical data and structure descriptors; data visualization and non-linear mapping; database design and management; chemical and biological data analysis and mining; cluster and diversity analysis; and software design and programming; cheminformatics in chemical reaction and property, analytical chemistry, and spectral analysis.

Prerequisite(s): CHEM 343 and CHEM ~~237~~ 235

Lecture: 3 Lab: 0 Credits: 3

CHEM 456

Computational Biochemistry and Drug Design

A project-based introduction to computer-aided drug design tools and the principles behind them. Molecular docking and molecular mechanics force fields for binding enthalpies. Continuum dielectric models of electrostatics and solvation. The Boltzmann distribution and alchemical binding free energy calculations. Quantitative structure property relationships, including for activity and membrane permeability. This course will include laboratory work.

Prerequisite(s): CHEM 343 and CHEM ~~237~~ 235

Lecture: 3 Lab: 0 Credits: 3

CHEM 460

Bioanalytical Chemistry

This course will provide an introduction to analysis of biomolecules and biologically active molecules and cover analytical and spectroscopic methods for characterization, separation, and detection of biomolecules and biologically active molecules. Students will learn chemical, biochemical, biophysical, chromatographic, electrochemical, and instrumental techniques for detection, qualitative and quantitative analysis, and characterization of small drugs, biomolecules, bioconjugates, biosimilars, and biopharmaceuticals including protein, antibodies, nucleic acid, and enzymes. Potential topics includes acid-base chemistry, chemical kinetics and thermodynamics, biomolecular structure, enzyme and protein chemistry, bioconjugate chemistry, spectroscopy, mass spectrometry, fluorescence microscopy, chromatography, electrochemistry, and analysis and characterization of proteins and nucleic acids.

Prerequisite(s): CHEM ~~237~~ 235 and CHEM 343 and CHEM 247

Lecture: 3 Lab: 0 Credits: 3

CHEM 461

Bioanalytical Chemistry Laboratory

In this laboratory course of bioanalytical chemistry, students will learn chemical, biochemical, and instrumental lab techniques for detection, analysis, separation, and characterization of small drugs, bioactive agents, and biomolecules. Students will gain hands-on lab experience in the biochemical assays, microscopic, and spectroscopic analysis of biologically active molecules including small drugs, proteins, and DNAs. Potential topics include instrumental and spectroscopic analysis using FTIR, Raman, UV-visible, fluorescence, NMR, AFM, ICP, HPLC, calorimetry, fluorescence microscope, and mass spectrometry; DNA and protein electrophoresis; chromatographic separation; immunoassay; DNA profiling; peptide sequencing; PCR; centrifugation; and microdialysis; and statistical analysis.

Prerequisite(s): CHEM ~~237~~ 236 and CHEM 343 and CHEM ~~247~~ 248

Lecture: 1 Lab: 7 Credits: 3

Satisfies: Communications (C)

CHEM 463

Analytical Method Development Laboratory

In this laboratory course, students will learn about method development and assessment for analysis of chemicals, organic compounds, polymers, drugs, pharmaceuticals, and biopharmaceuticals. Students will gain hands-on experience in quantitative analysis and quality assurance and control of diverse chemicals and bioactive agents. This course will foster students to develop quantitative and technical analysis techniques, literature comprehension, critical thinking, problem-solving, and communication skills. The literature and guidance on analytical method development and validation reported by the industry and government agencies will be studied. Potential topics include: analytical separation; instrumental analysis; chromatographic and electrophoretic methods; quality assurance and control; analytical method validation; sampling, preparations and storage of samples and standard solutions; physiochemical characterization; statistical analysis; good laboratory practice (GLP) requirement; and validation, verification, and documentation of analytical testing methods and procedure.

Prerequisite(s): CHEM ~~237~~ 236 and CHEM 343 and CHEM ~~247~~ 248

Lecture: 1 Lab: 7 Credits: 3

Satisfies: Communications (C)

CHEM 472

Environmental Chemistry

This course provides an introduction to environmental chemistry and is focused on application of chemical principles and theories to the study of environmental phenomena and issues and covers matters related to environment and earth. Potential topics include aquatic chemistry, water pollution and purification, atmospheric chemistry, air pollution, hydrology and geochemistry, soil chemistry and pollution, natural resource and cycle, energy and sustainability, climate change, chemical bonding and reactions, thermodynamics and kinetics, acid-base chemistry, redox chemistry, bio-inorganic chemistry on earth and living systems, organic and inorganic toxicants and pollutants, hazardous heavy metals, nuclear wastes, waste and recycling, green chemistry, environmental toxicology, and chemical and environmental health and safety.

Prerequisite(s): ~~(CHEM 125 or CHEM 126)~~ CHEM 126 and CHEM 247

Lecture: 3 Lab: 0 Credits: 3

CHEM 473

Environmental Analytical Chemistry

This course provides an overview of applications of analytical chemistry to environment and environmental problems. Students will learn spectrometric, chromatographic, electrochemical measurement methods and concepts for analysis of environmental samples and tracing and monitoring of environmental problems. Potential topics include: quality assurance (QA) and quality control (QC) in environmental sampling and analysis; determination of trace elements, toxicants, organics, pollutants, heavy metals, and radionuclides in environmental samples and drinking water; analytical tools for tracing and monitoring of pollution and contamination; instrumental analysis of environmental samples using ICP-MS (inductively coupled plasma-mass spectrometry), ICP-AAS (atomic absorption spectroscopy), ICP-AES (atomic emission spectrometry), ion chromatography, and gas chromatography (GC), GC-MS, high performance liquid chromatography (HPLC); chemometrics; electrochemical methods; GC/LC separation methods, liquid-liquid and solid phase extraction; statistical data analysis.

Prerequisite(s): ~~(CHEM 125 or CHEM 126)~~ CHEM 126 and CHEM 247

Lecture: 3 Lab: 0 Credits: 3

CHEM 475

Forensic Chemistry

This course will provide an introduction to forensic chemistry and prepare students to build a sound knowledge in chemical, biochemical, and instrumental methods for forensic analysis and statistical analysis of forensic data. The class will cover principles and applications of chemical, biochemical, spectroscopic, and chromatographic methods for analysis and characterization of forensic samples. Potential topics include forensic applications of UV-Visible, IR, Raman, NMR, atomic absorption (AA) spectroscopy, fluorescence microscopy, X-ray, mass spectrometry; chromatographic methods (GC, HPLC, and TLC) and capillary electrophoresis for separation of forensics; analysis and identification of enforced drugs; colorimetric methods; microscopy and immunoassays for forensic examination; chemistry in examination and analysis of chemical, biological, and physical forensic samples (alcohol, carbon monoxide, papers, hair, gunpowder, inks, fibers, paints, firearms, fingerprint, palmprint, documents, and body fluid and blood samples); crime lab services; forensic statistics; introduction to international forensic databases.

Prerequisite(s): ~~CHEM 237~~ CHEM 235 and CHEM 343 and CHEM 247

Lecture: 3 Lab: 0 Credits: 3

CHEM 476

Forensic Chemistry Laboratory

This lab course will cover chemical, spectroscopic, and chromatographic methods for analysis and characterization of forensic samples. Students will gain hands-on lab experience in instrumental, colorimetric, and microscopic analysis of forensic samples, controlled substances, and standards. Potential topics include: colorimetric assay for identification and quantification of illicit drugs; fingerprint chemistry; IR, Raman, Fluorescence, and NMR-based spectroscopic analysis of controlled substances, forensic samples, and gold standards; GC-MS, HPLC, and TLC for detection and separation of forensic samples; spot testing and microscopic analysis and characterization of biologic fluids and forensic samples; construction of calibration curves; analysis of forensic

samples using an international database including paint data query (PDQ), NIST's Forensic database trace evidence table, international ink library, glass evidence reference; introduction to visualization software.

Prerequisite(s): ~~CHEM 237~~ CHEM 236 and CHEM 343 and ~~CHEM 247~~ CHEM 248

Lecture: 1 Lab: 7 Credits: 3

Satisfies: Communications (C)