Chemistry

Chemistry is a versatile subject area and the pursuit of a career in chemistry can be a most intellectually satisfying experience. No other basic science touches and shapes as many aspects of modern society as does chemistry. The study of chemistry has provided solutions to complex problems and has improved the quality of all phases of human life from soft contact lenses and synthetic blood to longer-lasting paint and alternative fuels. A particular strength of this department is in surface and interface chemistry, which bridges many areas of modern science and technology.

Chemists at all levels of education find a market for their skills and knowledge in many employment areas. Chemists provide the technical backbone for the manufacturing industries (pharmaceuticals, plastics, paper, semiconductor electronics technology, and agriculture), for service industries (clinical and forensic laboratories, academe, environmental protection, and information science) and for governmental positions in regulatory agencies and in science policy analyses. Many chemists are employed in nontraditional areas, such as patent law, insurance underwriting, sales, product management, journalism, and even banking.

The alluring challenge of chemistry inspires many bachelor degree recipients to study for advanced degrees within the discipline of chemistry and in other areas, as well. Chemistry or biochemistry is the strongest preparation for graduate studies or for professional school in the health-related disciplines (medicine, pharmacology, and biochemistry), and for other science programs (materials science, polymers, biotechnology, environmental studies, and mineralogy).

The study of chemistry opens doors to satisfying careers, to a stimulating view of the world, and to a professional life in which one's natural tendency to ask "Why?" can lead to personally rewarding endeavors. The undergraduate curriculum in chemistry contains many of the prerequisites for biology, earth and environmental sciences, materials science, molecular biology, physics, and chemical engineering. This allows students to transfer credits among these majors through the sophomore year.

Chemistry students have the opportunity to design their undergraduate curricula for specialization in a variety of fields through the ChemFlex curriculum.

THE CHEMFLEX CURRICULUM

The Department of Chemistry offers degrees in both the College of Arts and Sciences and the College of Engineering and Applied Sciences. Students in the College of Arts and Sciences have three options: the B. S. in Chemistry, the B. A. in Chemistry, and the B. S. in Pharmaceutical Chemistry. In addition we offer an interdepartmental B. S. in Biochemistry in collaboration with the Department of Biological Sciences. For students in the College of Engineering and Applied Sciences we offer the B. S. in Chemistry.

In the College of Arts and Sciences, the traditional degree certified by the American Chemical Society is offered; the B. S. degree in the College of Engineering is the ACS certified degree and is identical in terms of degree program requirements. All B. S. programs have a Common Chemistry Core and similar collateral science requirements. These programs are pre-professional in nature, and students planning to attend graduate school in chemistry or an allied science should elect the B. S. program in the college to which they have been admitted. The traditional B. A. Program in the College of Arts and Sciences is not a pre-professional program and may be elected by students who do not plan to do graduate work in chemistry or allied sciences but who desire a stronger background in chemistry than is provided by a chemistry minor.

In addition to the traditional certified B. S degree and B. A. degree, the B. A. and B. S. Chemistry programs in the College of Arts and Sciences feature an alternative flexible curriculum, called ChemFlex, which enables a student to concentrate in a specific area. The concentrations possible for the B. S. are Physical/Analytical, Polymers, and Materials. The B. A. has two areas of concentration: Business and the Health Professions. All concentrations in ChemFlex share a Common Chemistry Core; all students complete the core and then follow one of two paths for collateral courses (Path A or Path B for math, physics, and programming) as outlined in the following lists.

Students may transfer from a B. S. program to a B. A. program easily, but the reverse is more difficult. Students in a B. A. program who make the decision to attend graduate school in chemistry or allied sciences can achieve a minimum preparation for this transition by electing 307 Advanced Inorganic Chemistry.

DEGREES IN THE COLLEGE OF ARTS AND SCIENCES

In the College of Arts and Sciences the Chemistry Department offers three degrees: a B.S. in Chemistry, a B.A. in Chemistry and a B.S. in Pharmaceutical Chemistry with an interdepartmental B.S. in Biochemistry degree with the Department of Biological Sciences. The ChemFlex Curriculum allows the flexibility for a student to develop a concentration in a specific area if he/she wishes to do so. The specific concentrations are noted in the following Table.

Table: ChemFlex Curriculum Overview

Specialization Requirements

- B.S. Chemistry (ACS)^{1,2,3}
- B.S. Chemistry Analytical/Physical^{1,2,3}
- B.S. Chemistry Polymers^{1,2,3}
- B.S. Chemistry Materials^{1,2,3}
- B.A. Chemistry ^{1, 2, 3 or 4}
- B.A. Chemistry Business ^{1, 2, 3 or 4}
- B.A. Chemistry Health Professions ^{1, 2, 3 or 4}
- B.S. Pharmaceutical Chemistry ^{1, 2, 3 or 4}
- B.S. Biochemistry (interdepartmental degree)^{1,2, 3 or 4}

1

Common Chemistry Core

Courses required for specific concentration

3

4

Path A (see below)

Path B (see below)

With regard to the B.S. in Pharmaceutical Chemistry, the pharmaceutical industry is focused on exploring the biochemistry of disease and designing or finding drugs to cure or ameliorate disease. Biochemists, organic chemists, biologists, and chemical engineers collaborate to achieve this end. The majority of chemists hired today go into the pharmaceutical industry. The B.S. in Pharmaceutical Chemistry is a chemistry degree option which focuses on core chemistry, biochemistry, and molecular biology to prepare students for careers in this field. Since it is a highly interdisciplinary field it requires the breadth of knowledge offered by this degree program.

Freshman chemistry courses

Common Chemistry Core Select one of the following: 8 CHM 040 Honors General Chemistry I & CHM 041 and Honors General Chemistry II or CHM 030 Introduction to Chemical Principles & CHM 031 and Chemical Equilibria in Aqueous Systems CHM 110 Organic Chemistry I 4 & CHM 111 and Organic Chemistry Laboratory I CHM 112 Organic Chemistry II 4 and Organic Chemistry Laboratory II & CHM 113 CHM 332 Analytical Chemistry 3 Concentrations (see below) 3-8 CHM 307 Advanced Inorganic Chemistry 3

2 Chemistry

CHM 351	Professional Development Seminar	2
Total Credits		27-32
Collateral requirements		
Path A		
MATH 021	Calculus I	4
MATH 022	Calculus II	4
MATH 023	Calculus III	4
MATH 205	Linear Methods	3
	Introductory Physics I	5
& PHY 012	and Introductory Physics Laboratory L	5
PHY 021	Introductory Physics II	5
& PHY 022	and Introductory Physics Laboratory II	0
ENGR 010	Applied Engineering Computer	2
	Methods	
or CSE 002		
Total Credits		27
Dath D		
	Our set Oslavilus I	4
	Survey of Calculus I	4
MATH 052	Survey of Calculus II	3
MATH 043	Survey of Linear Algebra	3
PHY 010	General Physics I	5
& PHY U12	and Introductory Physics Laboratory I	
	General Physics II	4
	and infroductory Physics Laboratory if	40
Total Credits		19
SPECIALIZATIONS		
B.S. Chemistry (ACS cer	rtified Degree)	
Common Core		
Select one of the followi	ng:	8
CHM 040	Honors General Chemistry I	
& CHM 041	and Honors General Chemistry II	
CHM 030	Introduction to Chemical Principles	
& CHM 031	and Chemical Equilibria in Aqueous	
01104.440	Systems	4
	and Organic Chemistry Laboratory L	4
	Organic Chomistry II	Λ
& CHM 113	and Organic Chemistry Laboratory II	4
CHM 332	Analytical Chemistry	3
CHM 307	Advanced Inorganic Chemistry	3
CHM 351	Professional Development Seminar	2
Collatoral Boguiroman		2
		1
		4
		4
MATH 023		4
MATH 205	Linear Methods	3
PHY 011	Introductory Physics I	5
	and Infroductory Physics Laboratory I	5
	Introductory Physics I aboratory II	5
Soloct one from the follo	wing:	2-4
	Applied Engineering Computer	2-4
ENGRUIU	Methods	
CSE 003	Introduction to Programming Part A	
CSE 007	Introduction to Programming, Full A	
Specialization Courses		
CHM 334	Advanced Chemistry Laboratory	3
	Advanced Chemistry Laboratory	3
	Auvanceu Chemistry Laboratory II	3
CHM 341	Iviolecular Structure, Bonding and	3
	Thormodynamics & Kingdian	0
	Developed Chamistry Laboratory	3
0111/1 343	Physical Chemistry Laboratory	2

	Elements of Biochemistry I	3
CHM 375	Research Chemistry Laboratory	2
Advanced Chemistry E	lective Requirement	
Select one of the following	ng:	3
CHM 305	Organometallic Chemistry	
CHM 323	Chemical Biology	
CHM 336	Clinical Chemistry	
CHM 337	Crystallography and Diffraction	
CHM 340	Solid-State Chemistry	
CHM 350	Special Topics	
CHM 356	Spectral Analysis	
CHM 357	Organic Reaction Mechanisms	
CHM 358	Advanced Organic Chemistry	
CHM 362	Molocular Biophysics	
CHM 365	Protoin Sonaration & Biophysical	
	Analysis	
CHM 372	Elements of Biochemistry II	
CHM 373	Lipids and Membranes	
CHM 376	Advanced Research Chemistry Laboratory	
CHM 377	Biochemistry Laboratory	
CHM 388	Polymer Characterization	
CHM 391	Colloid and Surface Chemistry	
CHE 392	Introduction to Polymer Science	
CHM 393	Physical Polymer Science	
CHM 394	Organic Polymer Science I	
PHY 363	Physics of Solids	
Total Credits	,	73-75
		1010
B.S. Chemistry- Analytic	al/Physical Concentration	
Common Core		
Select one of the following	ng:	8
CHM 040 & CHM 041	And Honors General Chemistry I and Honors General Chemistry II	
CHM 030	Introduction to Chemical Principles	
CHM 030 & CHM 031	Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems	
CHM 030 & CHM 031 CHM 110 & CHM 111	Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems Organic Chemistry I and Organic Chemistry Laboratory I	4
CHM 030 & CHM 031 CHM 110 & CHM 111 CHM 112	Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems Organic Chemistry I and Organic Chemistry Laboratory I Organic Chemistry II	4
CHM 030 & CHM 031 CHM 110 & CHM 111 CHM 112 & CHM 113	Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems Organic Chemistry I and Organic Chemistry Laboratory I Organic Chemistry II and Organic Chemistry II	4
CHM 030 & CHM 031 CHM 110 & CHM 111 CHM 112 & CHM 113 CHM 332	Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems Organic Chemistry I and Organic Chemistry Laboratory I Organic Chemistry II and Organic Chemistry Laboratory II Analytical Chemistry	4
CHM 030 & CHM 031 CHM 110 & CHM 111 CHM 112 & CHM 113 CHM 332 CHM 307	Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems Organic Chemistry I and Organic Chemistry Laboratory I Organic Chemistry II and Organic Chemistry Laboratory II Analytical Chemistry Advanced Inorganic Chemistry	4 4 3 3
CHM 030 & CHM 031 CHM 110 & CHM 111 CHM 112 & CHM 113 CHM 332 CHM 307 CHM 351	Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems Organic Chemistry I and Organic Chemistry Laboratory I Organic Chemistry II and Organic Chemistry Laboratory II Analytical Chemistry Advanced Inorganic Chemistry Professional Development Seminar	4 4 3 3 2
CHM 030 & CHM 031 CHM 110 & CHM 111 CHM 112 & CHM 113 CHM 332 CHM 307 CHM 351 Collateral Requirement	Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems Organic Chemistry I and Organic Chemistry Laboratory I Organic Chemistry II and Organic Chemistry Laboratory II Analytical Chemistry Advanced Inorganic Chemistry Professional Development Seminar t- Path A	4 4 3 3 2
CHM 030 & CHM 031 CHM 110 & CHM 111 CHM 112 & CHM 113 CHM 332 CHM 307 CHM 351 Collateral Requiremen MATH 021	Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems Organic Chemistry I and Organic Chemistry Laboratory I Organic Chemistry II and Organic Chemistry Laboratory II Analytical Chemistry Advanced Inorganic Chemistry Professional Development Seminar t- Path A Calculus I	4 4 3 3 2 4
CHM 030 & CHM 031 CHM 110 & CHM 111 CHM 112 & CHM 113 CHM 332 CHM 307 CHM 351 Collateral Requiremen MATH 021 MATH 022	Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems Organic Chemistry I and Organic Chemistry Laboratory I Organic Chemistry II and Organic Chemistry Laboratory II Analytical Chemistry Advanced Inorganic Chemistry Professional Development Seminar t- Path A Calculus I Calculus II	4 4 3 3 2 4
CHM 030 & CHM 031 CHM 110 & CHM 111 CHM 112 & CHM 113 CHM 332 CHM 307 CHM 351 Collateral Requiremen MATH 021 MATH 022 MATH 023	Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems Organic Chemistry I and Organic Chemistry Laboratory I Organic Chemistry Laboratory II Analytical Chemistry Advanced Inorganic Chemistry Professional Development Seminar t- Path A Calculus I Calculus II Calculus III	4 3 3 2 4 4
CHM 030 & CHM 031 CHM 110 & CHM 111 CHM 112 & CHM 113 CHM 332 CHM 307 CHM 351 Collateral Requiremen MATH 021 MATH 022 MATH 023 MATH 205	Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems Organic Chemistry I and Organic Chemistry Laboratory I Organic Chemistry Laboratory II Analytical Chemistry Laboratory II Analytical Chemistry Advanced Inorganic Chemistry Professional Development Seminar t- Path A Calculus I Calculus II Calculus III Linear Methods	4 3 3 2 4 4 4 4 3
CHM 030 & CHM 031 CHM 110 & CHM 111 CHM 112 & CHM 113 CHM 332 CHM 307 CHM 351 Collateral Requiremen MATH 021 MATH 022 MATH 023 MATH 205 PHY 011	Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems Organic Chemistry I and Organic Chemistry Laboratory I Organic Chemistry Laboratory II Analytical Chemistry Laboratory II Analytical Chemistry Advanced Inorganic Chemistry Professional Development Seminar t- Path A Calculus I Calculus II Calculus III Linear Methods Introductory Physics I	4 3 3 2 4 4 4 3 5
CHM 030 & CHM 031 CHM 110 & CHM 111 CHM 112 & CHM 113 CHM 332 CHM 307 CHM 351 Collateral Requiremen MATH 021 MATH 022 MATH 023 MATH 205 PHY 011 & PHY 012	Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems Organic Chemistry I and Organic Chemistry Laboratory I Organic Chemistry Laboratory II Analytical Chemistry Laboratory II Analytical Chemistry Advanced Inorganic Chemistry Professional Development Seminar t- Path A Calculus I Calculus II Calculus III Linear Methods Introductory Physics I and Introductory Physics Laboratory I	4 3 3 2 4 4 4 3 5
CHM 030 & CHM 031 CHM 110 & CHM 111 CHM 112 & CHM 113 CHM 332 CHM 307 CHM 351 Collateral Requiremen MATH 021 MATH 022 MATH 023 MATH 205 PHY 011 & PHY 012 PHY 021	Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems Organic Chemistry I and Organic Chemistry Laboratory I Organic Chemistry Laboratory II Analytical Chemistry Advanced Inorganic Chemistry Professional Development Seminar t- Path A Calculus I Calculus II Calculus III Linear Methods Introductory Physics I and Introductory Physics II	4 3 3 2 4 4 4 3 5 5
CHM 030 & CHM 031 CHM 110 & CHM 111 CHM 112 & CHM 113 CHM 332 CHM 307 CHM 351 Collateral Requiremen MATH 021 MATH 022 MATH 023 MATH 205 PHY 011 & PHY 012 PHY 021 & PHY 022	Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems Organic Chemistry I and Organic Chemistry Laboratory I Organic Chemistry Laboratory II Analytical Chemistry Advanced Inorganic Chemistry Professional Development Seminar t- Path A Calculus I Calculus II Calculus III Linear Methods Introductory Physics I and Introductory Physics II and Introductory Physics II and Introductory Physics II and Introductory Physics II and Introductory Physics II	4 3 3 2 4 4 4 3 5 5
CHM 030 & CHM 031 CHM 110 & CHM 111 CHM 112 & CHM 113 CHM 332 CHM 307 CHM 351 Collateral Requiremen MATH 021 MATH 022 MATH 023 MATH 023 MATH 205 PHY 011 & PHY 012 PHY 021 & PHY 022 Select one of the followin	Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems Organic Chemistry I and Organic Chemistry Laboratory I Organic Chemistry Laboratory II Analytical Chemistry Advanced Inorganic Chemistry Professional Development Seminar t- Path A Calculus I Calculus II Calculus III Linear Methods Introductory Physics I and Introductory Physics Laboratory I Introductory Physics II and Introductory Physics II	4 3 3 2 4 4 4 3 5 5 5 2-4
CHM 030 & CHM 031 CHM 110 & CHM 111 CHM 112 & CHM 113 CHM 332 CHM 307 CHM 351 Collateral Requirement MATH 021 MATH 022 MATH 023 MATH 205 PHY 011 & PHY 012 PHY 021 & PHY 022 Select one of the followin ENGR 010	Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems Organic Chemistry I and Organic Chemistry Laboratory I Organic Chemistry Laboratory II Analytical Chemistry Laboratory II Analytical Chemistry Advanced Inorganic Chemistry Professional Development Seminar t- Path A Calculus I Calculus II Calculus III Linear Methods Introductory Physics I and Introductory Physics Laboratory I Introductory Physics I and Introductory Physics Laboratory I Introductory Physics Laboratory II org: Applied Engineering Computer Methods	4 3 3 2 4 4 4 3 5 5 5 2-4
CHM 030 & CHM 031 CHM 110 & CHM 111 CHM 112 & CHM 113 CHM 332 CHM 332 CHM 351 Collateral Requiremen MATH 021 MATH 021 MATH 022 MATH 023 MATH 205 PHY 011 & PHY 012 PHY 021 & PHY 022 Select one of the followin ENGR 010 CSE 003	Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems Organic Chemistry I and Organic Chemistry Laboratory I Organic Chemistry Laboratory II Analytical Chemistry Laboratory II Analytical Chemistry Advanced Inorganic Chemistry Professional Development Seminar t- Path A Calculus I Calculus II Calculus III Linear Methods Introductory Physics I and Introductory Physics Laboratory I Introductory Physics II and Introductory Physics Laboratory II Introductory Physics Laboratory II ng: Applied Engineering Computer Methods Introduction to Programming, Part A	4 3 3 2 4 4 4 3 5 5 5 2-4
CHM 030 & CHM 031 CHM 110 & CHM 111 CHM 112 & CHM 113 CHM 332 CHM 332 CHM 351 Collateral Requiremen MATH 021 MATH 021 MATH 022 MATH 023 MATH 205 PHY 011 & PHY 012 PHY 021 & PHY 022 Select one of the followin ENGR 010 CSE 003 CSE 007	Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems Organic Chemistry I and Organic Chemistry Laboratory I Organic Chemistry Laboratory II Analytical Chemistry Laboratory II Analytical Chemistry Advanced Inorganic Chemistry Professional Development Seminar t- Path A Calculus I Calculus II Calculus II Calculus III Linear Methods Introductory Physics I and Introductory Physics Laboratory I Introductory Physics Laboratory I Introductory Physics Laboratory II ng: Applied Engineering Computer Methods Introduction to Programming, Part A Introduction to Programming	4 3 3 2 4 4 4 3 5 5 5 2-4
CHM 030 & CHM 031 CHM 110 & CHM 111 CHM 112 & CHM 113 CHM 332 CHM 332 CHM 351 Collateral Requiremen MATH 021 MATH 022 MATH 022 MATH 023 MATH 205 PHY 011 & PHY 012 PHY 021 & PHY 022 Select one of the followii ENGR 010 CSE 003 CSE 007 Specialization Courses	Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems Organic Chemistry I and Organic Chemistry Laboratory I Organic Chemistry Laboratory II Analytical Chemistry Laboratory II Analytical Chemistry Advanced Inorganic Chemistry Professional Development Seminar t- Path A Calculus I Calculus II Calculus II Calculus III Linear Methods Introductory Physics I and Introductory Physics Laboratory I Introductory Physics I and Introductory Physics Laboratory II org: Applied Engineering Computer Methods Introduction to Programming, Part A Introduction to Programming	4 3 3 2 4 4 4 4 3 5 5 2-4
CHM 030 & CHM 031 CHM 110 & CHM 111 CHM 112 & CHM 113 CHM 332 CHM 307 CHM 351 Collateral Requirement MATH 021 MATH 022 MATH 022 MATH 023 MATH 205 PHY 011 & PHY 012 PHY 012 PHY 021 & PHY 022 Select one of the followin ENGR 010 CSE 003 CSE 007 Specialization Courses CHM 334	Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems Organic Chemistry I and Organic Chemistry Laboratory I Organic Chemistry Laboratory II Analytical Chemistry Laboratory II Analytical Chemistry Advanced Inorganic Chemistry Professional Development Seminar t- Path A Calculus I Calculus II Calculus II Calculus III Linear Methods Introductory Physics I and Introductory Physics Laboratory I Introductory Physics Laboratory II ng: Applied Engineering Computer Methods Introduction to Programming, Part A Introduction to Programming	4 3 3 2 4 4 4 4 3 5 5 2-4
CHM 030 & CHM 031 CHM 110 & CHM 111 CHM 112 & CHM 113 CHM 332 CHM 307 CHM 351 Collateral Requiremen MATH 021 MATH 022 MATH 023 MATH 023 MATH 205 PHY 011 & PHY 012 PHY 011 & PHY 012 PHY 021 & PHY 022 Select one of the followin ENGR 010 CSE 003 CSE 007 Specialization Courses CHM 334 CHM 335	Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems Organic Chemistry I and Organic Chemistry Laboratory I Organic Chemistry Laboratory II Analytical Chemistry Laboratory II Analytical Chemistry Advanced Inorganic Chemistry Professional Development Seminar t- Path A Calculus I Calculus II Calculus III Linear Methods Introductory Physics I and Introductory Physics Laboratory I Introductory Physics II and Introductory Physics Laboratory I Introductory Physics II and Introductory Physics Laboratory II Introductor to Programming, Part A Introduction to Programming Advanced Chemistry Laboratory I Advanced Chemistry Laboratory II	4 3 3 2 4 4 4 4 3 5 5 2-4 3 3 3

CHM 342	Thermodynamics & Kinetics	
CHM 343	Physical Chemistry Laboratory	
Total Credits		
B.S. Chemistry- Polyme	rs Concentration	
Common Core		
Select one of the followi	ng:	8
CHM 040 & CHM 041	Honors General Chemistry I and Honors General Chemistry II	
CHM 030 & CHM 031	Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems	
CHM 110 & CHM 111	Organic Chemistry I and Organic Chemistry Laboratory I	4
CHM 112 & CHM 113	Organic Chemistry II and Organic Chemistry Laboratory II	4
CHM 332	Analytical Chemistry	3
CHM 307	Advanced Inorganic Chemistry	3
CHM 351	Professional Development Seminar	2
Collateral Requiremen	t- Path A	
MATH 021	Calculus I	4
MATH 022	Calculus II	4
MATH 023	Calculus III	4
MATH 205	Linear Methods	3
PHY 011 & PHY 012	Introductory Physics I and Introductory Physics Laboratory I	5
PHY 021	Introductory Physics II	5
& PHY UZZ	and Introductory Physics Laboratory II	0.4
Select one of the followi	ng:	2-4
ENGR 010	Applied Engineering Computer Methods	
CSE 003	Introduction to Programming, Part A	
CSE 007	Introduction to Programming	
Specialization Courses	S	-
CHM 341	Molecular Structure, Bonding and Dynamics	3
CHM 342	Thermodynamics & Kinetics	3
CHM 343	Physical Chemistry Laboratory	2
CHM 388	Polymer Characterization	3
CHM 393	Physical Polymer Science	3
CHM 394	Organic Polymer Science I	3
Total Credits		68-70
B.S. Chemistry- Material	Is Concentration	
Common Core		
Select one of the followi	ng:	8
CHM 040 & CHM 041	Honors General Chemistry I and Honors General Chemistry II	
CHM 030 & CHM 031	Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems	
CHM 110 & CHM 111	Organic Chemistry I and Organic Chemistry Laboratory I	4
CHM 112 & CHM 113	Organic Chemistry II and Organic Chemistry Laboratory II	4
CHM 332	Analytical Chemistry	3
CHM 307	Advanced Inorganic Chemistry	3
CHM 351	Professional Development Seminar	2
Collateral Requiremen	t- Path A	
MATH 021	Calculus I	4
MATH 022	Calculus II	4
MATH 023	Calculus III	4
MATH 205	Linear Methods	3
PHY 011	Introductory Physics I	5
a fituiz	and introductory Physics Laboratory I	

PHY 021	Introductory Physics II	5
& PHY 022	and Introductory Physics Laboratory II	
Select one of the followi	ng:	2-4
ENGR 010	Applied Engineering Computer Methods	
CSE 003	Introduction to Programming, Part A	
CSE 007	Introduction to Programming	
Specialization Courses	5	
CHM 334	Advanced Chemistry Laboratory I	3
CHM 335	Advanced Chemistry Laboratory II	3
CHM 341	Molecular Structure, Bonding and Dynamics	3
CHM 342	Thermodynamics & Kinetics	3
CHM 343	Physical Chemistry Laboratory	2
MAT 033	Engineering Materials and Processes	3
Total Credits		68-70
B. A. Chemistry		
Common Core		
Select one of the followi	ng:	8
CHM 040	Honors General Chemistry I	
& CHM 041	and Honors General Chemistry II	
CHM 030	Introduction to Chemical Principles	
& CHM 031	and Chemical Equilibria in Aqueous	
01104440	Systems	4
	organic Chemistry Laboratory	4
	Organic Chemistry Laboratory I	1
& CHM 113	and Organic Chemistry Laboratory II	4
CHM 332	Analytical Chemistry	З
CHM 307	Advanced Inerganic Chemistry	3
CHM 351	Professional Development Seminar	2
Collatoral Boguiromon		2
Collact Dath A ar Dath D	t .	10.00
		19-29
	Onlawlurg I	
MATH 021		
MATH 022		
MATH 023		
MATH 205	Linear Methods	
PHY 011 & PHY 012	Introductory Physics I and Introductory Physics I aboratory I	
PHY 021	Introductory Physics II	
& PHY 022	and Introductory Physics Laboratory II	
Select one of the followi	na:	2-4
ENGR 010	Applied Engineering Computer Methods	
CSE 003	Introduction to Programming, Part A	
CSE 007	Introduction to Programming	
Path B	indeddeller te'r regranning	
MATH 051	Survey of Calculus L ¹	
MATH 052	Survey of Calculus II ²	
	Survey of Linear Algebra ³	
	Conoral Physics I	
& PHY 012	and Introductory Physics Laboratory I	
PHY 013	General Physics II	
& PHY 022	and Introductory Physics Laboratory	
Specialization Courses	3	
CHM 343	Physical Chemistry Laboratory	2
Select one of the followi	ng:	3
CHM 341	Molecular Structure, Bonding and Dynamics	

CHM 342	Thermodynamics & Kinetics	
CHM 194 Physical Chemistry for Biological		
	Sciences	
Advanced CHM electiv	e (300 Level)	3
Select one of the following	ng:	
CHM 305	Chamical Biology	
	Chemical Biology	
	Advanced Chemistry Laboratory I	
	Clinical Chemistry Laboratory II	
CHM 337	Crystallography and Diffraction	
CHM 340	Solid-State Chemistry	
CHM 350	Special Tonics	
CHM 356	Spectral Analysis	
CHM 357	Organic Reaction Mechanisms	
CHM 358	Advanced Organic Chemistry	
CHM 362	Molecular Biophysics	
CHM 365	Protein Separation & Biophysical	
	Analysis	
CHM 371	Elements of Biochemistry I	
CHM 372	Elements of Biochemistry II	
CHM 373	Lipids and Membranes	
CHM 375	Research Chemistry Laboratory	
CHM 376	Advanced Research Chemistry	
	Laboratory	
CHM 377	Biochemistry Laboratory	
CHM 388	Polymer Characterization	
CHM 391	Colloid and Surface Chemistry	
CHE 392	Introduction to Polymer Science	
CHM 393	Physical Polymer Science	
CHM 394	Organic Polymer Science I	
	8 ,	
Total Credits		53-65
Total Credits		53-65
Total Credits 1 MATH 021 may substitut	te for MATH 051	53-65
Total Credits 1 MATH 021 may substitut 2	te for MATH 051	53-65
Total Credits 1 MATH 021 may substitut 2 MATH 022 may substitut	te for MATH 051	53-65
Total Credits 1 MATH 021 may substitut 2 MATH 022 may substitut 3	te for MATH 051 te for MATH 052	53-65
Total Credits 1 MATH 021 may substitut 2 MATH 022 may substitut 3 MATH 205 may substitut	te for MATH 051 te for MATH 052	53-65
Total Credits 1 MATH 021 may substitut 2 MATH 022 may substitut 3 MATH 205 may substitut 4	te for MATH 051 te for MATH 052 te for MATH 043	53-65
Total Credits 1 MATH 021 may substitut 2 MATH 022 may substitut 3 MATH 205 may substitut 4 PHX 011 may substitute	te for MATH 051 te for MATH 052 te for MATH 043	53-65
Total Credits 1 MATH 021 may substitut 2 MATH 022 may substitut 3 MATH 205 may substitut 4 PHY 011 may substitute	te for MATH 051 te for MATH 052 te for MATH 043 for PHY 010	53-65
Total Credits 1 MATH 021 may substitut 2 MATH 022 may substitut 3 MATH 205 may substitut 4 PHY 011 may substitute 5	te for MATH 051 te for MATH 052 te for MATH 043 for PHY 010	53-65
Total Credits 1 MATH 021 may substitut 2 MATH 022 may substitut 3 MATH 205 may substitut 4 PHY 011 may substitute 5 PHY 021 may substitute	te for MATH 051 te for MATH 052 te for MATH 043 for PHY 010 for PHY 013	53-65
Total Credits 1 MATH 021 may substitut 2 MATH 022 may substitut 3 MATH 205 may substitut 4 PHY 011 may substitute 5 PHY 021 may substitute B.A. Chemistry - Busine	te for MATH 051 te for MATH 052 te for MATH 043 for PHY 010 for PHY 013 ss Concentration	53-65
Total Credits 1 MATH 021 may substitut 2 MATH 022 may substitut 3 MATH 205 may substitut 4 PHY 011 may substitute 5 PHY 021 may substitute B.A. Chemistry - Busine Common Core	te for MATH 051 te for MATH 052 te for MATH 043 for PHY 010 for PHY 013 ss Concentration	53-65
Total Credits 1 MATH 021 may substitut 2 MATH 022 may substitut 3 MATH 205 may substitut 4 PHY 011 may substitute 5 PHY 021 may substitute B.A. Chemistry - Busine Common Core Select one of the followi	te for MATH 051 te for MATH 052 te for MATH 043 for PHY 010 for PHY 013 ss Concentration ng:	53-65
Total Credits 1 MATH 021 may substitut 2 MATH 022 may substitut 3 MATH 205 may substitut 4 PHY 011 may substitute 5 PHY 021 may substitute B.A. Chemistry - Busine Common Core Select one of the followi CHM 040	te for MATH 051 te for MATH 052 te for MATH 043 for PHY 010 for PHY 013 ss Concentration ng: Honors General Chemistry I	53-65
Total Credits 1 MATH 021 may substitut 2 MATH 022 may substitut 3 MATH 205 may substitut 4 PHY 011 may substitute 5 PHY 021 may substitute B.A. Chemistry - Busine Common Core Select one of the followi CHM 040 & CHM 041	te for MATH 051 te for MATH 052 te for MATH 043 for PHY 010 for PHY 013 ss Concentration ng: Honors General Chemistry I and Honors General Chemistry II	53-65
Total Credits 1 MATH 021 may substitut 2 MATH 022 may substitut 3 MATH 205 may substitut 4 PHY 011 may substitute 5 PHY 021 may substitute B.A. Chemistry - Busine Common Core Select one of the followi CHM 040 & CHM 041 CHM 030 0 00000000000000000000000000000000	te for MATH 051 te for MATH 052 te for MATH 043 for PHY 010 for PHY 013 ss Concentration ng: Honors General Chemistry I and Honors General Chemistry II Introduction to Chemical Principles	53-65
Total Credits 1 MATH 021 may substitut 2 MATH 022 may substitut 3 MATH 205 may substitut 4 PHY 011 may substitute 5 PHY 021 may substitute B.A. Chemistry - Busine Common Core Select one of the followi CHM 040 & CHM 041 CHM 030 & CHM 031	te for MATH 051 te for MATH 052 te for MATH 043 for PHY 010 for PHY 013 ss Concentration ng: Honors General Chemistry I and Honors General Chemistry II Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems	53-65
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Total Credits 1 MATH 021 may substitut 2 MATH 022 may substitut 3 MATH 205 may substitut 4 PHY 011 may substitute 5 PHY 021 may substitute 5 PHY 021 may substitute B.A. Chemistry - Busine Common Core Select one of the followi CHM 040 & CHM 041 CHM 030 & CHM 031 CHM 110 & CHM 111 CHM 112	te for MATH 051 te for MATH 052 te for MATH 043 for PHY 010 for PHY 013 ss Concentration ng: Honors General Chemistry I and Honors General Chemistry II Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems Organic Chemistry I and Organic Chemistry II	53-65 8 4
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Total Credits 1 MATH 021 may substitut 2 MATH 022 may substitut 3 MATH 205 may substitut 4 PHY 011 may substitute 5 PHY 021 may substitute 5 PHY 021 may substitute B.A. Chemistry - Busine Common Core Select one of the followi CHM 040 & CHM 041 CHM 030 & CHM 031 CHM 110 & CHM 111 CHM 112 & CHM 113 CHM 332	te for MATH 051 te for MATH 052 te for MATH 052 te for MATH 043 for PHY 010 for PHY 013 ss Concentration ng: Honors General Chemistry I and Honors General Chemistry II Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems Organic Chemistry I and Organic Chemistry Laboratory I Organic Chemistry II and Organic Chemistry Laboratory II Organic Chemistry II and Organic Chemistry Laboratory II Analytical Chemistry	53-65
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MATH 021	Calculus I	
MATH 022	Calculus II	
MATH 023	Calculus III	
MATH 205	Linear Methods	
PHY 011	Introductory Physics I	
& PHY 012	and Introductory Physics Laboratory I	
PHY 021	Introductory Physics II	
& PHY 022	and Introductory Physics Laboratory II	
Select one of the followi	ng:	2-4
ENGR 010	Applied Engineering Computer	
	Methods	
CSE 003	Introduction to Programming, Part A	
CSE 007	Introduction to Programming	
Path B	1	
MATH 051	Survey of Calculus I	
MATH 052	Survey of Calculus II 2	
MATH 043	Survey of Linear Algebra ³	
PHY 010	General Physics I	
& PHY 011	and Introductory Physics I	
PHY 013 & PHY 022	General Physics II and Introductory Physics Laboratory II ⁵	
Specialization Courses	6	
CHM 343	Physical Chemistry Laboratory	2
Select one of the followi	ng:	3
CHM 194	Physical Chemistry for Biological	
	Sciences	
CHM 341	Molecular Structure, Bonding and	
	Dynamics	
CHM 342	Thermodynamics & Kinetics	
Advanced CHM electiv	e (300 Level)	3
Select one of the followi	ng:	
CHM 305	Organometallic Chemistry	
CHM 323	Chemical Biology	
CHM 334	Advanced Chemistry Laboratory I	
CHM 335	Advanced Chemistry Laboratory II	
CHM 336	Clinical Chemistry	
CHM 337	Crystallography and Diffraction	
CHM 340	Solid-State Chemistry	
CHM 350	Special Topics	
CHM 356	Spectral Analysis	
CHM 357	Organic Reaction Mechanisms	
CHM 358	Advanced Organic Chemistry	
CHM 362	Molecular Biophysics	
CHM 365	Protein Separation & Biophysical	
	Analysis	
CHM 371	Elements of Biochemistry I	
CHM 372	Elements of Biochemistry II	
CHM 373	Lipids and Membranes	
CHM 375	Research Chemistry Laboratory	
CHM 376	Advanced Research Chemistry Laboratory	
CHM 377	Biochemistry Laboratory	
CHM 388		
CUM 201	Polymer Characterization	
	Polymer Characterization Colloid and Surface Chemistry	
CHE 392	Polymer Characterization Colloid and Surface Chemistry Introduction to Polymer Science	
CHE 392 CHM 393	Polymer Characterization Colloid and Surface Chemistry Introduction to Polymer Science Physical Polymer Science	
CHM 391 CHE 392 CHM 393 CHM 394	Polymer Characterization Colloid and Surface Chemistry Introduction to Polymer Science Physical Polymer Science Organic Polymer Science I	
CHM 391 CHE 392 CHM 393 CHM 394 ECO 001	Polymer Characterization Colloid and Surface Chemistry Introduction to Polymer Science Physical Polymer Science Organic Polymer Science I Principles of Economics	4
CHM 391 CHE 392 CHM 393 CHM 394 ECO 001 BUS 125	Polymer Characterization Colloid and Surface Chemistry Introduction to Polymer Science Physical Polymer Science Organic Polymer Science I Principles of Economics Behavioral Skills Workshop	4
CHM 391 CHE 392 CHM 393 CHM 394 ECO 001 BUS 125 BUS 126	Polymer Characterization Colloid and Surface Chemistry Introduction to Polymer Science Physical Polymer Science Organic Polymer Science I Principles of Economics Behavioral Skills Workshop Project Management Essentials	4
CHM 391 CHE 392 CHM 393 CHM 394 ECO 001 BUS 125 BUS 126 BUS 127	Polymer Characterization Colloid and Surface Chemistry Introduction to Polymer Science Physical Polymer Science Organic Polymer Science I Principles of Economics Behavioral Skills Workshop Project Management Essentials Product Innovation and Marketing	4 1 3

BUS 225	Understanding Business Accounting	3	CHM 194	Physical Chemistry for Biological	
BUS 226	Understanding Business Finance	3		Sciences	
BUS 326	Business Strategy	1	CHM 341	Molecular Structure, Bonding and Dynamics	
	Basic Statistics	75.05	CHM 342	Thermodynamics & Kinetics	
Total Credits		75-85	Advanced CHM el	ective (300 Level)	3
1			Select one of the fo	llowing:	
MATH 021 may substi	tute for MATH 051		CHM 305	Organometallic Chemistry	
2			CHM 323	Chemical Biology	
MATH 022 may substi	tute for MATH 052		CHM 336	Clinical Chemistry	
3			CHM 337	Crystallography and Diffraction	
	tuto for MATH 042		CHM 340	Solid-State Chemistry	
			CHM 350	Special Topics	
			CHM 358	Advanced Organic Chemistry	
PHY 011 may substitu	te for PHY 010		CHM 371	Elements of Biochemistry I	
5			CHM 372	Elements of Biochemistry II	
PHY 021 may substitu	te for PHY 013		CHM 375	Research Chemistry Laboratory	
6			CHM 376	Advanced Research Chemistry	
MATH 012 may be sub	ostituted by any statistics course			Laboratory	
P.A. Chamiotry, Haalt	h Drefessions Concentration		CHM 377	Biochemistry Laboratory	
B.A. Chemistry - Healt	n Professions Concentration		CHM 388	Polymer Characterization	
Common Core		0	CHM 391	Colloid and Surface Chemistry	
	wing:	8	CHE 392	Introduction to Polymer Science	
	Honors General Chemistry I		CHM 393	Physical Polymer Science	
	Introduction to Chemical Principles		CHM 394	Organic Polymer Science I	
& CHM 031	and Chemical Equilibria in Aqueous		BIOS 041	Introduction to Cellular and Molecular	4
	Systems		& BIOS 042	Biology	
CHM 110 & CHM 111	Organic Chemistry I	4		and Introduction to Cellular and Molecular Biology Laboratory	
CHM 112	Organic Chemistry II	4	BIOS 115	Genetics	4
& CHM 113	and Organic Chemistry Laboratory II	-	& BIOS 116	and Genetics Laboratory	
CHM 332	Analytical Chemistry	3	MATH 012	Basic Statistics ⁶	4
CHM 307	Advanced Inorganic Chemistry	3	Additional courses	in BioS are recommended.	
CHM 351	Professional Development Seminar	2	Total Credits		65-75
Collateral Requireme	ent		1		
Collateral Requirement Select Path A or Path	ent B	19-27	1 MATH 021 may sub	stitute for MATH 051	
Collateral Requireme Select Path A or Path Path A	ent B	19-27	1 MATH 021 may sub 2	ostitute for MATH 051	
Collateral Requirement Select Path A or Path Path A MATH 021	ent B Calculus I	19-27	1 MATH 021 may sub 2	estitute for MATH 051	
Collateral Requireme Select Path A or Path Path A MATH 021 MATH 022	ent B Calculus I Calculus II	19-27	1 MATH 021 may sub 2 MATH 022 may sub	ostitute for MATH 051	
Collateral Requireme Select Path A or Path Path A MATH 021 MATH 022 MATH 023	ent B Calculus I Calculus II Calculus III	19-27	1 MATH 021 may sub 2 MATH 022 may sub 3	ostitute for MATH 051	
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Collateral Requireme Select Path A or Path Path A MATH 021 MATH 022 MATH 023 MATH 205 PHY 011 & PHY 012 PHY 021 & PHY 022 Select one of the follow ENGR 010 CSE 003 CSE 007 Path B MATH 051 MATH 051 MATH 052 MATH 043 PHY 010 & PHY 012 PHY 013 & PHY 022	ent B Calculus I Calculus II Calculus III Linear Methods Introductory Physics I and Introductory Physics Laboratory I Introductory Physics II and Introductory Physics Laboratory II wing: Applied Engineering Computer Methods Introduction to Programming, Part A Introduction to Programming Survey of Calculus I Survey of Calculus II Survey of Linear Algebra ³ General Physics I and Introductory Physics Laboratory I 4	19-27	1 MATH 021 may sub 2 MATH 022 may sub 3 MATH 205 may sub 4 PHY 011 may subst 5 PHY 021 may subst 6 MATH 012 may be 8 B.S. Pharmaceutica Common Core Select one of the for CHM 040 & CHM 041 CHM 030 & CHM 031 CHM 110 & CHM 111 CHM 112	estitute for MATH 051 estitute for MATH 052 estitute for MATH 043 estitute for PHY 010 estitute for PHY 013 esubstituted by any statistics course I Chemistry Ilowing: Honors General Chemistry I and Honors General Chemistry I Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems Organic Chemistry I organic Chemistry II	8
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6 Chemistry

CHM 394

Organic Polymer Science I

Collateral Requirem	nent		BIOS 041	Introduction to Cellular and Molecular	4
Select Path A or Path	ו B	19-27	& BIOS 042	Biology	
Path A				and Introduction to Cellular and	
MATH 021	Calculus I			Molecular Biology Laboratory	0
MATH 022	Calculus II		BIOS 115	Genetics	3
MATH 023	Calculus III		MATH 012	Basic Statistics	3-4
MATH 205	Linear Methods		Total Credits		72-83
PHY 011 & PHY 012	Introductory Physics I and Introductory Physics Laboratory I		1 MATH 021 may subs	titute for MATH 051	
PHY 021 & PHY 022	Introductory Physics II and Introductory Physics Laboratory II		2		
Select one of the follo	owing:	2-4	MATH 022 may subs	titute for MATH 051	
ENGR 010	Applied Engineering Computer Methods		3 MATH 205 may subs	titute for MATH 043	
CSE 003	Introduction to Programming, Part A		4		
CSE 007	Introduction to Programming		PHY 011 may substit	ute for PHY 010	
Path B			5		
MATH 051	Survey of Calculus I ¹		PHY 021 may substit	ute for PHY 013	
MATH 052	Survey of Calculus II ²		6		
MATH 043	Survey of Linear Algebra ³				
PHY 010	General Physics I		MATH 012 may be su	ubstituted by any statistics course	
& PHY 012	and Introductory Physics Laboratory I		MODEL ROSTER WH	EN PATH A IS FOLLOWED	
PHY 013	General Physics II		College Seminar		3-4
& PHY 022	and Introductory Physics Laboratory				4
	II ³		CHM 040		4
Specialization Cour	ses		CHM 041		4
Select one of the follo	owing:	3	ENGL 001		3
CHM 194	Physical Chemistry for Biological Sciences		ENGL 002		3
CHM 341	Molecular Structure, Bonding and Dynamics		MATH 021 MATH 022		4
CHM 342	Thermodynamics & Kinetics		PHY 011		4
Science-based writin	g intensive course in consultation with	2			1
advisor.	-				1
CHM 358	Advanced Organic Chemistry	3			30-31
CHM 371	Elements of Biochemistry I	3	Second Year	CR	
CHM 372	Elements of Biochemistry II	3	CHM 110		4
Advanced CHM Ele	ctive (300 Level)	3	& CHM 111		
Select one of the follo	owing:		CHM 112		4
CHM 305	Organometallic Chemistry		& CHM 113		
CHM 334	Advanced Chemistry Laboratory I		PHY 021		5
CHM 335	Advanced Chemistry Laboratory II		& PHY 022		
CHM 356	Spectral Analysis		MATH 023		4
CHM 357	Organic Reaction Mechanisms		MATH 043		3
CHM 362	Molecular Biophysics		ENGR 010 or CSE 0	12	2
CHM 365	Protein Separation & Biophysical Analysis		distribution requirem	ents - free	9
CHM 336	Clinical Chemistry		electives		
CHM 337	Crystallography and Diffraction				31
CHM 350	Special Topics		Total Credits: 61-62		
CHM 373	Linids and Membranes		Note that come conc	entrotions would incert sources such as	
CHM 375	Research Chemistry Laboratory			1/BIOS 042 (B.S. Pharmaceutical Chemistry	<i>i</i>)
CHM 376	Advanced Research Chemistry		ECO 001 (B.ABusin	less), etc.	y),
CI IM 370	Laboratory		junior year/senior yea	ar (30-32 credits)	
CHM 377	Biocnemistry Laboratory		Student will need to n	neet with major advisor in order to formulate	Э
CHM 388	Polymer Characterization		courses to be taken.		
CHM 391	Colloid and Surface Chemistry		MODEL ROSTER WH	EN PATH B IS FOLLOWED	
CHE 392	Introduction to Polymer Science		First Year	CR	
CHM 393	Physical Polymer Science		College Seminar		3-4

First Year	CR
College Seminar	3-4
CHM 040	4
CHM 041	4

ENGL 001		3
ENGL 002		3
MATH 051		4
MATH 052		3
PHY 010		4
PHY 012		1
		29-30
Second Year	CR	29-30
Second Year CHM 110 & CHM 111	CR	29-30 4
Second Year CHM 110 & CHM 111 CHM 112 & CHM 113	CR	29-30 4 4

distribution requirements - free electives	
MATH 043	
& PHY 022	

3 15

30

Total Credits: 59-60

Note that some concentrations would insert courses such as MATH 012, BIOS 041/BIOS 042 (B.S. Pharmaceutical Chemistry), ECO 001 (B.A.-Business), etc.

junior year/senior year (30-32 credits)

Student will need to meet with major advisor in order to formulate courses to be taken.

B.S. DEGREE IN CHEMISTRY, COLLEGE OF ENGINEERING & APPLIED SCIENCE

Total Credits	123
Unrestricted electives	25
Chemistry	46
Physics, math, and computing	28
College distribution	24
Summary of Requirements	

Total Credits

Common Core

0
4
4
3
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2-4

Specialization CoursesCHM 334Advanced Chemistry Laboratory II33CHM 341Molecular Structure, Bonding and Dynamics33CHM 342Thermodynamics & Kinetics33CHM 343Physical Chemistry Laboratory22CHM 343Physical Chemistry Laboratory22CHM 375Research Chemistry Laboratory23CHM 305Organometallic Chemistry33CHM 317Elements of Biochemistry33CHM 323Chemical Biology34CHM 323Chemical Biology34CHM 336Clinical Chemistry34CHM 340Solid-State Chemistry34CHM 350Special Topics34CHM 351Organic Reaction Mechanisms35CHM 352Organic Reaction Mechanisms35CHM 354Advanced Organic Chemistry35CHM 355Protein Separation & Biophysical Analysis36CHM 372Elements of Biochemistry II37CHM 373Lipids and Membranes36CHM 374Biochemistry Laboratory37CHM 375Descentery36CHM 388Polymer Characterization37CHM 391Colloi and Surface Chemistry36CHM 393Physical Polymer Science3CHM 394Organic Polymer Science3CHM 394Organic Polymer Science3CHM 394Organic Polymer Science3Math 0214A MATH 0224Phy 363Physics of Sol	CSE 007	Introductio	n to Programming	
CHM 334 Advanced Chemistry Laboratory I CHM 335 Advanced Chemistry Laboratory II CHM 341 Molecular Structure, Bonding and Dynamics CHM 342 Thermodynamics & Kinetics CHM 343 Physical Chemistry Laboratory CHM 343 Physical Chemistry Laboratory Advanced Chemistry Elective Requirement Select one of the following: CHM 305 Organometallic Chemistry CHM 326 Clinical Chemistry CHM 336 Clinical Chemistry CHM 337 Crystallography and Diffraction CHM 340 Solid-State Chemistry CHM 356 Spectral Analysis CHM 356 Spectral Analysis CHM 357 Organic Reaction Mechanisms CHM 358 Advanced Organic Chemistry CHM 356 Spectral Analysis CHM 357 Organic Reaction Mechanisms CHM 358 Advanced Organic Chemistry CHM 358 Advanced Organic Chemistry CHM 372 Elements of Biochemistry II CHM 372 Elements of Biochemistry CHM 373 Lipids and Membranes CHM 376 Advanced Research Chemistry CHM 377 Biochemistry Laboratory CHM 378 Eloyiner Science CHM 379 Colloid and Surface Chemistry CHM 378 Lipids and Surface Chemistry CHM 379 Colloid and Surface Chemistry CHM 379 Colloid and Surface Chemistry CHM 391 Colloid and Surface Chemistry CHM 393 Physical Polymer Science CHM 394 Organic Polymer Science I PHY 363 Physics of Solids Total Credits 73-75 Model Roster First Year First Semester Credits Second Semester Credits ENGL 001 3 ENGL 002 3 MATH 021 4 MATH 022 4 ENGR 010 2 ENGR 005 22 Select one of the following: 4 Select one of the following: CHM 040 CHM 041 CHM 030 CHM 041 CHM 040 C	Specialization Courses	6		
CHM 335 Advanced Chemistry Laboratory II 33 CHM 341 Molecular Structure, Bonding and Dynamics CHM 342 Thermodynamics & Kinetics 33 CHM 343 Physical Chemistry Laboratory 23 Advanced Chemistry Elective Requirement Select one of the following: 3 CHM 375 Research Chemistry Laboratory 2 Advanced Chemistry Elective Requirement Select one of the following: 3 CHM 323 Chemical Biology CHM 336 Clinical Chemistry CHM 323 Chemical Biology CHM 336 Clinical Chemistry CHM 337 Crystallography and Diffraction CHM 340 Solid-State Chemistry CHM 356 Spectral Analysis CHM 356 Spectral Analysis CHM 358 Advanced Organic Chemistry II CHM 358 Advanced Research Chemistry CHM 356 Protein Separation & Biophysical Analysis CHM 372 Elements of Biochemistry II CHM 373 Lipids and Membranes CHM 376 Advanced Research Chemistry CHM 376 Advanced Research Chemistry CHM 377 Biochemistry Laboratory CHM 377 Biochemistry Laboratory CHM 391 Colloid and Surface Chemistry CHM 391 Colloid and Surface Chemistry CHM 393 Physical Polymer Science CHM 393 Physical Polymer Science I PHY 363 Physics of Solids Total Credits 73-75 Model Roster First Year First Semester Credits Second Semester Credits ENGL 001 3 ENGL 002 3 MATH 021 4 MATH 022 4 ENGR 010 2 ENGR 005 2 Select one of the following: 4 Select one of the following: CHM 031 CHM 040 CHM 041 CHM 041 CHM 041 CHM 041 A CHM 113 4 MATH 021 4 MATH 022 4 Select one of the following: 4 Select one of the following: CHM 031 CHM 041 CHM 041 CHM 041 CHM 041 A CHM 113 4 MATH 023 4 MATH 205 3 PHY 011 5 ECO 001 4 WATH 205 3 PHY 011 4 PHY 021 5 ECO 001 4 WATH 205 3 PHY 011 4 PHY 021 5 ECO 001 4 WATH 205 5 3 PHY 011 4 PHY 021 5 ECO 001 4 WATH 205 5 3 PHY 011 4 PHY 021 5 ECO 001 4 WATH 205 5 3 PHY 011 4 PHY 021 5 ECO 001 4 WATH 205 5 3 PHY 011 4 PHY 021 5 ECO 001 4 WATH 205 5 3 PHY 011 5 ECO 001 4 WATH 205 5 3 PHY 011 5 ECO 001 4 WATH 205 5 3 PHY 011 6 PHY 021 5 5 ECO 001 4 WATH 205 5 20 5 5 5 5 5 5 5 5 5 5	CHM 334	Advanced	Chemistry Laboratory I	3
CHM 341 Molecular Structure, Bonding and Dynamics 33 CHM 342 Thermodynamics & Kinetics 33 CHM 343 Physical Chemistry Laboratory 22 CHM 371 Elements of Biochemistry Laboratory 22 CHM 375 Research Chemistry Laboratory 23 CHM 375 Research Chemistry Laboratory 23 CHM 305 Organometallic Chemistry 33 CHM 323 Chemical Biology 44 CHM 336 Clinical Chemistry 44 CHM 337 Crystallography and Diffraction 64 CHM 340 Solid-State Chemistry 44 CHM 356 Spectral Analysis 44 CHM 356 Spectral Analysis 44 CHM 357 Organic Reaction Mechanisms 44 CHM 356 Spectral Analysis 44 CHM 357 Organic Reaction Mechanisms 44 CHM 358 Advanced Organic Chemistry 44 CHM 356 Protein Separation & Biophysical Analysis 44 CHM 377 Biochemistry Laboratory 44 CHM 376 Advanced Research Chemistry 44 CHM 377 Biochemistry Laboratory 44 CHM 378 Polymer Characterization 44 CHM 379 <td>CHM 335</td> <td>Advanced</td> <td>Chemistry Laboratory I</td> <td>1 3</td>	CHM 335	Advanced	Chemistry Laboratory I	1 3
CHM 342 Thermodynamics & Kinetics 3 CHM 343 Physical Chemistry Laboratory 2 CHM 371 Elements of Biochemistry Laboratory 2 Advanced Chemistry Elective Requirement 3 Select one of the following: 3 CHM 323 Chemical Biology CHM 323 Chemical Biology CHM 336 Clinical Chemistry CHM 340 Solid-State Chemistry CHM 350 Special Topics CHM 356 Special Topics CHM 357 Organic Reaction Mechanisms CHM 358 Advanced Organic Chemistry CHM 356 Spectral Analysis CHM 357 Organic Reaction Mechanisms CHM 362 Molecular Biophysics CHM 372 Elements of Biochemistry II CHM 373 Lipids and Membranes CHM 374 Advanced Research Chemistry Laboratory CHM 376 Advanced Research Chemistry CHM 377 Biochemistry Laboratory CHM 388 CHM 378 Polymer Science CHM 391 CHM 393 Colloid and Surface Chemistry CHM 393 CHM 394 Organic Polymer Science I PHY 363 PHY 363 Physical Polymer Science I PHY 363 PHY 363 Physi	CHM 341	Molecular Dynamics	Structure, Bonding and	3
CHM 343Physical Chemistry Laboratory2CHM 371Elements of Biochemistry I3CHM 375Research Chemistry Laboratory2Advanced Chemistry Elective Requirement3Select one of the following:3CHM 305Organometallic ChemistryCHM 336Clinical ChemistryCHM 337Crystallography and DiffractionCHM 340Solid-State ChemistryCHM 350Special TopicsCHM 356Spectral AnalysisCHM 357Organic Reaction MechanismsCHM 358Advanced Organic ChemistryCHM 356Protein Separation & Biophysical AnalysisCHM 372Elements of Biochemistry IICHM 376Advanced Research ChemistryCHM 377Biochemistry LaboratoryCHM 376Advanced Research ChemistryCHM 388Polymer CharacterizationCHM 391Colloid and Surface ChemistryCHM 393Physical Polymer ScienceCHM 394Organic Polymer Science ICHM 393Physics of SolidsTotal CreditsTor75Model RosterFirst SamesterFirst SamesterCreditsCHM 040CHM 041CHM 030CHM 041CHM 040CHM 041CHM 041CreditsCHM 0414CHM 0414CHM 0415CHM 0415CHM 0415CHM 0414CHM 1114CHM 0415CHM 1124ACHM 111	CHM 342	Thermody	namics & Kinetics	3
CHM 371Elements of Biochemistry Laboratory23Advanced Chemistry Elective Requirement33Select one of the following:33CHM 305Organometallic ChemistryCHM 323Chemical BiologyCHM 336Clinical ChemistryCHM 337Crystallography and DiffractionCHM 340Solid-State ChemistryCHM 356Special TopicsCHM 356Special TopicsCHM 357Organic Reaction MechanismsCHM 358Advanced Organic ChemistryCHM 358Advanced Organic ChemistryCHM 365Protein Separation & Biophysical AnalysisCHM 372Elements of Biochemistry IICHM 373Lipids and MembranesCHM 376Advanced Research ChemistryCHM 377Biochemistry LaboratoryCHM 378Polymer CharacterizationCHM 391Colloid and Surface ChemistryCHM 393Physical Polymer ScienceCHM 394Organic Polymer Science ICHM 393Physics of SolidsTotal Credits73-75Model RosterFirst Second SemesterFirst SemesterCreditsCHM 040CHM 041CHM 030CHM 041CHM 030CHM 041CHM 040CHM 041CHM 041CreditsCHM 041CreditsCHM 041CreditsCHM 0414CHM 0414CHM 0414CHM 0414CHM 0414CHM 1114& CHM 113 <td< td=""><td>CHM 343</td><td>Physical C</td><td>hemistry Laboratory</td><td>2</td></td<>	CHM 343	Physical C	hemistry Laboratory	2
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Advanced Chemistry Elective Requirement 3 Select one of the following: 3 CHM 305 Organometallic Chemistry CHM 323 Chemical Biology CHM 336 Clinical Chemistry CHM 337 Crystallography and Diffraction CHM 336 Special Topics CHM 356 Special Topics CHM 356 Special Analysis CHM 356 Special Analysis CHM 356 Special Analysis CHM 356 Protein Separation & Biophysical Analysis CHM 365 Protein Separation & Biophysical Analysis CHM 372 Elements of Biochemistry II CHM 373 Lipids and Membranes CHM 376 Advanced Research Chemistry CHM 377 Biochemistry Laboratory CHM 388 Polymer Characterization CHM 391 Colloid and Surface Chemistry CHM 393 Physical Polymer Science CHM 394 Organic Polymer Science I PHY 363 Physics of Solids Total Credits Second Semester CHM 390 CHM 040 CHM 040 CHM 041 CHM 040	CHM 375	Research	Chemistry Laboratory	2
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CHM 323Chemical BiologyCHM 336Clinical ChemistryCHM 337Crystallography and DiffractionCHM 350Special TopicsCHM 356Spectral AnalysisCHM 357Organic Reaction MechanismsCHM 358Advanced Organic ChemistryCHM 362Molecular BiophysicsCHM 365Protein Separation & Biophysical AnalysisCHM 372Elements of Biochemistry IICHM 373Lipids and MembranesCHM 376Advanced Research Chemistry LaboratoryCHM 377Biochemistry LaboratoryCHM 388Polymer CharacterizationCHM 391Colloid and Surface ChemistryCHM 393Physical Polymer ScienceCHM 394Organic Polymer ScienceCHM 393Physics of SolidsTotal Credits73-75Model RosterFirst Second SemesterFirst SemesterCreditsENGL 0013 ENGL 002Select one of the following: following:4 Select one of the following:CHM 040CHM 041CHM 030CHM 011CHM 040CHM 011CHM 0314MATTH 0234 MATH 205A CHM 1115 ECO 0014 PHY 0125Distribution Requirment/4 PHY 021 & PHY 022Electives4 PHY 021 & PHY 022	CHM 305	Organome	tallic Chemistry	
CHM 336 Clinical Chemistry CHM 337 Crystallography and Diffraction CHM 340 Solid-State Chemistry CHM 350 Special Topics CHM 356 Spectral Analysis CHM 357 Organic Reaction Mechanisms CHM 358 Advanced Organic Chemistry CHM 362 Molecular Biophysics CHM 365 Protein Separation & Biophysical Analysis CHM 372 Elements of Biochemistry II CHM 373 Lipids and Membranes CHM 376 Advanced Research Chemistry Laboratory CHM 377 Biochemistry Laboratory CHM 388 Polymer Characterization CHM 391 Colloid and Surface Chemistry CHM 393 Physical Polymer Science CHM 393 Physical Polymer Science I PHY 363 Physics of Solids Total Credits First Year First Semester Credits Second Semester Credits ENGL 001 3 ENGL 002 3 MATH 021 4 MATH 022 4 ENGR 010 2 ENGR 005 2 Select one of the following: 4 Select one of the following: CHM 040 CHM 041 CHM 030 CHM 041 CHM 030 CHM 041 CHM 030 CHM 041 CHM 040 CHM 041 CHM 030 CHM 041 CHM 040 CHM 041 CHM 030 CHM 031 13 13 Second Year First Semester Credits Second Semester Credits Second Year First Semester Credits Second Semester Credits PHY 012 4 MATH 205 3 PHY 011 5 ECO 001 4 & CHM 110 4 CHM 112 4 & CHM 111 4 KATH 205 3 PHY 012 5 Distribution Requirment/ 4 PHY 021 5 Electives 4 PHY 022	CHM 323	Chemical I	Biology	
CHM 337Crystallography and DiffractionCHM 340Solid-State ChemistryCHM 350Special TopicsCHM 356Spectral AnalysisCHM 357Organic Reaction MechanismsCHM 358Advanced Organic ChemistryCHM 362Molecular BiophysicsCHM 365Protein Separation & Biophysical AnalysisCHM 372Elements of Biochemistry IICHM 373Lipids and MembranesCHM 376Advanced Research Chemistry LaboratoryCHM 377Biochemistry LaboratoryCHM 376Advanced Research Chemistry LaboratoryCHM 377Biochemistry LaboratoryCHM 388Polymer CharacterizationCHM 391Colloid and Surface ChemistryCHE 392Introduction to Polymer ScienceCHM 393Physical Polymer ScienceCHM 394Organic Polymer Science IPHY 363Physics of SolidsTotal Credits73-75Model RosterCreditsFirst SemesterCreditsENGL 0013 ENGL 002Select one of the following: following:4 Select one of the following:CHM 040CHM 041CHM 030CHM 031TaseesterCreditsCreditsSecond SemesterCreditsSecond SemesterCreditsSecond SemesterCreditsSecond SemesterCreditsSecond SemesterCHM 1104 CHM 112A CHM 111& CHM 031MATH 0234 MATH 205PHY 0125	CHM 336	Clinical Ch	emistry	
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CHM 356Spectral AnalysisCHM 357Organic Reaction MechanismsCHM 358Advanced Organic ChemistryCHM 362Molecular BiophysicsCHM 365Protein Separation & Biophysical AnalysisCHM 372Elements of Biochemistry IICHM 373Lipids and MembranesCHM 376Advanced Research Chemistry LaboratoryCHM 377Biochemistry LaboratoryCHM 378Polymer CharacterizationCHM 391Colloid and Surface ChemistryCHE 392Introduction to Polymer ScienceCHM 393Physical Polymer ScienceCHM 394Organic Polymer ScienceCHM 393Physics of SolidsTotal CreditsSecond SemesterCredits Second Sem	CHM 350	Special To	pics	
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		17	,	16

	16-17		14
Distribution Requirement/ electives	6		
Advanced Chemistry Elective (CHM 3XX not specifically required))	3		
CHM 375	2-3		
CHM 343	2		
CHM 371	3	Distriibution Requirements/Electives	14
First Semester	Credits	Second Semester	Credits
Fourth Year			
	17		17
Disribution Requirement/ Electives	6		
CHM 351	2	Distribution Requirement/ Electives	8
CHM 342	3	CHM 341	3
CHM 332 & CHM 334	6	CHM 307 & CHM 335	6
First Semester	Credits	Second Semester	Credits
Third Year			

Total Credits: 123-124

ACCELERATED COMBINED B.S. - M.S. DEGREE OPTIONS IN CHEMISTRY

Individual degree paths can be designed to earn either the B.S. or both BS. and M.S. degrees in Chemistry over a reduced or accelerated time frame. A discussion with the Chemistry faculty advisor during the first academic year is required to successfully complete any of the following options:

- If you have more than 20 credits total of AP or transfer courses, it may be possible to earn the B.S. in three years and the M.S. in four. This path may require up to two summers of courses and/or research for most students.
- If you have 30 or more AP or transfer credits, then it may be possible to be supported as a Teaching Assistant or Research Assistant during the fourth year as a graduate student to finish the M.S. degree, although such support is not guaranteed. The B.S. degree must be completed in three years, and up to two summers of courses and/or research may be required.
- 3. If you have limited or no AP or transfer credits, then two paths are available: A) A five year path is possible with one summer of research work after the B.S. degree is finished in four years. B) A five year path with support during the fifth year as a TA or RA may be possible if courses are excluded from the undergraduate degree (requiring course overloads), and one summer of research is generally required, but support is not guaranteed.

Accelerated B.S. degree options are also possible for some students. See the Chemistry faculty advisor to develop a customized program for your situation.

B.S. IN BIOCHEMISTRY

An interdepartmental B.S. in Biochemistry major is offered in the College of Arts and Sciences. Faculty in both Chemistry (Glover, Pires and Thévenin) and Biological Sciences (Lowe-Krentz, Iovine and Behe) serve as advisors depending on student interest. Please see the section on Biochemistry (http://catalog.lehigh.edu/ coursesprogramsandcurricula/artsandsciences/biochemistry/) for details of the major.

MINOR IN CHEMISTRY

A minor in chemistry may be achieved by completing the following requirements:

CHM 031

Chemical Equilibria in Aqueous Systems

Total Credits		16
CHM 343	Physical Chemistry Laboratory	2
CHM 342	Thermodynamics & Kinetics	3
CHM 332	Analytical Chemistry	3
CHM 110 & CHM 111	Organic Chemistry I and Organic Chemistry Laboratory I	4
or CHM 041	Honors General Chemistry II	

Necessary pre- or co-requisites for the above would be CHM 030 or CHM 040 and (MATH 021 or MATH 022) and (PHY 013 or PHY 021).

Students who wish to minor in chemistry but whose major program requires any of the above courses may achieve the minor with substitutions approved by the department chair.

GRADUATE PROGRAMS IN CHEMISTRY

The Department of Chemistry offers graduate studies leading to two advanced degrees. Doctor of philosophy degrees in Chemistry and in Polymer science and engineering may be obtained by study and research in any appropriate area of chemistry.

The following information on admissions, proficiency examinations and other policies applies to doctor of philosophy degrees in chemistry.

Admission to graduate study in chemistry assumes that a student has met, or is willing to meet though further study, minimum undergraduate requirements for a bachelor's degree in chemistry. This would include (beyond two semesters of introductory chemistry) two semesters of organic chemistry, two semesters of physical chemistry, two semesters of analytical chemistry and one semester of inorganic chemistry. A promising student whose degree is in a field related to chemistry (e.g., biology, chemical engineering) may be admitted to graduate study in chemistry provided that any deficiencies in basic chemistry preparation are made up in the first year of graduate study, noting that some of the courses required for this may not carry graduate credit.

The Chemistry Department administers proficiency examinations at the advanced undergraduate level in analytical, biochemistry, inorganic, organic and physical chemistry to all regular graduate students at the time of matriculation. Each student is required to take three examinations. Information regarding material to be covered on these examinations will be sent to each student several months in advance of matriculation. It is expected that each student will prepare diligently for these tests. A Ph.D. candidate must show proficiency in three areas. An incoming student who fails one or more of the examinations will have two additional opportunities to demonstrate proficiency by re-taking the examination(s). The student is highly encouraged to meet with the Graduate Advising Director to determine the best course of action in light of the exam performance and projected area of study. The student may prepare for the examination(s) by self-study and/or enrolling in or auditing of appropriate courses, and is strongly encouraged to seek faculty advice on preparing to retake any exam.

Doctor of Philosophy Degree

4

Completion of a doctor of philosophy degree program normally requires a minimum of four years of full time work after entrance with a bachelor's degree. There are few specific course credit requirements for the Ph.D.; however, approved degree programs generally have at least 26 hours of course work. A minimum of 15 credits must be obtained in the Department of Chemistry. Thus, the program consists of approximately one-third formal course work and two-thirds independent study and research. There is a two-credit seminar requirement (CHM 481). After Ph.D. proficiency has been established and the research advisor selected (this must be done by the end of the first semester in residence), the major hurdle is the general doctoral examination in the student's area of concentration. This exam must be passed by the end of 2 1/2 years of residence. If this hurdle is surmounted, the remaining time is spent completing (and ultimately defending) the dissertation research under the guidance of the research advisor and the dissertation committee.

Course Work		18
CHM 421	Chemistry Research	6

CHM 481	Chemistry Seminar	2
Total Credits		26

CURRENT RESEARCH PROJECTS

Current research projects of interest are listed below.

Analytical Chemistry

NMR studies of organic solids and polymeric systems; biosensors; microfluidic platforms; electroanalytical chemistry.

Biochemistry

Membrane protein interactions; structural characterization of membrane proteins; production of membrane proteins; biophysical characterization of membrane proteins; biomaterials; multi-drug resistance; selective drug delivery; anti-cancer therapy; antibiotic drug discovery; cell surface remodeling; immunotherapy; activity based probes; fluorescence assay development.

Inorganic Chemistry

Synthesis, characterization, and reactivity of transition metal complexes and nano particles; coordination chemistry and molecular self-assembly at metal surfaces and semi-metal surfaces; electrochemistry at metal, semi-metal, and oxide-coated electrodes; synthesis and characterization of mesoporous solids from transition metal and main-group element precursors; applications of mesoporous solids for carbon sequestration; formation of multilayered thin films of inorganic and organic-inorganic hybrid materials; and application of lanthanide catalysis in organic synthesis.

Materials and Polymer Chemistry

Inorganic and organometallic chemistry in the synthesis of thin-film materials; synthesis at and dynamics of polymer interfaces; acoustic, optical, permeability, dielectric and mechanical behavior of thin films; laser light scattering and small-angle X-ray scattering studies on polymer solutions; polyelectrolytes and ion-containing solutions; nanofabrications in polymer systems; organic-inorganic hybrid solid state materials; synthesis and characterization of novel mesoporous materials; characterization of semiconducting material

Organic Chemistry

Synthesis of medicinal agents and functional materials, correlation of molecular structure with pharmacological behavior; chemical models for biochemical reactions; chemistry of monolayers and organized molecule assemblages; drug carriers; synthetic ion conductors; Langmuir-Blodgett films; organometallic reaction mechanisms; organofluorine chemistry; protein folding and renaturation; molecular recognition; calorimetry; electrochemical studies of electron transfer reactions; synthetic methods development.

Physical Chemistry

Chemistry at surfaces and interfaces of polymers, electrodes, thin films, and biosensors using an array of surface sensitive methods: spectroscopic ellipsometry, scanning probe microscopy, angle resolved X-ray photo electron spectroscopy, electrochemistry, and quartz crystal microbalance; nanomechanics; intermolecular interactions in soft matter; single-molecule force spectroscopy; chemically sensitive imaging at nanoscale; development of optics-based tools for chemical analysis; femtosecond ultrafast spectroscopy; investigation of charge transfer in energy materials; spectroscopy; transient absorption spectroscopy; time-resolved photoluminescence; proton-coupled electron transfer reactions.

Major Instrumentation

Chemistry research spans all areas: analytical, biochemistry, inorganic, organic, and physical. Special equipment available for graduate research in chemistry is as follows.

Research facilities

LC/MS/MS, GC-MS, MALDI-TOF-MS, HPLCs, GCs, ultracentrifuges, cold rooms, cell disintegrator, zone and disc electrophoresis apparatus, column chromatograph, autoclave, freezers (-80C), rotary vaporator, Milli-Q water purification system, shaking heated water baths, spectropolarimeter with circular dichroism capability. Cell culture facilities – complete with optical microscopes having fluorescent and photographic capabilities. Electron optical facilities – transmission electron microscope, and scanning electron

microprobe. Gas chromatographs. Liquid chromatographs – high performance for analytical and preparative work. NMR spectrometers – 400 MHz for both solids and solutions, and 500 MHz for solutions with an enhanced sensitivity multinuclear cyroprobe. Photochemistry equipment – lamps and filters for selected wavelength work. Polarographs, chronopotentiometers, electrophoresis apparatus, electrochemical impedance, electrochemical scanning tunneling microscope, potentiostats, and rotating disk electrode. Portable data interface (8-channel 50 KHz), digital readout polarimeter, Vibron elastoviscometers, differential refractometer.

Spectrometers

UV/visible double beam automated, fluorescence, UV/visible/near IR, Fourier transform IR with diffuse reflectance, photoacoustic and attenuated reflectance capability, and GC mass spectrometers. Surface analysis facilities – rotating anode high-sensitivity high-energy resolution ESCA with imaging capability (ESCA is equipped with automated angular data acquisition). Surface science facility – Low energy electron diffraction (LEED), photocorrelation spectroscopy for submicron particle analysis. Ellipsometer, contact angle capabilities, gas adsorption apparatus (BET), atomic force microscope, instructional scanning tunneling microscope, and light scanning. Microcalorimeter (flowing with UV and refractive index detectors), differential scanning calorimeter (DSC).

Courses

CHM 030 Introduction to Chemical Principles 0,4 Credits

An introduction to important topics in chemistry: atomic structure, properties of matter, chemical reactions, energy, structure and bonding in organic and inorganic compounds. The course features a lecture tightly linked to a three-hour studio experience that combines laboratory work and recitation.

Attribute/Distribution: NS

CHM 031 Chemical Equilibria in Aqueous Systems 0,4 Credits

An introduction to: intermolecular forces and their influence on physical properties and phase behavior; chemical kinetics; thermodynamics in chemical systems; and electrochemistry. The course includes a detailed treatment of equilibria in aqueous solutions, including acid-base, precipitation-solubility, metal-ligand, oxidationreduction and distribution equilibria. The laboratory work emphasizes the qualitative and quantitative analysis of equilibria in aqueous media. Three lectures and one three-hour laboratory period. **Prerequisites:** (CHM 030 or CHM 040) and (MATH 021 or MATH 031 or MATH 051 or MATH 076) **Attribute/Distribution:** NS

CHM 040 Honors General Chemistry I 0,4 Credits

A first-semester course in chemistry for students planning to major in chemistry, biochemistry, chemical engineering, materials science, or other chemistry-related fields. Chemical and physical properties, structures, bonding concepts, and quantitative analysis. Laboratory includes synthesis, separation and analysis procedures; computer applications to chemistry. Three lectures and one three-hour laboratory period.

Attribute/Distribution: NS

CHM 041 Honors General Chemistry II 0,4 Credits

Continuation of Chemistry 40. Three lectures and one three-hour laboratory period.

Prerequisites: (CHM 040 or CHM 030) and (MATH 021 or MATH 031 or MATH 051)

Attribute/Distribution: NS

CHM 110 Organic Chemistry I 0,3 Credits

Systematic survey of the typical compounds of carbon, their classification, and general relations; study of synthetic reactions. **Prerequisites:** CHM 031 or CHM 041 **Attribute/Distribution:** NS

CHM 111 Organic Chemistry Laboratory I 1 Credit

Preparation of pure organic compounds. Modern techniques of characterization. **Prerequisites:** CHM 110 **Can be taken Concurrently:** CHM 110

Attribute/Distribution: NS

CHM 112 Organic Chemistry II 0,3 Credits Continuation of CHM 110. Prerequisites: CHM 110 Attribute/Distribution: NS

CHM 113 Organic Chemistry Laboratory II 1 Credit

Continuation of Organic Chemistry Laboratory I. **Prerequisites:** CHM 111 and CHM 112 **Can be taken Concurrently:** CHM 112 **Attribute/Distribution:** NS

CHM 177 Introduction to Research 1-2 Credits

For advanced freshmen and sophomore chemistry majors. Consent of department chair required. **Repeat Status:** Course may be repeated. **Attribute/Distribution:** NS

CHM 194 Physical Chemistry for Biological Sciences 3 Credits

The principles and applications of physical chemical concepts to systems of biological interest, including the gas laws, thermodynamics of metabolic reactions, colligative properties, electrochemical equilibria, reaction kinetics and enzyme catalysis, and transport of macromolecules and viruses.

Prerequisites: (CHM 030 or CHM 040) and (CHM 031 or CHM 041) Attribute/Distribution: NS

CHM 250 Special Topics 1-4 Credits

Selected topics in chemistry. Consent of instructor required. **Repeat Status:** Course may be repeated.

CHM 300 Apprentice Teaching 3 Credits

Consent of instructor required. Repeat Status: Course may be repeated.

CHM 305 Organometallic Chemistry 3 Credits

The chemistry of compounds containing bonds between carbon and the transition metals. Topics include the synthesis, characterization, and electronic structure of organometallic compounds, and mechanistic studies of their reactions. A description of common ligands and their bonding is covered, as well as applications of organometallic chemistry in organic synthesis and catalysis. **Prerequisites:** CHM 112

Attribute/Distribution: NS

CHM 307 Advanced Inorganic Chemistry 3 Credits

Introduction to transition metal complexes; theories of bonding; kinetics and mechanisms of transition metal complex reactions; selected aspects of organometallic chemistry; bioinorganic chemistry. **Prerequisites:** CHM 031 or CHM 041

Attribute/Distribution: NS

CHM 323 Chemical Biology 3 Credits

Chemical biology is a discipline at the interface of organic and biological chemistry. It entails the design, synthesis, and evaluation of probes, substrates, and materials for the study of biological systems using chemical principles. Chemical biology can also take inspiration from biological systems for the design and synthesis of novel molecules and materials for non-biological applications. The class is designed to be an introduction to chemical biology for upperlevel undergraduates and graduate students.

Prerequisites: CHM 112 and (BIOS 371 or CHM 371)

CHM 332 Analytical Chemistry 3 Credits

Theory and practice of chemical analysis. Principles of quantitative separations and determinations; theory and application of selected optical and electrical instruments in analytical chemistry; interpretation of numerical data, design of experiments, solute distribution in separation methods.

Prerequisites: (CHM 031 or CHM 041) and CHM 110 Attribute/Distribution: NS

CHM 334 Advanced Chemistry Laboratory I 0,3 Credits

Exploration of synthetic methods and analysis techniques for inorganic and organic compounds. Determination of product structures and quantitative analysis using modern chemical analysis techniques, including NMR, GC-MS, GC, HPLC, FT-IR, and Electrochemistry.

Prerequisites: (CHM 110 and CHM 111 and CHM 112 and CHM 113 and CHM 332)

Can be taken Concurrently: CHM 332

CHM 335 Advanced Chemistry Laboratory II 0,3 Credits Continuation of CHM 334.

Prerequisites: (CHM 334)

CHM 336 Clinical Chemistry 3 Credits

Applications of analytical chemistry to clinical problems. Discussion of methods in common use and the biochemical/medical significance of the results.

Prerequisites: CHM 332 or CHM 112 Attribute/Distribution: NS

CHM 337 Crystallography and Diffraction 3 Credits

Introduction to crystal symmetry, point groups, and space groups. Emphasis on materials characterization by Xray diffraction and electron diffraction. Specific topics include crystallographic notation, stereographic projections, orientation of single crystals, textures, phase identification, quantitative analysis, stress measurement, electron diffraction, ring and spot patterns, convergent beam electron diffraction (CBED), and space group determination. Applications in mineralogy, metallurgy, ceramics, microelectronics, polymers, and catalysts. Lectures and laboratory work. Prerequisites may be waived if student has senior standing in chemistry.

Prerequisites: MAT 203 or EES 131 Attribute/Distribution: NS

CHM 340 Solid-State Chemistry 3 Credits

This solid state chemistry course will introduce students into symmetry of extended solids, X-ray crystallography of solids, crystal structures, band theory, electronic and ionic conductivity in solids, defects in solids, silicate chemistry and nonoporous solids. **Prerequisites:** CHM 031 or CHM 041

Attribute/Distribution: NS

CHM 341 Molecular Structure, Bonding and Dynamics 3 Credits Nature of chemical bonding as related to structure and properties of

molecules and extended systems. Quantum chemistry of atoms and molecules applied to chemical transformations and spectroscopic transitions. Symmetry analysis and selections rules. Interpretation of electronic, vibrational and rotational spectra.

Prerequisites: (MATH 023 or MATH 033) and (PHY 021 or PHY 013) and (CHM 031 or CHM 041)

Attribute/Distribution: NS

CHM 342 Thermodynamics & Kinetics 3 Credits

Development of the principles of classical and statistical thermodynamics and their application to chemical systems. In classical thermodynamics emphasis will be on systems in which composition is of major concern: solutions, chemical and phase equilibria. Kinetic theory of gases; chemical reaction kinetics; chemical reaction dynamics.

Prerequisites: (CHM 031 or CHM 041) and (PHY 013 or PHY 021) and (MATH 022 or MATH 032 or MATH 052)

CHM 343 Physical Chemistry Laboratory 2 Credits

Laboratory studies that illustrate and extend the various fields of study in experimental physical chemistry as discussed in CHM 341 and CHM 342. This course fulfills the junior year writing intensive course requirement in CAS.

Prerequisites: CHM 194 or CHE 210 or CHM 342 Attribute/Distribution: NS

CHM 346 Photochemistry of Consequence 3 Credits

Photochemistry involves using photons (light from the sun) to drive critical chemical reactions and is attractive because of its application to solar energy. Fundamental processes in photochemistry will be covered . Topics will include: energy transfer, electron transfer, proton-coupled electron transfer processes and their applications to biological systems.

Prerequisites: CHM 031 or CHM 041 Attribute/Distribution: NS

CHM 350 Special Topics 1-3 Credits

Selected advanced topics in chemistry. Repeat Status: Course may be repeated. Attribute/Distribution: NS

CHM 351 Professional Development Seminar 2 Credits

Topics for the developing professional chemist include lab safety, using a laboratory notebook, searching the scientific literature, reading and writing scientific papers, ethics, and developing both a poster and an oral presentation. Students will present their own poster and a short talk on the same subject. Each student will write his/her own resume and participate in a mock interview session.

Attribute/Distribution: NS

CHM 356 Spectral Analysis 3 Credits

Use of data from nuclear magnetic residence, infrared, ultraviolet, and mass spectrometric techniques for the determination of structure of organic compounds. Emphasis on information from one- and twodimensional proton and carbon NMR, and a mechanistic interpretation of data from mass spectrometry.

Prerequisites: CHM 112

CHM 357 Organic Reaction Mechanisms 3 Credits

Intensive in class problem solving that involves the formulation of reasonable reaction mechanisms for complex multistep pathways, i.e. organic transformations that proceed via highly energetic intermediates such as carbocations, carbanions, free radicals, carbenes, and nitrenes.

Prerequisites: CHM 112

CHM 358 Advanced Organic Chemistry 3 Credits

Reaction mechanism types and supporting physical-chemical data. Classes of mechanisms include elimination, substitution, rearrangement, oxidation-reduction, enolate alkylations, and others. Must have completed one year of organic chemistry. Prerequisites: CHM 112

Attribute/Distribution: NS

CHM 362 Molecular Biophysics 3 Credits

This course focuses on the physical tools that exist to obtain information about biological macromolecules, with an emphasis on spectroscopic and imaging techniques (e.g., circular dichroism, fluorescence spectroscopy, FRET, BRET, calorimetry, analytical ultracentrifugation, X-ray crystallography, electron microscopy, dynamic light scattering, surface plasmon resonance). Lectures and discussion of research articles are used to illustrate the use of the different tools and methods.

Prerequisites: BIOS 371 or CHM 371 Attribute/Distribution: NS

CHM 364 Bioinorganic Chemistry 3 Credits

This course will cover inorganic chemistry as it relates to biology, with emphasis on how metal ions and cofactors are employed by biological systems. Topics will include metalloproteins, metal cofactors, and metals in medicine. Experimental methods used to study bioinorganic chemistry will also be discussed.

Prerequisites: CHM 371 or BIOS 371 Attribute/Distribution: NS

CHM 365 Protein Separation & Biophysical Analysis 3 Credits

Laboratory studies of techniques and principles used for the isolation, characterization, and biophysical analysis of proteins. Prerequisites: BIOS 371 or CHM 371 Attribute/Distribution: NS

CHM 371 (BIOS 371) Elements of Biochemistry I 0,3 Credits

A general study of carbohydrates, proteins, lipids, nucleic acids and other biological substances and their importance in life processes. Protein and enzyme chemistry are emphasized. Must have completed one year of organic chemistry.

Prerequisites: CHM 112 Attribute/Distribution: NS

CHM 372 (BIOS 372) Elements of Biochemistry II 3 Credits

Dynamic aspects of biochemistry: enzyme reactions including energetics, kinetics and mechanisms, metabolism of carbohydrates, lipids, proteins and nucleic acids, photosynthesis, electron transport mechanisms, coupled reactions, phosphorylations, and the synthesis of biological macromolecules.

Prerequisites: BIOS 473 or ((BIOS 371 or CHM 371) and BIOS 041) Attribute/Distribution: NS

CHM 373 Lipids and Membranes 3 Credits

The study of lipids and lipid membranes similar to those found in mammalian cells including methods of synthesis, surface activity, bilayer and micellar structures, lipid mixing, fluidity, permeability and membrane stability. Special emphasis will be given to the current evidence for and against the lipid raft hypothesis. Prerequisites: BIOS 372 or CHM 372 Attribute/Distribution: NS

CHM 375 Research Chemistry Laboratory 1-3 Credits

An introduction to independent study or laboratory investigation under faculty guidance. Consent of instructor required. Repeat Status: Course may be repeated. Attribute/Distribution: NS

CHM 376 Advanced Research Chemistry Laboratory 1-6 Credits Advanced independent study or laboratory investigation under faculty

guidance. Consent of faculty research supervisor. Repeat Status: Course may be repeated. Attribute/Distribution: NS

CHM 377 (BIOS 377) Biochemistry Laboratory 0,3 Credits

Laboratory studies of the properties of chemicals of biological origin and the influence of chemical and physical factors on these properties. Laboratory techniques used for the isolation and identification of biochemicals.

Prerequisites: (BIOS 371 or CHM 371) and (BIOS 031 or BIOS 041) Can be taken Concurrently: BIOS 371, CHM 371 Attribute/Distribution: NS

CHM 388 (CHE 388, MAT 388) Polymer Characterization 3 Credits

Description of molecular weight measurements using dilute solutions (solution viscosity, size exclusion chromatography, osmotic pressure, and light scattering). Introduction to polymer thermal analysis techniques such as differential scanning calorimetry (DSC), dynamic mechanical analysis (DMA), and thermomechanical analyzer (TMA). Discussion of structure and morphology of polymers and polymer blends using nuclear magnetic resonance (NMR), infrared spectroscopy (IR), Raman spectroscopy, UV analysis, transmission electron microscopy (TEM), scanning electron microscopy (SEM), atomic force microscopy (AFM). Crystallinity measurements using SANS, SAXS, and WAXS.

Prerequisites: MAT 033 or MAT 204 or MAT 392 or MAT 393

CHM 389 Honors Project 1-6 Credits

Repeat Status: Course may be repeated.

CHM 391 (CHE 391) Colloid and Surface Chemistry 3 Credits

Physical chemistry of everyday phenomena. Intermolecular forces and electrostatic phenomena at interfaces, boundary tensions and films at interfaces, mass and charge transport in colloidal suspensions, electrostatic and London forces in disperse systems, gas adsorption and heterogeneous catalysis.

Prerequisites: CHM 342

Attribute/Distribution: NS

CHM 393 (CHE 393, MAT 393) Physical Polymer Science 3 Credits

Structural and physical aspects of polymers (organic, inorganic, natural). Molecular and atomic basis for polymer properties and behavior. Characteristics of glassy, crystalline, and paracrystal-line states (including viscoelastic and relaxation behavior) for singleand multi-component systems. Thermodynamics and kinetics of transition phenomena. Structure, morphology, and behavior. Available to graduate and undergraduate students (with senior level standing) in CHE, CHEM or MAT.

CHM 394 (CHE 394) Organic Polymer Science I 3 Credits

Organic chemistry of synthetic high polymers. Polymer nomenclature, properties, and applications. Functionality and reactivity or monomers and polymers. Mechanism and kinetics of step-growth and chain-growth polymerization in homogenous and heterogenous media. Brief description of emulsion polymerization, ionic polymerization, and copolymerization. Must have completed one year of physical chemistry and one year of organic chemistry. **Prerequisites:** CHM 112 or CHM 342 or CHE 210

Attribute/Distribution: NS

CHM 400 First Year Graduate Student Seminar 0 Credits

First year graduate student seminar course and introduction to research. Topics include: research opportunities in the department, introduction to instrumentation facilities, ethics in science, use of library facilities, effective teaching methods. Course may be repeated. **Repeat Status:** Course may be repeated.

CHM 405 Organometallic Chemistry 3 Credits

The chemistry of compounds containing bonds between carbon and the transition metals. Topics include the synthesis, characterization, and electronic structure of organometallic compounds, and mechanistic studies of their reactions. A description of common ligands and their bonding is covered, as well as applications of organometallic chemistry in organic synthesis and catalysis.

CHM 407 Advanced Inorganic Chemistry 3 Credits

Introduction to transition metal complexes; theories of bonding; kinetics and mechanisms of transition metal complex reactions; selected aspects of organometallic chemistry; bio-inorganic chemistry. Must have completed one semester of physical chemistry and have CAS graduate student status.

CHM 421 Chemistry Research 1-6 Credits

Research in one of the following fields of chemistry: analytical, inorganic, organic, physical, polymer, biochemistry. A maximum of 6 credits total may be earned. Consent of the instructor is required. **Repeat Status:** Course may be repeated.

CHM 423 Chemical Biology 3 Credits

Chemical biology is a discipline at the interface of organic and biological chemistry. It entails the design, synthesis, and evaluation of probes, substrates, and materials for the study of biological systems using chemical principles. Chemical biology can also take inspiration from biological systems for the design and synthesis of novel molecules and materials for non-biological applications. The class is designed to be an introduction to chemical biology for upperlevel undergraduates and graduate students.

CHM 426 Statistical Thermodynamics 3 Credits

Principles and applications of statistical mechanics to chemical problems. A study of the techniques for evaluating the properties of matter in bulk from the properties of molecules and their interactions.

CHM 427 Thermodynamics & Kinetics 3 Credits

Development of the principles of classical and statistical thermodynamics and their applications to chemical systems. In classical thermodynamics, emphasis will be on systems in which composition is of major concern: solutions, chemical and phase equilibria. Kinetic theory of gases; chemical reaction kinetics. Must have CAS graduate student status. This course cannot be taken by students who have already taken CHM 342.

CHM 434 Advanced Topics in Spectroscopy 3 Credits

Fundamentals of interactions of electromagnetic radiation with matter: electronic, vibrational, scattering based spectroscopies, instrumentation and signal processing. Advanced applications to the analysis of molecular structure and chemical processes including surface analysis, time-resolved spectroscopies, and ultrasensitive spectroscopic techniques.

CHM 436 Special Topics in Analytical Chemistry 1-3 Credits Topics of contemporary interest in analytical chemistry.

Repeat Status: Course may be repeated.

CHM 438 Analytical Chemistry 3 Credits

Theory and practice of chemical analysis. Principles of quantitative separations and determinations; theory and application of selected optical and electrical instruments in analytical chemistry; interpretation of numerical data; design of experiments; solute distribution in separation methods. Must have CAS graduate student status.

CHM 443 (MAT 443) Solid-State Chemistry 3 Credits

This solid state chemistry course will introduce students into symmetry of extended solids, X-ray crystallography of solids, crystal structures, band theory, electronic and ionic conductivity in solids, defects in solids, silicate chemistry and nonoporous solids.

CHM 444 Molecular Structure, Bonding and Dynamics 0,3 Credits

Nature of chemical bonding as related to structure and properties of molecules and extended systems. Quantum chemistry of atoms and molecules applied to chemical transformations and spectroscopic transitions. Symmetry analysis and selections rules. Interpretation of electronic, vibrational and rotational spectra. Must have CAS graduate student status.

CHM 446 Photochemistry of Consequence 3 Credits

Photochemistry involves using photons (light from the sun) to drive critical chemical reactions and is attractive because of its application to solar energy. Fundamental processes in photochemistry will be covered. Topics will include: energy transfer, electron transfer, protoncoupled electron transfer processes and their applications to biological systems.

CHM 452 Advanced Organic Chemistry 3 Credits

Reaction mechanism types and supporting physical chemical data. Classes of mechanisms include elimination, substitution, rearrangement, oxidation reduction, enolate alkylations, and others. Must have completed one year of organic chemistry and have CAS graduate student status.

CHM 453 Heterocyclic Compounds 3 Credits

An intensive study of the syntheses, reactions and properties of heteroaromatic compounds including derivatives of thiophene, pyrrole, furan, indole, pyridine, quinoline, the azoles and the diazines all considered from the viewpoint of modern theories of structure and reaction mechanisms.

Prerequisites: CHM 358 or CHM 452

CHM 455 Organic Reactions 3 Credits

Intensive survey of modern synthetic organic chemistry from a mechanistic standpoint. Classical Namereactions, olefin synthesis, organometallic reagents in synthesis, Woodward-Hoffmann rules, electrocyclic processes, enolate chemistry, and related reactions. **Prerequisites:** or CHM 452, CHM 358 or CHM 452

CHM 456 Spectral Analysis 3 Credits

Use of data from nuclear magnetic resonance, infrared, ultraviolet, and mass spectrometric techniques for the determination of structure of organic compounds. Emphasis on information from one- and twodimensional proton and carbon NMR, and a mechanistic interpretation of data from mass spectrometry.

CHM 457 Organic Reaction Mechanisms 3 Credits

Intensive in class problem solving that involves the formulation of reasonable reaction mechanisms for complex multistep pathways, i.e. organic transformations that proceed via highly energetic intermediates such as carbocations, carbanions, free radicals, carbenes, and nitrenes.

CHM 458 Topics in Organic Chemistry 1-3 Credits

An intensive study of limited areas in organic chemistry. Repeat Status: Course may be repeated.

CHM 462 3 Credits

This course focuses on the physical tools that exist to obtain information about biological macromolecules, with an emphasis on spectroscopic and imaging techniques (e.g., circular dichroism, fluorescence spectroscopy, FRET, BRET, calorimetry, analytical ultracentrifugation, X-ray crystallography, electron microscopy, dynamic light scattering, surface plasmon resonance). Lectures and discussion of research articles are used to illustrate the use of the different tools and methods.

CHM 464 Bioinorganic Chemistry 3 Credits

This course will cover inorganic chemistry as it relates to biology, with emphasis on how metal ions and cofactors are employed by biological systems. Topics will include metalloproteins, metal cofactors, and metals in medicine. Experimental methods used to study bioinorganic chemistry will also be discussed.

CHM 465 Protein Separation & Biophysical Analysis 3 Credits

Laboratory studies of techniques and principles used for the isolation, characterization, and biophysical analysis of proteins. Attribute/Distribution: NS

CHM 472 (BIOS 472) Lipids and Membranes 3 Credits

The study of lipids and lipid membranes similar to those found in mammalian cells including methods of synthesis, surface activity, bilayer and micellar structures, lipid mixing, fluidity, permeability and membrane stability. Special emphasis will be given to the current evidence for and against the lipid raft hypothesis. Prerequisites: BIOS 372 or CHM 372

CHM 473 (BIOS 473) Principles of Biochemistry I 3 Credits

Study of proteins, carbohydrates, lipids, nucleic acids and other biological substances. Protein and enzyme chemistry are emphasized. Must have completed one year each of general chemistry and organic chemistry.

CHM 475 Advanced Topics in Chemistry 1 Credit

Audiovisual courses in topics such as acid-base theory, NMR, chromatography, electroanalytical chemistry and mass-spectroscopy interpretation; course material obtained from the American Chemical Society.

Repeat Status: Course may be repeated.

CHM 477 (BIOS 477) Topics In Biochemistry 1-3 Credits

Selected areas of biochemistry, such as mechanisms of enzyme action, new developments in the chemistry of lipids, nucleic acids, carbohydrates and proteins. Must have completed one semester of biochemistry.

Repeat Status: Course may be repeated.

CHM 481 Chemistry Seminar 1 Credit

Student presentations on current research topics in the student's discipline but not on subjects close to the thesis. A one-hour presentation and attendance at other presentations are required for credit.

Repeat Status: Course may be repeated.

CHM 482 (CHE 482, MAT 482) Mechanical Behaviors of Polymers **3 Credits**

Mechanical behavior of polymers. Characterization of experimentally observed viscoelastic response of polymeric solids with the aid of mechanical model analogs. Topics include time-temperature superposition, experimental characterization of large deformation and fracture processes, polymer adhesion, and the effects of fillers, plasticizer, moisture, and aging on mechanicial behavior.

CHM 483 (CHE 483, MAT 483) Emulsion Polymers 3 Credits Fundamental concepts important in manufacture, characterization, and application of polymer latexes. Topics include colloidal stability, polymerization mechanisms and kinetics, reactor design, characterization of particle surfaces, latex rheology, morphology considerations, polymerization with functional groups, film formation and various application problems.

CHM 485 (CHE 485, MAT 485) Polymer Blends 3 Credits

Synthesis, morphology, and mechanical behavior of polymer blends. Polymer/polymer miscibility and thermodynamics of mixing of polymer/ solvent and polymer/polymer blends. Prediction of miscibility using various theoretical models and methods that can be used to help enhance miscibility (H bonding etc.). Methods to enhance the compatibility of polymer/polymer blends (e.g., block copolymers, ternary addition, IPNs), etc.). Types of polymer blends. Must have completed any introductory polymer course or equivalent.

CHM 487 Topics in Colloid and Surface Chemistry 3 Credits Applications of colloid chemistry; special topics in surface chemistry. Lectures and seminar.

Repeat Status: Course may be repeated.

CHM 488 Advanced Topics in Physical Chemistry 1-3 Credits Advanced topics in physical chemistry, such as photochemistry and molecular beam dynamics, Fourier transform spectroscopy, kinetics of rapid reactions, theory of magnetic resonance, liquids and solutions. Topic changes almost every time it is offered.

Repeat Status: Course may be repeated

CHM 489 Organic Polymer Science II 3 Credits

Continuation of CHM 394. Theory and mechanism of ionic vinyladdition chaingrowth polymerization. Chain copolymerization by radical and ionic mechanism. Mechanism of ring-opening polymerization, stereochemistry of polymerization including ionic, coordination, and Ziegler-Natta mechanisms. Reactions of polymers, including crosslinking, reaction of functional groups, graft and block copolymers, and polymer carriers and supports.

CHM 490 Thesis 1-6 Credits

Repeat Status: Course may be repeated.

CHM 492 (CHE 492, MAT 492) Topics in Polymer Science 3 Credits

Intensive study of topics selected from areas of current research interest such as morphology and mechanical behavior, thermodynamics and kinetics of crystallization, new analytical techniques, molecular weight distribution, non-Newtownian flow behavior, second-order transition phenomena, novel polymer structures. Credit above three hours is granted only when different material is covered.

CHM 494 Quantum Chemistry 3 Credits

Principles and applications of quantum mechanics to chemical problems. Applications to chemical bonding, molecular structure, reactivity and spectroscopy.

CHM 499 Dissertation 1-15 Credits

Repeat Status: Course may be repeated.