SCC agenda 21 April 2010

1. Discussion of results from department meeting (attachment)

2. Discussion of catalog package presented to College Curriculum Committee on Monday (attachment)

3. Twice and done policy

4. Old Business

5. Agenda for May 5 meeting
1. Catalog Changes (these passed 14-0-0)

**CHEM 127 General Chemistry I (4) GE B3 & B4**

**Current:**
Introduction to atomic theory, chemical reactions, bonding, stoichiometry, nomenclature, gas laws, colligative properties, colloids and solutions. Intended primarily for students whose majors are in the College of Science and Mathematics. Not open to students with credit for CHEM 111 or CHEM 124. 3 lectures, 1 laboratory. Prerequisite: High school chemistry or CHEM 106 or equivalent, and passing score on the ELM examination for MATH 116 eligibility or an ELM exemption or MATH 104. Fulfills GE B3 & B4.

**Proposed:**
Introduction to atomic theory, chemical reactions, bonding, stoichiometry, nomenclature, gas laws, thermochemistry, molecular structure, and intermolecular forces. Intended primarily for students whose majors are in the College of Science and Mathematics. Not open to students with credit for CHEM 111 or CHEM 124. 3 lectures, 1 laboratory. Prerequisite: High school chemistry and passing score on the ELM examination for MATH 116 eligibility or an ELM exemption or MATH 104. Fulfills GE B3 & B4.

**CHEM 128 General Chemistry II (4)**

**Current:**
Continuation of CHEM 127. Oxidation-reduction reactions, electrochemistry, kinetics, equilibria, thermodynamics, acids and bases. Intended primarily for students whose majors are in the College of Science and Mathematics. Not open to students with credit for CHEM 125. 3 lectures, 1 laboratory. Prerequisite: CHEM 127.

**Proposed:**
Continuation of CHEM 127. Colligative properties, colloids and solutions, oxidation-reduction reactions, electrochemistry, kinetics, equilibria, and thermodynamics. Intended primarily for students whose majors are in the College of Science and Mathematics. Not open to students with credit for CHEM 125. 3 lectures, 1 laboratory. Prerequisite: CHEM 127.

**CHEM 129 General Chemistry III (4)**

**Current:**
Acid and base equilibria, buffers, transition elements, solubility, complex ions, hybridization, nuclear chemistry. Laboratory study of the chemical properties and semi-micro qualitative analysis of the representative group elements of the periodic table. 3 lectures, 1 laboratory. Prerequisite: CHEM 125 or CHEM 128.

**Proposed:**
Continuation of CHEM 128. Acid and base equilibria, buffers, transition elements, solubility, complex ions, hybrid orbital theory, molecular orbital theory, and nuclear chemistry. Laboratory study of the chemical properties and semi-micro qualitative analysis of the representative group elements of the periodic table. 3 lectures, 1 laboratory. Prerequisite: CHEM 125 or CHEM 128.
CHEM 373 Molecular Biology (3)
Current:
Proposed:

CHEM 441 Bioinformatics Applications (4)
Current:
Introduction to new problems in molecular biology and current computer applications for genetic database analyses. Use of software for: nucleic acid, genome and protein sequence analysis; genetic databases, database tools; industrial applications in bioinformatics; ethical and societal concerns. 3 lectures, 1 laboratory. Prerequisite: One course in college biology (BIO 111 or BIO 161 recommended). Recommended: BIO 303, BIO 351 or CHEM 373. Crosslisted as BIO/CHEM 441.
Proposed:
Introduction to new problems in molecular biology and current computer applications for genetic database analyses. Use of software for: nucleic acid, genome and protein sequence analysis; genetic databases, database tools; industrial applications in bioinformatics; ethical and societal concerns. 3 lectures, 1 laboratory. Prerequisite: BIO 161 or BIO 303 and junior standing. Recommended: BIO 302, 303, 351 or CHEM 373. Crosslisted as BIO/CHEM 441.

CHEM 474 Protein Techniques Laboratory (2)
Current:
Experiments in protein affinity chromatography, electrophoresis and blotting, immunoprecipitation techniques, antibody-enzyme conjugation, and immunoassay. 2 laboratories. Prerequisite: CHEM 371 or consent of instructor.
Proposed:
Experiments in protein purification and analysis from recombinant sources. Ion-exchange and affinity chromatography, electrophoresis and blotting. UV, chemical, immuno, and fluorescent detection. Enzyme kinetic analysis. Prerequisite: CHEM 371 or consent of instructor.
2. 316 prereq change: No action necessary—we voted on this last term.

3. 312 prereq change: We will delay our implementation of the change in prereq until next year catalog cycle so that we can accommodate ANSI and NUTR.

4. Somehow 441 (Bioinformatics) disappeared from both elective lists. We will put it back on.

5. SCC proposes that we reserve 3 spots in 127-129 and 316-317 for our majors. **This item requires a vote.** (This item passed 13-0-1)
   Rationale: the members of SCC would like to assure the timely progress to degree of our majors. Usually, non-majors can better afford to wait a quarter or two for these courses.

6. SCC proposes that we bar students from registering for any chemistry course a third time. **This item requires a vote.** (After much discussion, we sent this back to SCC for more work.)
   Rationale: the members of SCC believe that this policy would have two desirable effects. First, it would open some spaces for students taking a course for the first time. Second, it would motivate students taking a course for the second time to a greater level of effort, thus improving their chances for success.

7. We are working a system of caps for course enrollments. (Many of us are very unhappy that the two largest sections last fall were both in 127—a majors course.) We would like initiate a department-wide discussion of this topic.
CHEMISTRY AND BIOCHEMISTRY CATALOG PACKAGE 2011-2013
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      ii. CHEM 128
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VIII. USCP COURSES
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    none

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   Please see attached catalog copy.

[Signature]

Chair, Undergraduate Committee
Dept. of Chemistry and Biochemistry
# Course Modification Form

Note: If requesting to make change using "Continuous Review" process, you may use this form if you are proposing a course modification that does not affect another department/program. If course is required by another program, the request must be submitted during Catalog Review cycle.

If course content is being revised to meet GE or USCP, use "Course Proposal" form and refer to GE/USCP Criteria. Don't use this form.

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<tbody>
<tr>
<td>Proposer: <a href="mailto:jhagen@calpoly.edu">jhagen@calpoly.edu</a></td>
<td>Requested start term: Fall 2011</td>
</tr>
<tr>
<td>telephone:x61651</td>
<td></td>
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## 1. Existing Course.

Copy & Paste your course prefix, number, title and catalog description from the Current Cal Poly Catalog. (include the prerequisite, units, mode, grading method, crosslisting, GE area, USCP.)

**CHEM 127 General Chemistry I (4) GE B3 & B4**

Introduction to atomic theory, chemical reactions, bonding, stoichiometry, nomenclature, gas laws, colligative properties, colloids and solutions. Intended primarily for students whose majors are in the College of Science and Mathematics. Not open to students with credit for CHEM 111 or CHEM 124. 3 lectures, 1 laboratory. Prerequisite: High school chemistry or CHEM 106 or equivalent, and passing score on the ELM examination for MATH 116 eligibility or an ELM exemption or MATH 104. Fulfills GE B3 & B4.

## 2. Modified Course.

Enter the modified course prefix, number, title and description exactly as it should appear in the catalog. Underline new or strike through existing text to indicate changes.

**CHEM 127 General Chemistry I (4) GE B3 & B4**

Introduction to atomic theory, chemical reactions, bonding, stoichiometry, nomenclature, gas laws, thermochemistry, molecular structure, and intermolecular forces. Colligative properties, colloids and solutions. Intended primarily for students whose majors are in the College of Science and Mathematics. Not open to students with credit for CHEM 111 or CHEM 124. 3 lectures, 1 laboratory. Prerequisite: High school chemistry and passing score on the ELM examination for MATH 116 eligibility or an ELM exemption or MATH 104. Fulfills GE B3 & B4.

## 3. Indicate All Changes and Reason for Each

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4. Consultation:

Identify programs affected by this change:

Attach signed consultation memos from other departments affected by the change.

5. Resources:

Explain if the change will require any additional or redistributed resources.

No additional resources are required.

Approval Signatures:

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<td>College Dean:</td>
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<td>(This signature is the Dean’s guarantee that s/he will provide any additional or redistributed resources needed to support this course.)</td>
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Submit completed form with any attachments to Office of the Registrar, Attn: Susan Olivas

Revised 3/1/2010
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If course content is being revised to meet GE or USCP, use "Course Proposal" form and refer to GE/USCP Criteria. Don't use this form.

Department: Chemistry and Biochemistry  Date: 13 April 2010

Proposer:
email: jhagen@calpoly.edu
telephone: x61651

Requested start term:  Fall 2011

1. Existing Course.

Copy & Paste your course prefix, number, title and catalog description from the Current Cal Poly Catalog. (include the prerequisite, units, mode, grading method, crosslisting, GE area, USCP.)

CHEM 128 General Chemistry II (4)
Continuation of CHEM 127. Oxidation-reduction reactions, electrochemistry, kinetics, equilibria, thermodynamics, acids and bases. Intended primarily for students whose majors are in the College of Science and Mathematics. Not open to students with credit for CHEM 125. 3 lectures, 1 laboratory. Prerequisite: CHEM 127.

2. Modified Course.

Enter the modified course prefix, number, title and description exactly as it should appear in the catalog. Underline new or strike through existing text to indicate changes.

CHEM 128 General Chemistry II (4)
Continuation of CHEM 127. Colligative properties, colloids and solutions, oxidation-reduction reactions, electrochemistry, kinetics, equilibria, and thermodynamics-acids and bases. Intended primarily for students whose majors are in the College of Science and Mathematics. Not open to students with credit for CHEM 125. 3 lectures, 1 laboratory. Prerequisite: CHEM 127.

3. Indicate All Changes and Reason for Each

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Revised 3/1/2010
| Units | | |
| Crosslisting | | |
| Grading Method | (CR/NC or Regular) | | |
| Mode of Instruction | (For Academic Programs' use: CS # ________) | | |
| Prerequisite | | |
| Repeatability | | |
| Is the course repeatable for multiple credit? | Yes | No |
| If yes, what is maximum # of units? | | |
| Is the course repeatable in the same term? | Yes | No |

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Identify programs affected by this change:
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5. Resources:
Explain if the change will require any additional or redistributed resources.
No additional resources are required.

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Department: Chemistry and Biochemistry          Date: 13 April 2010
Proposer:                                          Requested start term:  Fall 2011
email: jhagen@calpoly.edu
telephone:x61651

1. **Existing Course.**

   Copy & Paste your course prefix, number, title and catalog description from the Current Cal Poly Catalog. (include the prerequisite, units, mode, grading method, crosslisting, GE area, USCP.)

   **CHEM 129 General Chemistry III (4)**
   Acid and base equilibria, buffers, transition elements, solubility, complex ions, hybridization, nuclear chemistry. Laboratory study of the chemical properties and semi-micro qualitative analysis of the representative group elements of the periodic table. 3 lectures, 1 laboratory. Prerequisite: CHEM 125 or CHEM 128.

2. **Modified Course.**

   Enter the modified course prefix, number, title and description exactly as it should appear in the catalog. Underline new or strike through existing text to indicate changes.

   **CHEM 129 General Chemistry III (4)**
   Continuation of CHEM 128. Acid and base equilibria, buffers, transition elements, solubility, complex ions, hybridization, hybrid orbital theory, molecular orbital theory, and nuclear chemistry. Laboratory study of the chemical properties and semi-micro qualitative analysis of the representative group elements of the periodic table. 3 lectures, 1 laboratory. Prerequisite: CHEM 125 or CHEM 128.

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Proposer: jhagen@calpoly.edu
telephone:x61651
Requested start term: Fall 2011

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   (include the prerequisite, units, mode, grading method, crosslisting, GE area, USCP.)

CHEM 373 Molecular Biology (3)

2. Modified Course.

   Enter the modified course prefix, number, title and description exactly as it should appear in the catalog.
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CHEM 373 Molecular Biology (3)

3. Indicate All Changes and Reason for Each

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4. Consultation:

Identify programs affected by this change: None.

Attach signed consultation memos from other departments affected by the change.

5. Resources:

Explain if the change will require any additional or redistributed resources.

No additional resources are required.

Approval Signatures:

Department Curriculum Chair: Date: 

Department Chair/Head: Date: 

College Curriculum Committee Chair: Date: 

College Dean: Date: 

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Department: Chemistry and Biochemistry      Date:  13 April 2010
Proposer:                                     Requested start term:  Fall 2011
email: jhagen@calpoly.edu
telephone:x61651

1. Existing Course.

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CHEM 474 Protein Techniques Laboratory (2)
Experiments in protein affinity chromatography, electrophoresis and blotting, immunoprecipitation techniques, antibody-enzyme conjugation, and immunoassay. 2 laboratories. Prerequisite: CHEM 371 or consent of instructor.

2. Modified Course.

Enter the modified course prefix, number, title and description exactly as it should appear in the catalog. Underline new or strike through existing text to indicate changes.

CHEM 474 Protein Techniques Laboratory (2)
Experiments in protein purification and analysis from recombinant sources. Ion-exchange and affinity chromatography, electrophoresis and blotting, immunoprecipitation techniques, antibody-enzyme conjugation, and immunoassay. UV, chemical, immuno, and fluorescent detection. Enzyme kinetic analysis. Prerequisite: CHEM 371 or consent of instructor.

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<td>The selection of lab experiments has evolved over the years; the description proposed reflects this.</td>
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College Curriculum Committee Chair: Date: 

College Dean: Date: 

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## 1. Existing Course.

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CHEM 316 Organic Chemistry I (5)
Structure, bonding, nomenclature, isomerism, stereochemistry and physical properties of organic compounds. Introduction to spectroscopy. Reactions and mechanisms of alkanes, alkenes, alkynes, cycloalkanes and aromatic compounds. Laboratory techniques in organic preparations. 4 lectures, 1 laboratory. Prerequisite: CHEM 125 or CHEM 128.

## 2. Modified Course.

Enter the modified course prefix, number, title and description exactly as it should appear in the catalog. Underline new or strike through existing text to indicate changes.

CHEM 316 Organic Chemistry I (5)
Structure, bonding, nomenclature, isomerism, stereochemistry and physical properties of organic compounds. Introduction to spectroscopy. Reactions and mechanisms of alkanes, alkenes, alkynes, cycloalkanes and aromatic compounds. Laboratory techniques in organic preparations. 4 lectures, 1 laboratory. Prerequisite: CHEM 125 or CHEM 128 CHEM 129.

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<tr>
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<td>(if substantially different, use Course Proposal form)</td>
</tr>
</tbody>
</table>

Revised 3/1/2010
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
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</tr>
</tbody>
</table>

**Units**

**Crosslisting**

**Grading Method**
(CR/NC or Regular)

**Mode of Instruction**
(For Academic Programs’ use: CS #______)

**Prerequisite**

- Much of the background needed to understand CHEM 316 is included in CHEM 129.

**Repeatability**
- Is the course repeatable for multiple credit?
  - Yes [ ]
  - No [ ]
- If yes, what is maximum # of units? _______
- Is the course repeatable in the same term?
  - Yes [ ]
  - No [ ]

4. **Consultation:**

- Identify programs affected by this change:
- Attach signed consultation memos from other departments affected by the change.

5. **Resources:**

- Explain if the change will require any additional or redistributed resources.

  No additional resources are required.

**Approval Signatures:**

<table>
<thead>
<tr>
<th>Department Curriculum Chair:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department Chair/Head:</td>
<td>Date:</td>
</tr>
<tr>
<td>College Curriculum Committee Chair:</td>
<td>Date:</td>
</tr>
<tr>
<td>College Dean:</td>
<td>Date:</td>
</tr>
</tbody>
</table>

(This signature is the Dean’s guarantee that s/he will provide any additional or redistributed resources needed to support this course.)

**Registrar:** Date: __________________________

Submit completed form with any attachments to Office of the Registrar, Attn: Susan Olivas

Revised 3/1/2010
Course Modification Form

Note: If requesting to make change using "Continuous Review" process, you may use this form if you are proposing a course modification that does not affect another department/program. If course is required by another program, the request must be submitted during Catalog Review cycle.

If course content is being revised to meet GE or USCP, use "Course Proposal" form and refer to GE-USCP Criteria. Don't use this form.

Department: Chemistry and Biochemistry  Date: 13 April 2010

Proposer:  Requested start term:  Fall 2011
email: jhagen@calpoly.edu
telephone: x61651

1. Existing Course.

Copy & Paste your course prefix, number, title and catalog description from the current Cal Poly Catalog. (include the prerequisite, units, mode, grading method, crosslisting, GE area, USCP.)

CHEM 441 Bioinformatics Applications (4)
Introduction to new problems in molecular biology and current computer applications for genetic database analyses. Use of software for: nucleic acid, genome and protein sequence analysis; genetic databases, database tools; industrial applications in bioinformatics; ethical and societal concerns. 3 lectures, 1 laboratory. Prerequisite: One course in college biology (BIO 111 or BIO 161 recommended). Recommended: BIO 303, BIO 351 or CHEM 373. Crosslisted as BIO/CHEM 441.

2. Modified Course.

Enter the modified course prefix, number, title and description exactly as it should appear in the catalog. Underline new or strike through existing text to indicate changes.

CHEM 441 Bioinformatics Applications (4)
Introduction to new problems in molecular biology and current computer applications for genetic database analyses. Use of software for: nucleic acid, genome and protein sequence analysis; genetic databases, database tools; industrial applications in bioinformatics; ethical and societal concerns. 3 lectures, 1 laboratory. Prerequisite: One course in college biology (BIO 111 or BIO 161 recommended). Recommended: BIO 303, BIO 351 or CHEM 373. BIO 161 or BIO 303 and junior standing. Recommended: BIO 302, 303, 351 or CHEM 373.
Crosslisted as BIO/CHEM 441.

3. Indicate All Changes and Reason for Each

<table>
<thead>
<tr>
<th>Check all that apply.</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delete Course</td>
<td></td>
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<tr>
<td>(only to be proposed as a catalog change)</td>
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</tr>
<tr>
<td>Course Prefix</td>
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<tr>
<td>(only to be proposed as a catalog change)</td>
<td></td>
</tr>
<tr>
<td>Number</td>
<td></td>
</tr>
<tr>
<td>Title</td>
<td></td>
</tr>
</tbody>
</table>

Revised 3/1/2010
| Description (if substantially different, use Course Proposal form) |
| Units |
| Crosslisting |
| Grading Method (CR/NC or Regular) |
| Mode of Instruction (For Academic Programs' use: CS #_______) |
| Prerequisite |
| Repeatability |
| Is the course repeatable for multiple credit? Yes No |
| If yes, what is maximum # of units? ______ |
| Is the course repeatable in the same term? Yes No |

**The instructors believe that the present prerequisites do not adequately prepare the students for the course.**

4. **Consultation:**

Identify programs affected by this change: None.

Attach signed consultation memos from other departments affected by the change.

5. **Resources:**

Explain if the change will require any additional or redistributed resources.

No additional resources are required.

**Approval Signatures:**

| Department Curriculum Chair: | Date: |
| Department Chair/Head: | Date: |
| College Curriculum Committee Chair: | Date: |
| College Dean: | Date: |

(This signature is the Dean's guarantee that s/he will provide any additional or redistributed resources needed to support this course.)

| Registrar: | Date: |

Submit completed form with any attachments to Office of the Registrar, Attn: Susan Olivas

Revised 3/1/2010
Course Modification Form

Note: If requesting to make change using "Continuous Review" process, you may use this form if you are proposing a course modification that does not affect another department/program. If course is required by another program, the request must be submitted during Catalog Review cycle.

If course content is being revised to meet GE or USCP, use "Course Proposal" form and refer to GE/USCP Criteria. Don't use this form.

Department: Chemistry and Biochemistry  Date: 13 April 2010

Proposer: Requested start term:  Fall 2011
email: jhagen@calpoly.edu
telephone:x61651

1. Existing Course.

Copy & Paste your course prefix, number, title and catalog description from the Current Cal Poly Catalog. (include the prerequisite, units, mode, grading method, crosslisting, GE area, USCP.)

CHEM 472 Plant Biochemistry (3)
Application of plant biochemistry, molecular biology and physiology to topics, including plant secondary metabolism, defense mechanisms, drought tolerance, functional genomics, advanced photosynthesis, circadian rhythms, manipulation of plants for improved nutrition, other current research topics. 3 lectures. Prerequisite: CHEM 313 or CHEM 371 or BIO 435.

2. Modified Course.

Enter the modified course prefix, number, title and description exactly as it should appear in the catalog. Underline new or strike through existing text to indicate changes.

3. Indicate All Changes and Reason for Each

Check all that apply. Reasons

- [x] Delete Course  This course was offered infrequently, and
  (only to be proposed as a catalog change) enrollment was always low.

- [ ] Course Prefix  
  (only to be proposed as a catalog change)

- [ ] Number

- [ ] Title

- [ ] Description  
  (if substantially different, use Course Proposal form)

- [ ] Units

- [ ] Crosslisting

- [ ] Grading Method  
  (CR/NC or Regular)

Revised 3/1/2010
| **Mode of Instruction** |  
| (For Academic Programs' use: CS # _______) |
| **Prerequisite** |
| **Repeatability** |
| Is the course repeatable for multiple credit?  
| [ ] Yes  
| [ ] No  
| If yes, what is maximum # of units?  
|  
| Is the course repeatable in the same term?  
| [ ] Yes  
| [ ] No |

4. **Consultation:**

Identify programs affected by this change: None

Attach signed consultation memos from other departments affected by the change.

5. **Resources:**

Explain if the change will require any additional or redistributed resources.

No additional resources are required.

**Approval Signatures:**

| Department Curriculum Chair: | Date: |
| Department Chair/Head: | Date: |
| College Curriculum Committee Chair: | Date: |
| College Dean: | Date: |

(This signature is the Dean’s guarantee that s/he will provide any additional or redistributed resources needed to support this course.)

| Registrar: | Date: |

Submit completed form with any attachments to Office of the Registrar, Attn: Susan Olivas

Revised 3/1/2010
Chemistry & Biochemistry

Faculty Offices East Bldg. (25), Room 125B
(805) 756-2693
www.calpoly.edu/~chem

Department Chair, Christina A. Bailey

Philip S. Bailey       Eric J. Kantorowski
Seth Bush             David L. Keeling
Jennifer Carroll      Kevin B. Kingsbury
Albert C. Censullo    Corinne Lehr
Philip Costanzo       Lisa M. Lindert
Leland S. Endres      John F. Marlier
Raymond Fernando      Kristen Meisenheimer
Emily Fogle            Grace Ann Neff
John W. F. Goers      Hasan Palandoken
Anya Goodman          Margaret (Peggy) S. Rice
Derek E. Gragson      Lori Robins
John P. Hagen         Rod W. Schoonover
Chad E. Immoos        Michael G. Silvestri
Dane R. Jones         Jari W. Cimek
                     Nanine A. Van Draanen

ACADEMIC PROGRAMS
Biochemistry – BS
Chemistry – BS
Polymers and Coatings Science – MS

The Chemistry and Biochemistry Department has two roles in the university: to provide professional education for students who are majors in chemistry and biochemistry and who plan careers in the natural sciences and related fields, and to provide instruction in the fundamentals of chemistry to students with majors in fields related to chemistry, especially in the life sciences, agriculture, and engineering.

The Chemistry and Biochemistry Department provides curricula leading to the Bachelor of Science in Chemistry, the Bachelor of Science in Chemistry with a certified concentration in Polymers and Coatings, the Bachelor of Science in Biochemistry, the Bachelor of Science in Biochemistry with a concentration in Polymers and Coatings, the Bachelor of Science in Biochemistry with a concentration in Molecular Biology, and the Master of Science in Polymers and Coatings Science. The BS in Chemistry and the concentration in Polymers and Coatings are certified by the American Chemical Society. An option in Chemical Education designed for aspiring teachers in secondary schools is also available.
The baccalaureate curricula in biochemistry and chemistry include required courses in general chemistry, analytical chemistry, inorganic chemistry, organic chemistry, biochemistry and physical chemistry. Advanced undergraduates choose electives from courses that cover a broad range of specialized topics, such as environmental chemistry, geochemistry, glass chemistry, immunology, nutritional biochemistry, advanced organic and physical chemistry, pharmacology, and polymer chemistry. The curricula emphasize laboratory work, especially current techniques and the use of instrumentation in all fields of chemistry. The programs provide opportunities for independent research under faculty guidance, including a requirement for a senior project. A senior project may consist of pure or applied research in chemistry or biochemistry, or it may involve interdisciplinary work with another field such as art, biology, civil or environmental engineering, psychology, or soil science. Under the department's cooperative education program, bachelor's degree candidates may work full-time in industry or government for one or two quarters, for pay and academic credit.

Career opportunities for chemists are increasing. There are openings in traditional areas such as clinical chemistry, environmental analysis, the health professions, industrial research and production, pharmacology, toxicology, product quality control, and teaching at the secondary or university level. Newer opportunities lie in related areas such as library science, market research, patent law, and safety engineering.

There is a rapidly increasing number of career opportunities in the expanding fields of biotechnology and polymers and coatings. Students completing a concentration in either molecular biology or in polymers and coatings are prepared for direct entry into these careers, as well as for postgraduate education in a professional specialty.

The department offers a flexible chemical education degree option for students interested in a career in pre-college science education. Interested students should contact the single subject teaching credential advisor early in their academic career for more information.
Curricular Concentrations

Polymers and Coatings. Includes the required courses in the chemistry or biochemistry curriculum and electives in the area of polymers, coatings, surface chemistry and materials engineering. The concentration gives students the background and practical experience to move into a rewarding career in a wide range of fields including textiles, paints and varnishes, rubber, plastics, adhesives and resins.

Molecular Biology. (discontinued Summer 2009)

Biotechnology Minor

For information regarding the Biotechnology minor, see College of Science and Mathematics section.
BS CHEMISTRY

☐ 60 units upper division ☐ GWR
☐ 2.0 GPA ☐ USCP

* = Required in Major/Support; also satisfies GE

Course sequencing: See flowcharts at
www.csmadvising.calpoly.edu

Note: No major, support or concentration courses
may be taken as credit/no credit.

MAJOR COURSES

CHEM 127 General Chemistry (B3 & B4)*.............. 4
CHEM 128 General Chemistry.......................... 4
CHEM 129 General Chemistry.......................... 4
CHEM 316 Organic Chemistry I.......................... 5
CHEM 317 Organic Chemistry II.......................... 5
CHEM 318 Organic Chemistry III...................... 3
CHEM 319 Advanced Organic Chemistry Lab........... 2

1 CHEM 331 Quantitative Analysis...................... 5
CHEM 351 Physical Chemistry I....................... 3
CHEM 352 Physical Chemistry II...................... 3
CHEM 353 Physical Chemistry III...................... 3
CHEM 354 Physical Chemistry Laboratory............. 2
CHEM 357 Physical Chemistry III Laboratory........ 1
CHEM 371 Biochemical Principles...................... 5
CHEM 439 Instrumental Analysis....................... 5

2 CHEM 459 Undergraduate Seminar (2) or SCM
491 Student Teacher Seminar (1) (1).................. 2
CHEM 461 Senior Project Report....................... 1
CHEM 481 Inorganic Chemistry......................... 3
CHEM 484 Inorganic Chemistry Lab..................... 2

Select 15 units of approved advanced chemistry
electives (a minimum of three courses from
List B) or Polymers and Coatings

Concentration to complete major...................... 15/18

List A

CHEM 252, 341, 349, 372, 373, 377, 4001, 4014,
447, 448, 449, 465, 474, 477, 478, 4852, 4953,
528;
BIO/ CHEM 375;
PSC/BIO 424; SCM 451

List B (Select at least 3 courses)

CHEM 405, 419, 420, 444, 445, 446, 458, 463,
470

77/80

---

1 Students should take CHEM 331 during their second year.

2 SCM 491 only for students pursuing Single-Subject Teaching
     Credential.

3 No more than 2 units may apply to approved advanced chemistry
electives.

4 No more than 4 units may apply to approved advanced chemistry
electives.
**SUPPORT COURSES**

- BIO 161 Intro to Cell & Molecular Biology (B2)* .................. 4
- MATH 141, 142, 143 Calculus I, II, III (B1)* ............... 4,4,4
- MATH 241 Calculus IV ................................................. 4
- MATH 244 or 200-400 level STAT or CSC course ............... 4
- PHYS 141 General Physics IA .................................................. 4
- PHYS 132 General Physics II .................................................. 4
- PHYS 133 General Physics III .................................................. 4
- Physics elective (200-level and above) ......................... 3

\[ \text{Total: 39 units} \]

---

**GENERAL EDUCATION (GE)**

- 72 units required, 16 of which are specified in Major/Support.
- See page 50 for complete GE course listing.
- Minimum of 12 units required at the 300 level.

### Area A Communication (12 units)

- A1 Expository Writing .......................................................... 4
- A2 Oral Communication .......................................................... 4
- A3 Reasoning, Argumentation, and Writing ......................... 4

### Area B Science and Mathematics (no additional units are required)

- B1 Mathematics/Statistics * 8 units in Support .... 0
- B2 Life Science * 4 units in Support .................. 0
- B3 Physical Science * 4 units in Major .................. 0
- B4 One lab taken with either a B2 or B3 course ....... 0

### Area C Arts and Humanities (20 units)

- C1 Literature .......................................................................... 4
- C2 Philosophy ....................................................................... 4
- C3 Fine/Performing Arts ......................................................... 4
- C4 Upper-division elective ...................................................... 4
- Area C elective (Choose one course from C1-C4) . 4

### Area D/E Society and the Individual (20 units)

- D1 The American Experience (40404) ............... 4
- D2 Political Economy .............................................................. 4
- D3 Comparative Social Institutions .................. 4
- D4 Self Development (CSU Area E) .................. 4
- D5 Upper-division elective ...................................................... 4

### Area F Technology Elective (upper division)

- (4 units) ........................................................................... 4

\[ \text{Total: 56 units} \]

### FREE ELECTIVES

\[ \text{Total: 8/5 units} \]

\[ \text{Total: 180 units} \]
Concentration
(Students may select the following concentration)

Polymers and Coatings Concentration
CHEM 444 Polymers and Coatings I .................. 3
CHEM 445 Polymers and Coatings II ............... 3
CHEM 446 Surface Chemistry of Materials ........ 3
CHEM 447 Polymers and Coatings Lab I .......... 2
CHEM 448 Polymers and Coatings Lab II ......... 2
CHEM 449 Internship in Polymers and Coatings .. 2
MATE 210 Materials Engineering .................. 3

18
**Concentration**  
(Students may select the following concentration)

**Polymers and Coatings Concentration**  
<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 444 Polymers and Coatings I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 445 Polymers and Coatings II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 446 Surface Chemistry of Materials</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 447 Polymers and Coatings Lab I</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 448 Polymers and Coatings Lab II</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 449 Internship in Polymers and Coatings</td>
<td>2</td>
</tr>
<tr>
<td>MATE 210 Materials Engineering</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total** 18 credits
MASTER OF SCIENCE DEGREE IN POLYMERS AND COATINGS SCIENCE

General Characteristics
The MS degree in Polymers and Coatings Science offers a unique, focused program closely tied to industry. Students gain academic preparation in polymers and coatings science through lecture and laboratory courses, then undertake a rigorous industrial internship. While on the internship students specialize and develop advanced skills through directed study in areas related to their internship work. The program is designed to prepare students for challenging careers in the polymers and coatings industry. The program also provides excellent background for doctoral studies in areas related to polymer and coatings science. This program is unique in California and relies on the close relationship between the department and the polymers and coatings industry for its success.

Prerequisites
Students entering the program must have a bachelor's degree from an accredited institution with a minimum grade point average of 2.5 in the last 90 quarter units attempted. Applicants with majors in chemistry, biochemistry, materials engineering, chemical engineering or related fields generally meet the prerequisites for courses in the program. Applicants with degrees in other areas may need to take supplemental courses in organic and physical chemistry and can be admitted conditionally. For information concerning additional departmental requirements, the student should contact the Graduate Advisor in the Chemistry and Biochemistry Department.

Advancement to candidacy requires completion of 12 units of an approved study plan with a minimum grade point average of 3.0.

Blended BS + MS Program in Chemistry or Biochemistry (BS) and Polymers and Coatings Science (MS)
The blended program provides motivated students with an accelerated route to the MS in Polymers and Coatings Science, with simultaneous conferring of both bachelor's and master's degrees. Students in the blended program are provided with a seamless process whereby they can progress from undergraduate to graduate status.

Eligibility
Students majoring in chemistry or biochemistry may be eligible to pursue the blended program toward the MS in Polymers and Coatings Science. Participation in the program is based on prior academic performance and other measures of professional promise, with a minimum GPA of 2.5 required (3.0 recommended). Students are generally selected for the blended program by a faculty committee during the junior year. Please see the catalog description on Blended Programs for eligibility criteria.

Students may begin taking the required graduate courses in either their junior or senior year depending on their
preparation. Students may not pursue both the Concentration in Polymers and Coatings and the MS in Polymers and Coatings Science. Students pursuing the concentration take the 400-level polymers and coatings courses while those pursuing the MS degree take the 500-level polymers and coatings courses. Students cannot receive credit for both 400 and 500-level courses in the same topic.

Students in the blended program are eligible to apply for the Graduate Internship upon completion of the required graduate-level chemistry courses.

<table>
<thead>
<tr>
<th>Required courses</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 544 Polymer Physical Chemistry and Analysis (3)</td>
<td>27</td>
</tr>
<tr>
<td>CHEM 545 Polymer Synthesis and Mechanisms (3)</td>
<td></td>
</tr>
<tr>
<td>CHEM 547 Polymer Characterization and Analysis Laboratory (2)</td>
<td></td>
</tr>
<tr>
<td>CHEM 548 Polymer Synthesis Laboratory (2)</td>
<td></td>
</tr>
<tr>
<td>CHEM 550 Coatings Formulation Principles (3)</td>
<td></td>
</tr>
<tr>
<td>CHEM 551 Coatings Formulation Laboratory (2)</td>
<td></td>
</tr>
<tr>
<td>CHEM 590 Graduate Seminar (1,1,1)</td>
<td></td>
</tr>
<tr>
<td>CHEM 598 Graduate Project (3)(3)(3) or CHEM 599 Graduate Thesis (3)(3)(3)</td>
<td></td>
</tr>
</tbody>
</table>

**Restricted Electives** .................................................. 18

18 units of advisor-approved electives (at least 3 units must be from 500 level). See department for list.

A complete project report or thesis must be submitted to the graduate committee. Guidelines on how to prepare report or thesis are available from the graduate coordinator.”
CHEM--CHEMISTRY

CHEM 101 Introduction to the Chemical Sciences (1) (CR/NC)
Introduction to the chemistry and biochemistry disciplines. Orientation, advising, career opportunities and introduction to the faculty. Designed for first-year CHEM and BCHEM majors. Credit/No Credit grading only. 1 lecture. Prerequisite: CHEM/BCHEM major or consent of instructor.

CHEM 106 Introductory Chemistry (3)
Introductory course in chemistry. Measurement, metric system, properties of matter, chemical symbols, atomic structure, chemical formulas, nomenclature, chemical equations, the mole concept, stoichiometry. Not open to students who have credit in a college chemistry course. 3 lectures.

CHEM 110 World of Chemistry (4)  GE B3 & B4
The fundamentals of chemical cause and effect-structure/function relationships. The basic principles of chemistry and their applications to solving human problems in organic materials science, biochemistry, toxicology, environmental science, agriculture, nutrition, and medicine. Not open to students majoring in Chemistry or Biochemistry. Not open to students with credit for CHEM 111, CHEM 124, or CHEM 127. 3 lectures, 1 laboratory. Prerequisite: Passing score on the ELM examination for MATH 116 eligibility, or an ELM exemption, or MATH 104. Fulfills GE B3 & B4.

CHEM 111 Survey of Chemistry (5)  GE B3 & B4
Introduction to atomic theory, chemical reactions, bonding, stoichiometry, nomenclature, and solutions. Intended for students who are preparing for CHEM 212/312. Not open to students with credit for CHEM 110, CHEM 124, or CHEM 127. 4 lectures, 1 laboratory. Prerequisite: High school chemistry or CHEM 106 or equivalent, and passing score on the ELM examination for MATH 116 eligibility, or an ELM exemption, or MATH 104. Fulfills GE B3 & B4.

CHEM 124 General Chemistry for the Engineering Disciplines I (4)  GE B3 & B4
General chemistry concepts presented using a materials science approach with engineering applications. Thermochemistry, bonding, solid-state structures, fundamentals of organic chemistry including polymers. Classwork is presented in an integrated lecture-laboratory format, with an emphasis on computer-based data acquisition, collaborative methods and multimedia-based presentation. Not open to students with credit for CHEM 110, CHEM 111 or CHEM 127. Equivalent to 3 lectures, 1 laboratory. Prerequisite: High school chemistry or CHEM 106 or equivalent, and passing score on the ELM examination for MATH 116 eligibility or an ELM exemption or MATH 104. Fulfills GE B3 & B4.

CHEM 125 General Chemistry for the Engineering Disciplines II (4)  GE B3 & B4
A continuation of general chemistry designed for engineering students. Topics include solution chemistry, thermodynamics, kinetics, equilibrium, acids and bases, electrochemistry, and nuclear chemistry. Integration of laboratory with theoretical concepts. Use of computers for data acquisition and multimedia resources. Guided inquiry and collaborative methods emphasized. Not open to students with credit for CHEM 128. 3 lectures, 1 laboratory. Prerequisite: CHEM 124 or consent of course coordinator. Fulfills GE B3 & B4.

CHEM 127 General Chemistry I (4)  GE B3 & B4
Introduction to atomic theory, chemical reactions, bonding, stoichiometry, nomenclature, gas laws, colligative properties, colloids and solutions. Intended primarily for students whose majors are in the College of Science and Mathematics. Not open to students with credit for CHEM 111 or CHEM 124. 3 lectures, 1 laboratory. Prerequisite: High school chemistry or CHEM 106 or equivalent, and passing score on the ELM examination for MATH 116 eligibility or an ELM exemption or MATH 104. Fulfills GE B3 & B4.

CHEM 128 General Chemistry II (4)
Continuation of CHEM 127. Oxidation-reduction reactions, electrochemistry, kinetics, equilibria, thermodynamics, acids and bases. Intended primarily for students whose majors are in the College of Science and Mathematics. Not open to students with credit for CHEM 125. 3 lectures, 1 laboratory. Prerequisite: CHEM 127.

CHEM 129 General Chemistry III (4)
Acid and base equilibria, buffers, transition elements, solubility, complex ions, hybridization, nuclear chemistry. Laboratory study of the chemical properties and semi-micro qualitative analysis of the representative group elements of the periodic table. 3 lectures, 1 laboratory. Prerequisite: CHEM 125 or CHEM 128.
CHEM 200 Special Problems for Undergraduates (1–2)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter. Prerequisite: CHEM 111, CHEM 124, or CHEM 127 and consent of department chair.

CHEM 201 Undergraduate Research (1-3) (CR/NC)
Laboratory research under faculty supervision. Credit/No Credit grading only. Total credit limited to 6 units. 1-3 laboratories. Prerequisite: Consent of instructor.

CHEM 212 Introduction to Organic Chemistry (5)
Introduction to the fundamentals of organic chemistry nomenclature and selected reactions for the major functional groups. Promotes an understanding of how the structure and reactions of selected organic molecules relate to living systems and our environment. CHEM 212 accepted in lieu of CHEM 312, but not for upper division credit. Not open to students with credit in CHEM 312, CHEM 216/316. 4 lectures, 1 laboratory. Prerequisite: CHEM 111 or CHEM 128 or equivalent.

CHEM 216 Introduction to Organic Chemistry I (5)
Basic principles of the bonding, isomerism and stereochemistry in compounds of carbon. Essentials of organic nomenclature. Representative reactions and mechanisms for selected aliphatic and aromatic compounds. Introduction to the physical analysis and synthesis of organic compounds. CHEM 216 accepted in lieu of CHEM 316, but not for upper division credit. Not open to students with credit in CHEM 316. 4 lectures, 1 laboratory. Prerequisite: CHEM 111 or CHEM 125 or CHEM 128.

CHEM 217 Introduction to Organic Chemistry II (5)
Properties and reactions of carbonyl compounds, alcohols, and organic halides with an overview of the mechanisms of the reactions. Introductory concepts and applications of infrared and NMR spectroscopy. CHEM 217 accepted in lieu of CHEM 317, but not for upper division credit. Not open to students with credit in CHEM 317. 3 lectures, 2 laboratories. Prerequisite: CHEM 216/316.

CHEM 218 Introduction to Organic Chemistry III (3)
Properties and reactions of amines, heterocyclic and aromatic compounds with an overview of the mechanisms of the reactions. Introductory concepts and applications of ultraviolet spectroscopy and mass spectrometry. CHEM 218 accepted in lieu of CHEM 318, but not for upper division credit. Not open to students with credit in CHEM 318. 3 lectures. Prerequisite: CHEM 217/317.

CHEM 222 Introduction to Computational Chemistry (2)
Introduction to chemical structure and behavior by computational chemistry techniques. Applications include scientific visualization, molecular modeling, geometry optimization, transition states and molecular dynamics. 1 lectures, 1 laboratory. Prerequisite: CHEM 129, CHEM 316 and MATH 142 or MATH 162.

CHEM 231 Introduction to Quantitative Analysis (5)
Fundamental theory for common titrimetric and spectrophotometric methods in analytical chemistry. Essentials of chemical equilibria as it applies to titration curves. The laboratory focuses on precision and accuracy for common, practical methods in analytical chemistry. CHEM 231 accepted in lieu of CHEM 331, but not for upper division credit. Not open to student with credit in CHEM 331. 3 lectures, 2 laboratories. Prerequisite: CHEM 129.

CHEM 252 Laboratory Glassblowing (1)
Techniques of glassblowing applied to the making of simple laboratory apparatus. 1 laboratory. Prerequisite: CHEM 111, CHEM 124 or CHEM 127.

CHEM 270 Selected Topics (1–4)
Directed group study of selected topics. The Schedule of Classes will list title selected. Total credit limited to 8 units. 1 to 4 lectures. Prerequisite: Open to undergraduate students and consent of instructor.

CHEM 285 Physical Chemistry for Engineers (4) GE B6
Fundamentals and applications of chemical thermodynamics of particular interest to engineers. Chemical and phase equilibria. 4 lectures. Prerequisite: PHYS 123 or PHYS 133, CHEM 125 or CHEM 129, MATH 143. Fulfills GE B6.

CHEM 312 Survey of Organic Chemistry (5)
Structure, isomerism, nomenclature, fundamental reactions of major functional groups and applications of organic chemicals in agriculture, medicine, industry, and the home. Not open to students with credit in CHEM 212 or CHEM 216/316. 4 lectures, 1 laboratory. Prerequisite: CHEM 111 or equivalent.
CHEM 313 Survey of Biochemistry and Biotechnology (5)
Chemistry of biomolecules including carbohydrates, proteins, fats, vitamins, enzymes and hormones. Basic molecular biology with applications to biotechnology and genetic engineering. Practical intermediary metabolism of prokaryotic and eukaryotic systems. 4 lectures, 1 laboratory. Prerequisite: CHEM 212/312 or equivalent.

CHEM 316 Organic Chemistry I (5)
Structure, bonding, nomenclature, isomerism, stereochemistry and physical properties of organic compounds. Introduction to spectroscopy. Reactions and mechanisms of alkanes, alkenes, alkynes, cycloalkanes and aromatic compounds. Laboratory techniques in organic preparations. 4 lectures, 1 laboratory. Prerequisite: CHEM 125 or CHEM 128.

CHEM 317 Organic Chemistry II (5)
Reactions and reaction mechanisms of organic halides, alcohols, phenols, epoxides, ethers, carboxylic acids and their derivatives, aldehydes, ketones; acidity and basicity; infrared and NMR spectroscopy. 3 lectures, 2 laboratories. Prerequisite: CHEM 216/316.

CHEM 318 Organic Chemistry III (3)
Chemistry of amines, aromatic compounds, heterocycles, macromolecules, some biomolecules, carbonions, rearrangement and ultraviolet and mass spectrometry. 3 lectures. Prerequisite: CHEM 217/317.

CHEM 319 Advanced Organic Chemistry Laboratory (2)
Practice in multiple step organic synthesis, column chromatography, vacuum distillation, enzymes as chemical reagents, inert atmosphere techniques, introduction to FT NMR spectroscopy and mass spectrometry, survey of organic chemical literature. 2 laboratories. Prerequisite: Concurrent or prior enrollment in CHEM 218/318.

CHEM 331 Quantitative Analysis (5)
Theory and application of chemical equilibrium to analytical problems. Survey of important analytical methods with stress placed on the theory and application associated with titrimetric and spectrophotometric analysis. 3 lectures, 2 laboratories. Prerequisite: CHEM 129.

CHEM 341 Environmental Chemistry: Water Pollution (3)
Chemical aspects of water and water pollution: alkalinity; acid deposition, particularly relating to lake and stream acidification and forest decline; drinking water treatment and THMs; wastewater treatment; detergents, builders, and eutrophication; pesticides; other toxic organic compounds such as PCBs and dioxin; hazardous wastes; toxic elements such as Pb, Hg, Sn, Cd, and Se. 3 lectures. Prerequisite: CHEM 129 and CHEM 212/312 or CHEM 216/316.

CHEM 342 Environmental Chemistry: Air Pollution (3)
Chemical aspects of the atmosphere and air pollution: greenhouse effect and global climate change; CFCs, the ozone layer, and the ozone hole; carbon monoxide, nitrogen oxides, and photochemical smog, particulate matter; radon, asbestos, indoor air pollution; sulfur oxides and acid deposition, particularly relating to atmospheric reactions and control options. 3 lectures. Prerequisite: CHEM 129 and CHEM 212/312 or CHEM 216/316.

CHEM 349 Chemical and Biological Warfare (4) GE Area F
History, development, and use of chemical and biological warfare (CBW). Chemical and biological disarmament. Production and destruction of CBW agents. Uses of CBW. CBW terrorism. Ethics of CBW. 2 lectures, 2 seminars. Prerequisite: Junior standing, completion of GE Area B, including a chemistry course (CHEM), and a course in biology (BIO, MCRO or ZOO). Fulfills GE Area F.

CHEM 350 Chemical Safety (1)
Laboratory regulations, equipment hazard analysis, hazardous chemicals, classification of chemicals, toxic materials handling, reaction hazards, radiation, emergency procedures, safety management programs and legal concerns. Includes project. 1 lecture. Prerequisite: CHEM 212/312 or equivalent.

CHEM 351 Physical Chemistry I (3)
Basic physical chemistry for the study of chemical and biochemical systems. Kinetic-molecular theory, gas laws, principles of thermodynamics. Not open to students with credit in CHEM 305. 3 lectures. Prerequisite: CHEM 129, PHYS 122 or PHYS 132, MATH 143.

CHEM 352 Physical Chemistry II (3)
Application of physical chemistry to chemical and biochemical systems. Electrochemistry, kinetics, viscosity, surface and transport properties. 3 lectures. Prerequisite: CHEM 305 or CHEM 351.
CHEM 353  Physical Chemistry III (3)
Principles and applications of quantum chemistry. Chemical bonding and molecular structure. Spectroscopy and diffraction. 3 lectures. Prerequisite: CHEM 352.

CHEM 354  Physical Chemistry Laboratory (3)
Experimental studies of gases, solutions, thermochemistry, chemical and phase equilibria, electrochemistry, chemical and enzyme kinetics, computational methods and applications to chemistry and biochemistry. Applicable literature and databases. 2 laboratories. Prerequisite: CHEM 231/331 and CHEM 352.

CHEM 357  Physical Chemistry III Laboratory (1)
Experimental and computational investigations of quantum chemistry, spectroscopy, symmetry and statistical chemistry. 1 laboratory. Corequisite: CHEM 353.

CHEM 371  Biochemical Principles (5)
Chemistry and function of major cellular constituents: proteins, lipids, carbohydrates, and membranes. 4 lectures, 1 laboratory. Prerequisite: CHEM 212/312 or CHEM 217/317, and BIO 161. Recommended: CHEM 231/331.

CHEM 372  Metabolism (4)
Intermediary metabolism of carbohydrates, lipids, amino acids and nucleotides, regulation and integration of metabolic pathways, bioenergetics, photosynthesis, electron transport, nitrogen fixation, biochemical function of vitamins and minerals. 4 lectures. Prerequisite: CHEM 371.

CHEM 373  Molecular Biology (3)

CHEM 375  Molecular Biology Laboratory (3)
Introduction to techniques used in molecular biology and biotechnology: DNA extraction, characterization, cloning, Southern blotting, reverse transcription, polymerase chain reaction, and sequencing analysis. 1 lecture, 2 laboratories. Prerequisite: BIO 161, and BIO 351 or CHEM 373. Crosslisted as BIO/CHM 375.

CHEM 377  Chemistry of Drugs and Poisons (3)
Introduction to pharmacology and toxicology: history, sources, development and testing, physical and chemical properties, biochemical and physiological effects, mechanisms of action, and the therapeutic uses and toxicity of common drugs and poisons. 3 lectures. Prerequisite: CHEM 313 or CHEM 371 or consent of instructor.

CHEM 385  Geochemistry (3)
Application of chemical principles to terrestrial and extraterrestrial systems. Formation of the elements; chemical influences on the earth's formation; chemical evolution studies; age-dating techniques; reactions in sea water; petroleum and ore formation; distribution and movement of the elements. 3 lectures. Prerequisite: CHEM 216/316, CHEM 231/331.

CHEM 400  Special Problems for Advanced Undergraduates (1-3)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 3 units per quarter. 1-3 laboratories. Prerequisite: Junior standing and consent of department chair.

CHEM 401  Advanced Undergraduate Research (1-3) (CR/NC)
Laboratory research under faculty supervision. Credit/No Credit grading only. Total credit limited to 6 units. 1-3 laboratories. Prerequisite: Consent of instructor. 4 units may be applied to approved chemistry electives. Crosslisted as CHM/SCM 401.

CHEM 405  Advanced Physical Chemistry (3)
Selected advanced topics in physical chemistry, which may include statistical mechanics, computational chemistry, nonequilibrium thermodynamics, lasers in chemistry, solid-state and/or advanced spectroscopy. Total credit limited to 6 units. 3 lectures. Prerequisite: CHEM 353 or consent of instructor.

CHEM 419  Bioorganic Chemistry (3)
Methods of investigating reaction mechanisms, mechanisms of chemical catalysis, organic models of enzymes, chemistry of vitamins that serve as enzyme catalysts, chemistry of the phosphate group, synthesis of biomolecules. 3 lectures. Prerequisite: CHEM 218/318.
CHEM 420 Advanced Organic Chemistry-Synthesis (3)

CHEM 439 Instrumental Analysis (5)
Theory, practice and method selection of modern instrumental analytical techniques, including spectroscopic, electrochemical, chromatographic and thermal methods. Current industrial applications. Laboratory work emphasizes optimization of experimental parameters. 3 lectures, 2 laboratories. Prerequisite: CHEM 231/331, CHEM 354. Recommended: CHEM 333.

CHEM 441 Bioinformatics Applications (4)
Introduction to new problems in molecular biology and current computer applications for genetic database analyses. Use of software for: nucleic acid, genome and protein sequence analysis; genetic databases, database tools; industrial applications in bioinformatics; ethical and societal concerns. 3 lectures, 1 laboratory. Prerequisite: One course in college biology (BIO 111 or BIO 161 recommended). Recommended: BIO 303, BIO 351 or CHEM 373. Crosslisted as BIO/CHM 441.

CHEM 444 Polymers and Coatings I (3)
Physical properties of polymers and coatings and their measurement. Molecular weight averages, glass transition, thermodynamics of polymers. Viscoelastic properties, rheology, molecular weight determination. Thermal analysis, spectroscopic analysis, mechanical testing. 3 lectures. Prerequisite: CHEM 212/312 or CHEM 216/316.

CHEM 445 Polymers and Coatings II (3)
Introduction to polymerization methods and mechanisms. Chemistry of initiators, catalysts and inhibitors, kinetics of polymerization. Uses of representative polymer types. Synthesis, film formation, structure and properties of polymers commonly used in coatings and adhesives. 3 lectures. Prerequisite: CHEM 217/317 and CHEM 444.

CHEM 446 Surface Chemistry of Materials (3)
Surface energy, Capillarity, solid and liquid interface, adsorption. Surface areas of solids. Contact angles and wetting. Friction, lubrication and adhesion. Relationship of surface to bulk properties of materials. Applications. 3 lectures. Prerequisite: CHEM 365 or CHEM 351 or course in engineering thermodynamics. Crosslisted as CHEM/MATE 446.

CHEM 447 Polymers and Coatings Laboratory I (2)

CHEM 448 Polymers and Coatings Laboratory II (2)

CHEM 449 Internship in Polymers and Coatings (2)
Selected students will spend up to 12 weeks with an approved polymers and coatings firm engaged in production or related business. Time will be spent applying and developing production and technical skills and abilities in the polymers and coatings industry. Prerequisite: CHEM 444 or consent of instructor.

CHEM 455 FT-NMR Laboratory (1) (CR/NC)
Basic theory and operation of the high-field Fourier transform nuclear magnetic resonance spectrometer. Credit/No Credit grading only. Not open to students with credit for CHEM 458. 1 laboratory. Prerequisite: CHEM 319.

CHEM 458 Instrumental Organic Qualitative Analysis (3)
Separation, purification, and identification of organic molecules using chemical and instrumental methods, including nuclear magnetic resonance, infrared and ultraviolet spectroscopy and mass spectroscopy, and techniques in high resolution FT-NMR. 1 lecture, 2 laboratories. Prerequisite: CHEM 319.
CHEM 459 Undergraduate Seminar (2)
Oral presentation of current developments in chemistry based on current literature. Searching for, organizing and presenting developments from current literature in chemistry and biochemistry. Preparation for employment and for independent work, including senior project, in chemistry and biochemistry. 2 seminars. Prerequisite or corequisite: CHEM 318 and junior standing.

CHEM 461 Senior Project Report (1)
Completion of a senior project report under faculty supervision. Minimum 30 hours time commitment. Prerequisite: CHEM 459 and consent of instructor.

CHEM 463 Honors Research (1)
Advanced laboratory research. Results are presented in a poster session or other public forum. 1 laboratory. Prerequisite: CHEM 461 and consent of instructor.

CHEM 465 College Teaching Practicum (1–2) (CR/NC)
Teaching assignment in an undergraduate college classroom. Includes teaching and related activities under the direction of a permanent faculty member in the Department of Chemistry and Biochemistry. Total credit limited to 4 units. Prerequisite: Junior standing, CHEM 231/331 (or permission of instructor), evidence of satisfactory preparation in chemistry. Department chair approval required.

CHEM 470 Selected Advanced Topics (1–4)
Directed group study of selected topics for advanced students. Open to undergraduate and graduate students. The Schedule of Classes will list title selected. Total credit limited to 8 units. 1 to 4 lectures. Prerequisite: CHEM 305, or CHEM 351, or CHEM 217/317 or consent of instructor.

CHEM 471 Selected Advanced Laboratory (1–4)
Directed group laboratory study of selected topics for advanced students. Open to undergraduate and graduate students. The Schedule of Classes will list title selected. Total credit limited to 8 units. 1–4 laboratories. Prerequisite: Consent of instructor.

CHEM 472 Plant Biochemistry (3)
Application of plant biochemistry, molecular biology and physiology to topics, including plant secondary metabolism, defense mechanisms, drought tolerance, functional genomics, advanced photosynthesis, circadian rhythms, manipulation of plants for improved nutrition, other current research topics. 3 lectures. Prerequisite: CHEM 313 or CHEM 371 or BIO 435.

CHEM 474 Protein Techniques Laboratory (2)
Experiments in protein affinity chromatography, electrophoresis and blotting, immunoprecipitation techniques, antibody-enzyme conjugation, and immunosassay. 2 laboratories. Prerequisite: CHEM 371 or consent of instructor.

CHEM 476 Gene Expression Laboratory (2)
Heterologous gene expression of a recombinant protein in a microbial system: gene cloning, construction of expression plasmid, DNA sequence analysis, transformation of microbial host, selection and analysis of transformed host cells, expression and purification of recombinant protein. 2 laboratories. Prerequisite: BIOCHEM 375; CHEM 313 or CHEM 371. Crosslisted as BIOCHEM 476.

CHEM 477 Biochemical Pharmacology (3)
Consideration of current selected topics in pharmacology and drug targeting. 3 lectures. Prerequisite: CHEM 377 or consent of instructor.

CHEM 478 Pharmaceutical Development (3)
Process of drug development from research clinical candidate to market. Chemical process development, including synthesis optimization, scale up, pilot plant work, manufacturing, and good manufacturing procedure (GMPs). Role of pharmaceutics in drug development, including various forms of formulation, analytical development requirements, and quality assurance. Project planning and timeline management, clinical trials, and regulatory affairs, including FDA filings. 3 lectures. Prerequisite: CHEM 318.

CHEM 481 Inorganic Chemistry (3)
A systematic study of chemical and physical properties of inorganic compounds based on periodic groupings with emphasis on chemical bonding and structure. Topics will include coordination chemistry and kinetics, organometallic chemistry, advanced acid-base relationships and bonding theories plus other selected topics. 3 lectures. Prerequisite: CHEM 352, and CHEM 231/331 or consent of instructor.

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CHEM 484 Inorganic Chemistry Laboratory (2)
Laboratory techniques in inorganic chemistry. Synthetic and analytic techniques as applied to inorganic and organometallic chemistry. 2 laboratories. Prerequisite: CHEM 481.

CHEM 485 Cooperative Education Experience (6) (CR/NC)
Part-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. 2 units only applicable to approved chemistry electives. Major credit limited to 4 units; total credit limited to 12 units. Credit/No Credit grading only. Prerequisite: Sophomore standing and consent of instructor.

CHEM 495 Cooperative Education Experience (12) (CR/NC)
Full-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. 2 units only applicable to approved chemistry electives. Major credit limited to 4 units; total credit limited to 24 units. Credit/No Credit grading only. Prerequisite: Sophomore standing and consent of instructor.

CHEM 500 Special Problems for Graduate Students (1-3)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 6 units, with a maximum of 3 units per quarter. Prerequisite: Graduate standing and consent of department chair.

CHEM 528 Nutritional Biochemistry (3)
Nutritional aspects of biochemistry. Lecture, library research and student presentations. Topics include vitamins and minerals, essential and energy providing nutrients, deficiency, degenerative and genetic diseases of metabolism. Emphasis on current research and controversy. 3 seminars. Prerequisite: CHEM 313 or CHEM 372 or consent of instructor.

CHEM 544 Polymer Physical Chemistry and Analysis (3)
Physical properties of polymers and coatings and their measurement; molecular weight averages, glass transition, thermodynamics of polymers, viscoelastic properties, rheology; molecular weight determination, thermal analysis, spectroscopic analysis, mechanical testing, atomic force microscopy. Special individual project. Not open to students with credit in CHEM 444. 3 lectures. Prerequisite: CHEM 212/312 or CHEM 216/316 or equivalent; CHEM 351 or equivalent.

CHEM 545 Polymer Synthesis and Mechanisms (3)
Polymerization methods and mechanisms; chemistry of initiators, catalysts and inhibitors; use of representative types; synthesis, structure and properties of polymers commonly used in coatings and adhesives. Special individual project. Not open to students with credit in CHEM 445. 3 lectures. Prerequisite: CHEM 544.

CHEM 547 Polymer Characterization and Analysis Laboratory (2)

CHEM 548 Polymer Synthesis Laboratory (2)

CHEM 550 Coatings Formulation Principles (3)
Formulation of modern coatings. Raw materials including resins, solvents, pigments, and additives. Formulation principles for solvent-borne and high solids coatings, water-borne coatings, powder coatings, radiation cure coatings and architectural coatings. Regulatory issues; VOC's. Coating properties, film formation, film defects, application methods, color and color acceptance. Special individual project. 3 lectures. Prerequisite: CHEM 444 or CHEM 544.
CHEM 551 Coatings Formulation Laboratory (2)

CHEM 570 Selected Advanced Topics (1-4)
Directed group study of selected topics for graduate students. Open to undergraduate and graduate students. The Schedule of Classes will list title selected. Total credit limited to 8 units. 1-4 lectures. Prerequisite: Graduate standing or consent of instructor.

CHEM 571 Selected Advanced Laboratory (1-4)
Directed group laboratory study of selected topics for advanced students. Open to undergraduate and graduate students. The Schedule of Classes will list title selected. Total credit limited to 8 units. 1-4 laboratories. Prerequisite: Graduate standing or consent of instructor.

CHEM 590 Graduate Seminar in Polymers and Coatings (1)
Problems and topics in polymers and coatings selected according to the interest and needs of the students enrolled. Total credit limited to 3 units. 1 seminar. Prerequisite: Graduate standing in the Polymers and Coatings program or consent of instructor.

CHEM 598 Graduate Project (3)
Supervised industrial graduate research in polymers and coatings science. Provides students with industrial research experience. Requires approval of graduate advisor. Total credit limited to 9 units. Prerequisite: CHEM 545, CHEM 547, CHEM 548, CHEM 550, CHEM 551.

CHEM 599 Graduate Thesis (3)
Directed graduate research in specialized advanced topics related to polymers and coatings science, leading to a graduate thesis of suitable quality. Requires approval of graduate advisor. Students are expected to work independently and report weekly to faculty advisor. Total credit limited to 9 units. Prerequisite: CHEM 545, CHEM 547, CHEM 548, CHEM 550, CHEM 551.
Formerly CHEM 570.