Proposal Form For Addition And Revision Of Courses

1. Proposing College / School: College of Science and Mathematics
   Department: Department of Chemistry and Biochemistry

2. Course Prefix and Number: CHEM 2087
   3. Effective Term: Fall 2013

4. Course Title: Honors Organic Chemistry II
   Abbreviated Title (30 characters or less): HON ORG CHEM II

5. Requested Action:
   - [ ] Renumber a Course
   - [ ] Add a Course
   - [ ] Revise a Course
   - Current Course Number:
     - [ ] Proposed Course Number: 2087
   - Type of Revision:

6. Course Credit:
   - Contact/Group Hours
   - Scheduled Type (e.g.: Lab, Lecture, Practicum, Directed Study)
   - Weekly or Per Term?
   - Credit Hours
   - Anticipated Enrollment
   - Maximum Hours (Repeatability):

<table>
<thead>
<tr>
<th>Contact/Group Hours</th>
<th>Scheduled Type</th>
<th>Weekly or Per Term?</th>
<th>Credit Hours</th>
<th>Anticipated Enrollment</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Lecture</td>
<td>Weekly</td>
<td>3</td>
<td>100</td>
</tr>
</tbody>
</table>

   Total Credit Hours: 3

7. Grading Type:
   - [ ] Regular (ABCDF)
   - [ ] Satisfactory/Unsatisfactory (S/U)
   - [ ] Audit

8. Prerequisites/Corequisites:
   Use “P” to indicate a prerequisite, “C” to indicate a corequisite, and “P/C” to indicate a prerequisite with concurrency.

   P Member of the Honors College or CHEM2077 or Department Approval

9. Restrictions: List specific restriction in space above.
   - [ ] College
   - [ ] Major
   - [ ] Standing
   - [ ] Degree

10. Course Description:
    (20 Words or Less; exactly as it should appear in the Bulletin)
    Organic chemistry for students in the honors program and Chemistry and Biochemistry majors. Topics similar to CHEM2080, but covered in more depth. Additional credit will not be given for CHEM2080

11. May Count Either:
    CHEM2080 or CHEM2087
    (Indicate if this particular course cannot be counted for credit in addition to another)

12. Affected Program(s):
    (Respond “N/A” if not included in any program; attach memorandum if more space is required)

<table>
<thead>
<tr>
<th>Program Type</th>
<th>Program Title</th>
<th>Requirement or Elective?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major</td>
<td>BS/BA Chemistry, BS Biochemistry</td>
<td>Required</td>
</tr>
<tr>
<td>Major</td>
<td>BS Lab Tech, Med Tech</td>
<td>Required</td>
</tr>
</tbody>
</table>

13. Overlapping or Duplication of Other Units’ Offerings:
    (If course is included in any other degree program, is used as an elective frequently by other unit(s), or is in an area similar to that covered by another college/school, attach correspondence with relevant unit)
   - [ ] Applicable
   - [ ] Not Applicable

(Include a concise, yet adequate rationale for the addition/revision of the course, citing accreditation, assessments (faculty, graduate, and/or external) where applicable)

15. Resources: Not Applicable

(Indicate whether existing resources such as library materials, classroom/lab space, and faculty appointments are adequate to support the proposed addition/revision; if additional resources are required, indicate how such needs will be met, referencing the appropriate level of authorization -- i.e.: Dean -- where necessary; if no additional resources or shifting of resources will be necessary, respond "Not Applicable")

16. Student Learning Outcomes: see attached syllabus

(State in measurable terms (reflective of course level) what students should be able to do when they have completed this course)

17. Course Content Outline: See attached syllabus

(Provide a comprehensive, week-by-week breakdown of course content, including assignment due dates)

18. Assignments / Projects: See attached syllabus

(List all quizzes, projects, reports, activities and other components of the course grade -- including a brief description of each assignment that clarifies its contribution to the course's learning objectives)

19. Rubric and Grading Scale: See attached syllabus

(List all components of the course grade -- including attendance and/or participation if relevant -- with point totals for each; indicate point totals and ranges or percentages for grading scale; for S/U grading, detail performance expectations for a passing grade)

20. Justification for Graduate Credit:

(Included below are standard statements regarding course policies. If necessary, a statement may be altered to reflect the academic policies of individual faculty members and/or the academic unit or department, provided that there is no conflict with the Tiger Cub, Faculty Handbook, or any existing university policy.)

POLICY STATEMENTS

Attendance: Although attendance is not required, students are expected to attend all classes, and will be held responsible for any content covered in the event of an absence.

Excused Absences: Students are granted excused absences from class for the following reasons: illness of the student or serious illness of a member of the student's immediate family, the death of a member of the student's immediate family, trips for student organizations sponsored by an academic unit, trips for university classes, trips for participation in intercollegiate athletic events, subpoena for a court appearance, and religious holidays. Students who wish to have an excused absence from class for any other reason must contact the instructor in advance of the absence to request permission. The instructor will weigh the merits of the request, and render a decision. When feasible, the student must notify the instructor prior to the occurrence of any excused absences, but in no case shall such notification occur more than one week after the absence. Appropriate documentation for all excused absences is required. Please see the Tiger Cub for more information on excused absences.

Make-Up Policy: An arrangement to make up a missed major examination (e.g.: hour exams, mid-term exams) due to properly authorized excused absences must be initiated by the student within one week of the end of the period of the excused absence(s). Except in unusual circumstances, such as the continued absence of the student or the advent of university holidays, a make-up exam will take place within two weeks of the date that the student initiates arrangements for it. Except in extraordinary circumstances, no make-up exams will be arranged during the last three days before the final exam period begins.

Academic Honesty Policy: All portions of the Auburn University student academic honesty code (Title XII) found in the Tiger Cub will apply to university courses. All academic honesty violations or alleged violations of the SGA Code of Laws will be reported to the Office of the Provost, which will then refer the case to the Academic Honesty Committee.

Disability Accommodations: Students who need special accommodations in class, as provided for by the Americans With Disabilities Act, should arrange for a confidential meeting with the instructor during office hours in the first week of classes (or as soon as possible if accommodations are needed immediately). The student must bring a copy of their Accommodation Letter and an Instructor Verification Form to the meeting. If the student does not have these forms, they should make an appointment with the Program for Students with Disabilities, 1288 Haley Center, 844-2086 (V/TI).
## CHEM2087 HONORS ORGANIC CHEMISTRY SYLLABUS

### 15 Structure Determination: Mass Spectrometry and Infrared Spectroscopy

- **a)** Mass Spectrometry of Small Molecules: Magnetic-Sector Instruments
- **b)** Interpreting Mass Spectra
- **c)** Mass Spectrometry of Some Common Functional Groups
- **d)** Mass Spectrometry in Biological Chemistry: Time-of-Flight (TOF) Instruments
- **e)** Spectroscopy and the Electromagnetic Spectrum
- **f)** Infrared Spectroscopy
- **g)** Interpreting Infrared Spectra
- **h)** Infrared Spectra of Some Common Functional Groups

### 16 Structure Determination: Nuclear Magnetic Resonance Spectroscopy

- **a)** Nuclear Magnetic Resonance Spectroscopy
- **b)** The Nature of NMR Absorptions
- **c)** Chemical Shifts
- **d)** $^{13}$C NMR Spectroscopy: Signal Averaging and FT-NMR
- **e)** Characteristics of $^{13}$C NMR Spectroscopy
- **f)** DEPT $^{13}$C NMR Spectroscopy
- **g)** Uses of $^{13}$C NMR Spectroscopy
- **h)** $^1$H NMR Spectroscopy and Proton Equivalence
- **i)** Chemical Shifts in $^1$H NMR Spectroscopy
- **j)** Integration of $^1$H NMR Absorptions: Proton Counting
- **k)** Spin—Spin Splitting in $^1$H NMR Spectra
- **l)** More Complex Spin—Spin Splitting Patterns
- **m)** Uses of $^1$H NMR Spectroscopy

### 17 Alcohols and Phenols

- **a)** Naming Alcohols and Phenols
- **b)** Properties of Alcohols and Phenols
- **c)** Preparation of Alcohols: A Review
- **d)** Alcohols from Reduction of Carbonyl Compounds
- **e)** Alcohols from Reaction of Carbonyl Compounds with Grignard Reagents
- **f)** Reactions of Alcohols
- **g)** Oxidation of Alcohols
- **h)** Protection of Alcohols
- **i)** Phenols and Their Uses
- **j)** Reactions of Phenols
- **k)** Spectroscopy of Alcohols and Phenols

### 18 Ethers and Epoxides; Thiols and Sulfides

- **a)** Names and Properties of Ethers
- **b)** Synthesis of Ethers
- **c)** Reactions of Ethers: Acidic Cleavage
- **d)** Reactions of Ethers: Claisen Rearrangement
- **e)** Cyclic Ethers: Epoxides
- **f)** Reactions of Epoxides: Ring-Opening
- **g)** Crown Ethers
- **h)** Thiols and Sulfides
- **i)** Spectroscopy of Ethers

### 19 Aldehydes and Ketones: Nucleophilic Addition Reactions

- **a)** Naming Aldehydes and Ketones
- **b)** Preparation of Aldehydes and Ketones
- **c)** Oxidation of Aldehydes and Ketones
- **d)** Nucleophilic Addition Reactions of Aldehydes and Ketones
- **e)** Nucleophilic Addition of H$_2$O: Hydration
- **f)** Nucleophilic Addition of HCN: Cyanohydrin Formation
- **g)** Nucleophilic Addition of Grignard and Hydride Reagents: Alcohol Formation
- **h)** Nucleophilic Addition of Amines: Imine and Enamine Formation
- **i)** Nucleophilic Addition of Hydrazine: The Wolff—Kishner Reaction
- **j)** Nucleophilic Addition of Alcohols: Acetal Formation
- **k)** Nucleophilic Addition of Phosphorus Ylides; The Wittig Reaction
- **l)** Biological Reductions
- **m)** Conjugate Nucleophilic Addition to $\alpha,\beta$-Unsaturated Aldehydes and Ketones
- **n)** Spectroscopy of Aldehydes and Ketones

### 20 Carboxylic Acids and Nitriles

- **a)** Naming Carboxylic Acids and Nitriles
- **b)** Structure and Properties of Carboxylic Acids
- **c)** Biological Acids and the Henderson-Hasselbalch Eq.
- **d)** Substituent Effects on Acidity
- **e)** Preparation of Carboxylic Acids
- **f)** Reactions of Carboxylic Acids: An Overview
- **g)** Chemistry of Nitriles
- **h)** Spectroscopy of Carboxylic Acids and Nitriles
- **i)** Carboxylic Acid Derivatives: Nucleophilic Acyl Substitution Reactions

### 21 Carboxylic Acid Derivatives: Nucleophilic Acyl Substitution Reactions

- **a)** Naming Carboxylic Acid Derivatives
- **b)** Nucleophilic Acyl Substitution Reactions
- **c)** Nucleophilic Acyl Substitution Reactions of Carboxylic Acids
- **d)** Chemistry of Acid Halides
- **e)** Chemistry of Acid Anhydrides
- **f)** Chemistry of Esters
- **g)** Chemistry of Amides
- **h)** Chemistry of Thioesters and Acyl Phosphates; Biological Carboxylic Acid Derivatives
- **i)** Polyamides and Polyesters; Step-Growth Polymers
- **j)** Spectroscopy of Carboxylic Acid Derivatives
22 Carbonyl Alpha-Substitution Reactions

a) Keto—Enol Tautomerism
b) Reactivity of Enols: The Mechanism of Alpha-Substitution Reactions
c) Alpha Halogenation of Aldehydes and Ketones
d) Alpha Bromination of Carboxylic Acids: The Hell—Volhard—Zelinskii Reaction
e) Acidity of Alpha Hydrogen Atoms: Enolate Ion Format
f) Reactivity of Enolate Ions
g) Alkylation of Enolate Ions
h) Carbonyl Condensation Reactions
i) Carbonyl Condensations versus Alpha Substitutions
j) Dehydration of Aldol Products: Synthesis of Enones
k) Using Aldol Reactions in Synthesis
l) Mixed Aldol Reactions
m) Intramolecular Aldol Reactions
n) The Claisen Condensation Reaction
o) Mixed Claisen Condensations
p) Intramolecular Claisen Condensations: The Dieckmann Cyclization
q) Conjugate Carbonyl Additions: The Michael Reaction
r) Carbonyl Condensations with Enamines: The Stork Reaction
s) The Robinson Annulation Reaction
t) Some Biological Carbonyl Condensation Reactions

24 Amines and Heterocycles

a) Naming Amines
b) Properties of Amines
c) Basicity of Amines
d) Basicity of Substituted Arylamines
e) Biological Amines and the Henderson—Hasselbalch Eq.
f) Synthesis of Amines
g) Reactions of Amines
h) Reactions of Arylamines
i) Heterocycles
j) Spectroscopy of Amines

25 Biomolecules: Carbohydrates

a) Classification of Carbohydrates
b) Depicting Carbohydrate Stereochemistry: Fischer Projections
c) D,L Sugars
d) Configurations of the Aldoses
e) Cyclic Structures of Monosaccharides: Anomers
f) Reactions of Monosaccharides
g) The Eight Essential Monosaccharides
h) Disaccharides
i) Polysaccharides and Their Synthesis
j) Some Other Important Carbohydrates
k) Cell-Surface Carbohydrates and Carbohydrate Vaccines

26 Biomolecules: Amino Acids, Peptides, and Proteins

a) Structures of Amino Acids
b) Amino Acids, the Henderson—Hasselbalch Equation, and Isoelectric Points
c) Synthesis of Amino Acids
d) Peptides and Proteins
e) Amino Acid Analysis of Peptides
f) Peptide Sequencing: The Edman Degradation
g) Peptide Synthesis
h) Automated Peptide Synthesis: The Merrifield Solid-Phase Method
i) Protein Structure
j) Enzymes and Coenzymes
k) How Do Enzymes Work? Citrate Synthase

27 Biomolecules: Nucleic Acids

a) Nucleotides and Nucleic Acids
b) Base Pairing in DNA; The Watson—Crick Model
c) Replication of DNA
d) Transcription of DNA
e) Translation of RNA; Protein Biosynthesis
f) DNA Sequencing
g) DNA Synthesis
h) The Polymerase Chain Reaction
Additional Information for Honors Organic Chemistry

SLO CHEM2077

After this course the student will have mastery of the concepts of the structure of organic compounds, the stereochemical aspects of organic structure, the nomenclature of the alkanes, alkenes and alkynes, and the mechanisms of electrophilic additions to pi systems, nucleophilic substitution reactions, and elimination reactions.

Rubric CHEM2077

The grades in this class will be based on the performance of the students on three hourly exams and a cumulative final. The expected grade distribution will be approximately 60% A, 30% B and 10% C and lower.

SLO CHEM2087

After this course the student will have mastery of using the techniques NMR, IR and UV-vis spectroscopy to determine molecular structure and the nomenclature of aromatic and carbonyl containing compounds, amines and carbohydrates. They will understand the concepts involved in the mechanisms of the reactions of aromatic systems, alcohols, ketones, aldehydes, and carboxylic acid derivatives, as well as amines and carbohydrates.

Rubric CHEM2087

The grades in this class will be based on the performance of the students on three hourly exams and a cumulative final. The expected grade distribution will be approximately 60% A, 30% B and 10% C and lower.

SLO CHEM2078

At the end of CHEM-2078 the students will have an appreciation of basic safety techniques and procedures required to work in an Organic chemistry lab. The above mentioned will be achieved by the students’ involvement in lab experiments including, but not limited to, purification of mixtures of organic compounds mixes utilizing distillation, recrystallization and extraction techniques. With the advancement of the semester the students will be learn the more practical aspects of organic chemistry, i.e. synthesis and reactions of alkanes, alkenes and alkynes. The products of these reactions will be further purified using techniques the students learned in the beginning of the semester. Students will learn how to construct a scientific lab report.

Rubric CHEM2078

The grades from lab reports will be 75% of the final grade for the course. In the lab report the students will have to show good comprehension of the material from the lecture course as the background for the experiments carried out in the lab. During the lab the students will collect observations describing all events during the experiment. These observations and their conclusions about the source of any problems in the experimental procedure and results will be included in their lab reports.
Prior each lab all students will be quizzed on the material they will use for the upcoming experiment. Those quizzes will be 20% of the final grade. Performance of the correct safety procedures and experimental techniques will be 5% of the grade.

The expected grade distribution will be approximately 80% A, 10% B and 10% C and lower.

SLO CHEM2088

In the course of CHEM-2088 students will rely on the practical knowledge gained in CHEM-2078 to conduct multiple wet-chemistry experiments. The synthesis problems will include more advanced procedures and techniques such as, but not limited to, extraction and reflux, conducting reactions sensitive to presence of oxygen and humidity etc. All students will be assigned unknown samples which, throughout the semester, will be analyzed using NMR, GC/MS and FTIR spectroscopy. The identity of this unknown sample will be reported in a final lab report.

Rubric CHEM2088

The grades from lab reports will be 70% of the final grade for the course. In the lab report the students will have to show good comprehension of the material from the lecture course as the background for the experiments carried out in the lab. During the lab the students will collect observations describing all events during the experiment. These observations and their conclusions about the source of any problems in the experimental procedure and results will be included in their lab reports.

Prior each lab all students will be quizzed on the material they will use for the upcoming experiment. Those quizzes will be 15% of the final grade. The final unknown lab report will be 10% of the final grade. Performance of the correct safety procedures and experimental techniques will be 5% of the grade.

The expected grade distribution will be approximately 80% A, 10% B and 10% C and lower.
CHEM2077 HONORS ORGANIC CHEMISTRY I (3). LEC. 3. Pr., Membership in the Honors College or CHEM1120 with a grade of A or B or CHEM1040 with a grade of A. Organic chemistry for students in the honors program and Chemistry majors. Topics similar to CHEM2070, but covered in more depth. Additional credit will not be given for CHEM2070.

CHEM2078 HONORS ORGANIC CHEMISTRY I LAB (1). LAB. 3. Pr., CHEM2077. Science Core. Laboratory experiments emphasizing course material in CHEM2077. Additional credit will not be given for CHEM2071.

CHEM2087 HONORS ORGANIC CHEMISTRY II (3). LEC. 3. Pr., Membership in the Honors College and/or CHEM2077. Science Core. Organic chemistry for students in the honors program and Chemistry majors. Topics similar to CHEM2080, but covered in more depth. Additional credit will not be given for CHEM2080.

CHEM2088 HONORS ORGANIC CHEMISTRY II LAB (1). LAB. 3. Pr., CHEM2078, CHEM2077. Science Core. Laboratory experiments emphasizing course material in CHEM2087. Additional credit will not be given for CHEM2081.