UNIVERSITY FACULTY SENATE FORMS

Academic Program Approval

This form is a routing document for the approval of new and revised academic programs. Proposing department should complete this form. Detailed instructions for the proposal should be followed. A checklist is available to assist in the preparation of a proposal. For more information, call the Faculty Senate Office at 831-2921.

Submitted by: Donald Watson phone number 302-831-8728
Department: Chemistry and Biochemistry email address dawatson@udel.edu
Date: Sept. 21, 2015

Action: Revise coursework for in- and out-of-division courses for graduate degree requirements.

(Example: add major/minor/concentration, delete major/minor/concentration, revise major/minor/concentration, academic unit name change, request for permanent status, policy change, etc.)

Effective term 16F (use format 04F, 05W)

Current degree MA, MS, PhD

(Example: BA, BACH, BACJ, HBA, EDD, MA, MBA, etc.)

Proposed change leads to the degree of: MA, MS, PhD

(Example: BA, BACH, BACJ, HBA, EDD, MA, MBA, etc.)

Proposed name: n/a

Proposed new name for revised or new major / minor / concentration / academic unit (if applicable)

Revising or Deleting:

Undergraduate major / Concentration:

(Example: Applied Music – Instrumental degree BMAS)

Undergraduate minor:

(Example: African Studies, Business Administration, English, Leadership, etc.)

Graduate Program Policy statement change: Summary of Requirements for Advanced Degrees in Chemistry and Biochemistry

Appendix A Divisional Course
Eliminated Language Requirement for Organic Division
(Must attach your Graduate Program Policy Statement)

Graduate Program of Study: MA, MS, PhD in Chemistry and Biochemistry

(Example: Animal Science: MS Animal Science: PHD Economics: MA Economics: PHD)

Graduate minor / concentration: Analytical, Physical, Organic, Inorganic, Biochemistry

Note: all graduate studies proposals must include an electronic copy of the Graduate Program Policy Document, either describing the new program or highlighting the changes made to the original policy document.
List new courses required for the new or revised curriculum. How do they support the overall program objectives of the major/minor/concentrations?
(Be aware that approval of the curriculum is dependent upon these courses successfully passing through the Course Challenge list. If there are no new courses enter “None”)

Supply support letter from the Library, Dean, and/or Department Chair if needed
(all new majors/minors will need a support letter from the appropriate administrator.)

Supply a resolution for all new majors/programs; name changes of colleges, departments, degrees; transfer of departments from one college to another; creation of new departments; requests for permanent status. See example of resolutions.

Explain, when appropriate, how this new/revised curriculum supports the 10 goals of undergraduate education: http://www2.udel.edu/gened/

Identify other units affected by the proposed changes:
(This would include other departments/units whose courses are a required part of the proposed curriculum. Attach permission from the affected units. If no other unit is affected, enter “None”)

None

Describe the rationale for the proposed program change(s):
(Explain your reasons for creating, revising, or deleting the curriculum or program.)

Several changes to our program requirements are proposed. Broadly, these changes are requested to strengthen the course requirements in each of our major areas of study for the PhD.

1. We propose to add language specifying what steps are required for a student to modify the course requirements. We wish to add this language to our degree requirements to ensure that students are taking discipline appropriate courses that will develop expertise relevant to chemistry or biochemistry.

2. For analytical chemistry, we propose to change the course requirements for elective courses. Previously, in addition to 6 units of core analytical courses, three additional units of analytical elective courses were required. We propose to change the elective course to 6 units of graduate course work approved by the research advisor. This change is requested to address the needs of the students. The broad range of research and the limited availability of courses within the analytical division meeting research needs in any semester make this change important. We are seeking breadth in the courses, recognizing that courses of interest to analytical PhD students may well be outside of the division and department.

3. We propose to update the analytical division elective listings to reflect current course offerings. These changes include correcting the name for Chem 625, now Heterogeneous Atmospheric Chemistry, and the removal of Chem 626 Instrumental Methods in Mass Spectrometry, which is no longer offered within the department. The changes to these courses have been previously approved by the faculty senate and only reflect updating our requirements to match current course descriptions and offerings.

4. We request to increase the number of required units of biochemistry courses to 9 (up form 6) and require Chem 641 for biochemistry PhD students. In addition, we have added approval requirements for the remaining course units from the division. We feel that there is now a compelling need to ensure that our students have a common foundation for subsequent course work that requires this change.
5. We propose to remove the language requirement for organic chemistry PhD students. The organic division has voted to remove the demonstration of proficiency in a foreign language from the divisional degree requirements. Traditionally this requirement was considered appropriate as a significant portion of the classic organic chemistry literature was in German, Russian or other foreign language. Today, the relevance of this older literature is much reduced and is no longer a priority in light of the advent of efficient language translation software. The organic division was the only chemistry division to retain a foreign language proficiency requirement. Although the requirement has been removed, the use of literature published in a foreign language will be incorporated within the remaining course work.

6. Finally, we wish to broaden the ability of physical chemistry students to select alternate courses to the suggested curriculum. This changes recognizes that there are may be courses in physical chemistry that might be appropriate to substitute in a student's PhD program.

All of these changes have been approved by faculty vote within the department and are now submitted for further consideration.

Program Requirements:
(Show the new or revised curriculum as it should appear in the Course Catalog. If this is a revision, be sure to indicate the changes being made to the current curriculum and include a side-by-side comparison of the credit distribution before and after the proposed change.) See example of side by side.

ROUTING AND AUTHORIZATION: (Please do not remove supporting documentation.)

Department Chairperson ___________________________ Date 21 Sept 2015

Dean of College ___________________________ Date

(By signing above, the Dean confirms that their college policies and bylaws have been followed correctly during consideration of the request described in this form.

The approval actions that were taken at the college level were (check all that apply):

________________________ college faculty vote; __________________________ college curriculum approval

________________________ college senate approval

Chairperson, College Curriculum Committee ___________________________ Date

Chairperson, Senate Com. on UG or GR Studies ___________________________ Date

Chairperson, Senate Coordinating Com. ___________________________ Date

Secretary, Faculty Senate ___________________________ Date

Date of Senate Resolution_________________________ Date to be Effective_________________________

Registrar ___________________________ Program Code ___________________________ Date

Vice Provost for Academic Affairs & International Programs ___________________________ Date

Board of Trustee Notification ___________________________ Date

Revised 10/27/2014/khs
The Department of Chemistry and Biochemistry offers programs leading to the PhD, MS, and MA degrees. Financial support for PhD students is available in the form of teaching assistantships, research assistantships, and fellowships. The thesis for the Master of Science degree or the doctoral dissertation may be in analytical chemistry, biochemistry, inorganic chemistry, organic chemistry, or physical chemistry. Certain courses offered in other departments may be taken for credit for advanced degrees in chemistry if these fit logically into the proposed course of study and have the approval of the candidate's advisor.

Four major state-of-the-art facilities support the research of faculty and students. These laboratories are operated by PhD-level scientists who provide analytical service and training courses. The Blue Hen NMR Complex houses six state-of-the-art NMR spectrometers with operating frequencies ranging from 400 MHz to 850 MHz and one FT-ESR spectrometer. Graduate students routinely use these instruments in their research. The departmental mass spectrometry laboratory encompasses instruments that provide service in electrospray ionization (ESI), matrix-assisted laser desorption ionization (MALDI), fast-atom bombardment (FAB), chemical ionization (CI), and electron ionization (EI) mass spectrometry. GC/MS, LC/MS, and MALDI instruments are available for routine student use. The X-ray laboratory includes two CCD X-ray diffractometers for small molecule crystallography. Our department also houses the university-wide Surface Analysis Facility, which provides analytical capabilities in scanning probe microscopy (SPM), including scanning tunneling microscopy (STM) and atomic force microscopy (AFM), Auger electron spectroscopy (AES), X-ray photoelectron spectroscopy (XPS or ESCA) and time-of-flight secondary ion mass spectrometry (TOF-SIMS).

A research facility to perform macromolecular crystallography is also housed in the department. A wide variety of equipment is available in individual research laboratories. The department maintains electronics, machine, and glass-blowing shops as well as a chemistry reference library. Further
information regarding research areas and resources can be found at the departmental web site http://www.chem.udel.edu

Requirements for Admission

Admission to the graduate program in the Chemistry and Biochemistry Department is evaluated on the basis of the applicant's GRE scores and undergraduate records including the transcript and letters of recommendation. TSE and TOEFL scores are required for foreign applicants for whom English is not the first language. Admission is selective and competitive based on the number of well-qualified applicants and the limits of available faculty and facilities. Those who meet stated minimum academic requirements are not guaranteed admission, nor are those who fail to meet those requirements necessarily precluded from admission if they offer other appropriate strengths.

Requirements for the Degrees

MA in the Department of Chemistry and Biochemistry

A minimum of 30 credit hours of graduate-level courses is required with an overall B average (3.00). A minimum of 18 credit hours must be course work at the 600 level or above (excluding pre-candidacy study, research, thesis or dissertation credits) as specified in the PhD requirements listed below. A maximum of 12 credit hours, 500 level or greater, may be taken in other departments toward the 30 credit hour requirement. No thesis is required. The MA degree requires successful completion of a series of cumulative examinations.

MS in the Department of Chemistry and Biochemistry

A minimum of 30 credit hours of graduate-level courses is required with an overall B average (3.00). A minimum of 18 credit hours must be course work at the 600 level or above (excluding pre-candidacy study, research, thesis or dissertation credits) as specified in the PhD requirements listed below. A maximum of 12 credit hours, 500 level or greater, may be taken in other departments toward the 30 credit hour requirement. First year-graduate students are required to take a non-credit one-hour special seminar, CHEM 865-010 (new student seminar) and CHEM 601, Introduction to Laboratory Instruction. Graduate students must also register for one of the topical

information regarding research areas and resources can be found at the departmental web site http://www.chem.udel.edu

Requirements for Admission

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Requirements for the Degrees

MA in the Department of Chemistry and Biochemistry

A minimum of 30 credit hours of graduate-level courses is required with an overall B average (3.00). A minimum of 18 credit hours must be course work at the 600 level or above (excluding pre-candidacy study, research, thesis or dissertation credits) as specified in the PhD requirements listed below. A maximum of 12 credit hours, 500 level or greater, may be taken in other departments toward the 30 credit hour requirement. No thesis is required. The MA degree requires successful completion of a series of cumulative examinations.

MS in the Department of Chemistry and Biochemistry

A minimum of 30 credit hours of graduate-level courses is required with an overall B average (3.00). A minimum of 18 credit hours must be course work at the 600 level or above (excluding pre-candidacy study, research, thesis or dissertation credits) as specified in the PhD requirements listed below. A maximum of 12 credit hours, 500 level or greater, may be taken in other departments toward the 30 credit hour requirement. First year-graduate students are required to take a non-credit one-hour special seminar, CHEM 865-010 (new student seminar) and CHEM 601, Introduction to Laboratory Instruction. Graduate students must also register for one of the topical
Dr. PhD in the Department of Chemistry and Biochemistry

A minimum of 30 credit hours of graduate-level courses is required with an overall B average (3.00). The department course requirements are a minimum of eighteen credit hours in graduate level courses (600-level or higher) excluding research and dissertation (CHEM 868 and CHEM 969). At least nine of these must be taken outside the student's division. Specific course requirements for each division are listed below. Scientific courses offered by other Departments may be counted as courses outside the student's division, if approved by the faculty in the student's division. The student must achieve at least a cumulative grade point average of 3.00 in the courses that fulfill this requirement. The course requirements, including the division's requirements, should be satisfied within four semesters of entering the program with a bachelor's degree.

First year graduate students are required to take a non-credit one-hour special seminar, CHEM 865-010 (new student seminar) and CHEM 601, Introduction to Laboratory Instruction. Graduate students must also register for one of the topical seminar series (CHEM 865-XXX - Biochemistry Seminar, Organic/Inorganic Seminar, Physical/Analytical Seminar), as well as Colloquia (CHEM 865-XXX). The PhD degree requires successful completion of a series of cumulative examinations. The PhD degree requires a thesis based on original research and a final public oral defense of the dissertation.

Specific course requirements by division are outlined below. If a student wished to take courses other than those specified, then each of these courses must be approved in writing: (a) at the Fall and Spring advisement for first-year graduate students by the representative from the respective Division on the Graduate Curriculum Committee, and (b) at other times by the research advisor.

The remaining courses satisfying the
Analytical Chemistry: Six credit hours of graduate analytical courses plus three additional credit hours of graduate coursework designated by the research advisor. The three additional credit hours can be selected from graduate level analytical courses, other graduate level courses in the Chemistry and Biochemistry Department, or graduate level courses in other departments. Courses in other departments must be approved by the analytical faculty. Analytical courses which can satisfy this requirement include:

- CHEM 620 Analytical Spectroscopy
- CHEM 621 Chemical Separations
- CHEM 622 Electroanalytical Chemistry
- CHEM 623 Chemometrics
- CHEM 624 Principles of Mass Spectrometry
- CHEM 625 Chemical Ionization Mass Spectrometry
- CHEM 626 Instrumental Methods in Mass Spectrometry
- CHEM 627 Practical Mass Spectrometry
- CHEM 628 Chemical Sensors
- CHEM 629 Surface Chemistry and Analysis
  Special topics in analytical chemistry (may be repeated for credit when topics vary)
- CHEM 820 Analytical Spectroscopy
- CHEM 621 Chemical Separations
- CHEM 622 Electroanalytical Chemistry
- CHEM 623 Chemometrics
- CHEM 624 Principles of Mass Spectrometry
- CHEM 625 Heterogeneous Atmospheric Chemistry
- CHEM 626 Instrumental Methods in Mass Spectrometry
- CHEM 627 Practical Mass Spectrometry
- CHEM 628 Chemical Sensors
- CHEM 629 Surface Chemistry and Analysis
  Special topics in analytical chemistry (may be repeated for credit when topics vary)

Biochemistry: At least 6 credits in graduate-level biochemistry courses. The Biochemistry Division or the student's research advisor must approve the courses used to satisfy the departmental course requirement of 18 credits in graduate level courses.

- CHEM 641 Biochemistry
- CHEM 642 Biochemistry
- CHEM 643 Intermediary Metabolism
- CHEM 644 Mechanisms of Enzyme

Departmental course requirement of 18 credits in graduate level coursework can be selected from offerings in the Department of Chemistry and Biochemistry, or appropriate graduate level courses in other Departments.

All students pursuing a degree program in Chemistry and Biochemistry need to secure the written permission from both their research advisor and the Director of Graduate Studies prior to enrolling in any course not bearing a CHEM-6XX or CHEM-8XX designation.

Analytical Chemistry: Six credit hours of graduate analytical courses from the list below plus six additional credit hours of graduate coursework designated by the research advisor.

- CHEM 620 Analytical Spectroscopy
- CHEM 621 Chemical Separations
- CHEM 622 Electroanalytical Chemistry
- CHEM 623 Chemometrics
- CHEM 624 Principles of Mass Spectrometry
- CHEM 625 Heterogeneous Atmospheric Chemistry
- CHEM 626 Instrumental Methods in Mass Spectrometry
- CHEM 627 Practical Mass Spectrometry
- CHEM 628 Chemical Sensors
- CHEM 629 Surface Chemistry and Analysis
  Special topics in analytical chemistry (may be repeated for credit when topics vary)

Biochemistry: At least 9 credits in graduate-level biochemistry courses. CHEM 641 must be taken as one of these courses unless this requirement is waived by the Biochemistry Division. The Division, or the student’s research advisor, must approve the courses used to satisfy the departmental course requirement of 18 credits in graduate level courses.

- CHEM 641 Biochemistry
- CHEM 642 Biochemistry
- CHEM 643 Intermediary Metabolism
- CHEM 644 Mechanisms of Enzyme
**Inorganic Chemistry:** Nine credit hours from the following courses:

- CHEM 651 Advanced Inorganic Chemistry
- CHEM 652 Organometallic Chemistry
- CHEM 653 Bioinorganic Chemistry
- CHEM 654 Advanced Inorganic Chemistry

**Organic Chemistry:**

- CHEM 633 Advanced Organic Chemistry: Physical
- CHEM 634 Advanced Organic Chemistry: Synthesis and Reactivity

Two additional courses (6 credit hrs) with a CHEM-63X or CHEM-83X designation (one of these courses may be audited)

It is strongly recommended that the courses taken outside of Organic Chemistry should be chosen from the following list:

- CHEM 641 Biochemistry
- CHEM 642 Biochemistry
- CHEM 651 Advanced Inorganic Chemistry
- CHEM 652 Organometallic Chemistry
- CHEM 654 Advanced Inorganic Chemistry

If a student wishes to take other courses than these outside of Organic Chemistry, then each of these courses must be approved: (a) at the Fall and Spring advisements for first-year graduate students by the representative from the Organic Chemistry Division on the Graduate Curriculum Committee and (b) at other times by the Organic Chemistry Faculty.

**Language Requirement (Organic Chemistry only):** Any modern foreign language is acceptable and proficiency may be established by any one of

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**Inorganic Chemistry:** Nine credit hours from the following courses:

- CHEM 651 Advanced Inorganic Chemistry
- CHEM 652 Organometallic Chemistry
- CHEM 653 Bioinorganic Chemistry
- CHEM 654 Advanced Inorganic Chemistry

**Organic Chemistry:**

- CHEM 633 Advanced Organic Chemistry: Physical
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Two additional courses (6 credit hrs) with a CHEM-63X or CHEM-83X designation (one of these courses may be audited)

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- CHEM 641 Biochemistry
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- CHEM 651 Advanced Inorganic Chemistry
- CHEM 652 Organometallic Chemistry
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If a student wishes to take other courses than these outside of Organic Chemistry, then each of these courses must be approved: (a) at the Fall and Spring advisements for first-year graduate students by the representative from the Organic Chemistry Division on the Graduate Curriculum Committee and (b) at other times by the Organic Chemistry Faculty.

**Language Requirement REMOVED.**
the following:

a. Two full years of college-level courses in one of the specified languages with an average grade of C or better. An equivalent undergraduate background may be accepted, upon request to GCC.
b. Submission of evidence of satisfactory performance (a score greater than 500 or one above the 50th percentile) on the ETS Graduate School Foreign Language Test for one of the specified languages. Students will make arrangements to take these examinations directly with ETS.
c. Satisfactory performance in a departmental reading examination in one of the specified languages. Responsibility for determining the frequency and content of these examinations, as well as their grading, will rest with the organic division and the examinations will be administered by the organic divisional secretary. The use of a dictionary will be permitted throughout each examination.

A student wishing to use options (a) or (b) should consult with the Executive Secretary of the Department of Chemistry and Biochemistry who will verify grades or test scores. A student wishing to use option (c) should consult with the secretary of the organic division who will arrange for an examination and communicate the result to the executive secretary of the Department of Chemistry and Biochemistry who will see that it is recorded in the student’s file.

**Physical Chemistry:** A minimum of three courses from among the following:

- **CHEM 671** Quantum Chemistry
- **CHEM 672** Advanced Quantum Chemistry
- **CHEM 674** Chemical Dynamics
- **CHEM 677** Chemical Thermodynamics
- **CHEM 678** Structure and properties of surfaces

One may substitute for one of these three courses from related three-credit courses outside physical chemistry upon the approval of the research advisor.