TO: University of Toronto Scarborough Academic Committee
SPONSOR: John Scherk, Vice-Dean, Undergraduate
DATE: January 22, 2013
AGENDA ITEM: For approval

ITEM IDENTIFICATION:
Curriculum change proposals from the Department of Physical and Environmental Sciences:
1. Major Modification Type A – addition of admission requirements:
   • Specialist in Biological Chemistry
   • Specialist in Chemistry
2. Minor Program Modifications:
   • Specialist Co-op in Biological Chemistry; Specialist Co-op in Chemistry; Major Co-op in Biochemistry; Major Co-op in Chemistry
   • Specialist in Biological Chemistry
   • Major in Biochemistry
   • Specialist in Chemistry
   • Major in Chemistry
   • Specialist in Environmental Biology
   • Specialist in Environmental Chemistry
   • Specialist in Environmental Physics
3. Deleted Courses
4. New Courses
5. Consent Agenda Course Changes - REVISED

JURISDICTIONAL INFORMATION:
University of Toronto Scarborough Academic Committee has authority to oversee and approve all curricular and academic matters on which the Committee’s decision is required, including programs, courses, and academic regulations and policies.

SUMMARY:
1. The Specialist programs in Biological Chemistry and Chemistry do not currently have an admission requirement. The Department proposes adding an admission requirement - which consists of the completion of a certain number of courses and a minimum CGPA - to both programs.

   The primary impetus for this change is to ensure that students choosing these programs are able to complete them. The Department has noted an increased student interest in the programs, but a high percentage of the students with CGPAs below 2.0 struggle with the material, particularly at the C- and D-levels.
A secondary impetus for this change is to make these programs consistent with programs in the Biological Sciences, as well as with other Chemistry programs at the University of Toronto.

2. The Department is revising the course admission requirements for their Co-op programs in Biological Chemistry, Biochemistry, and Chemistry. In addition, the mathematics requirements in several programs have been updated to ensure students are taking the most suitable course(s). There has been some minor restructuring of specific course requirements and options in several programs.

3. EESC15H3 is being deleted because it is redundant.

4. The Department is introducing two new courses: CHMB43Y and CHMC25H. CHMB43Y is a condensed version of CHMB41H Organic Chemistry I and CHMB42H Organic Chemistry II. The course material for CHMB43Y will be similar to the existing courses, but will be taught at a faster pace and more advanced level. The course will be offered in Summer sessions, and is aimed at co-op students who will benefit from an increased flexibility in scheduling their work-terms. CHMC25H introduces more advanced computational approaches used in quantum chemistry.

5. The Department is revising prerequisites, corequisites, recommended preparation and exclusions in several courses.

1. MAJOR PROGRAM MODIFICATIONS:

Specialist in Biological Chemistry:

Overview:
The Specialist program in Biological Chemistry is a program to which students apply near the end of their first year of study at the University. The program has not traditionally had an admission requirement. This proposal seeks approval for the imposition of an admission requirement.

The following admission requirements are proposed for this program:
1. Completion of at least 4.0 FCE including 1.0 FCE in CHM courses, 1.0 FCE in BIO courses, 0.5 FCE in MAT courses and 0.5 FCE in PHY courses; and
2. A cumulative grade point average (CGPA) of at least 2.0.

NOTE: the changes will not be applied to the Specialist (Co-op) program in Biological Chemistry because admission requirements for the Co-op program includes a minimum CGPA of 2.5.

Rationale:
Since 2003, the number of students enrolled in this program has been steadily increasing (from 34 to more than 100); however, we have not been attracting many high quality students. As of January 30th 2012, 38% of the students enrolled in the biological chemistry specialist had a cumulative grade point average (CGPA) of less than 2.0. In 2011, that number was 30%. One likely reason for the large proportion of below average students in this program is that other departments (most notably Biological Sciences) have a cumulative grade point average (CGPA) requirement for entry into their programs. In contrast, the biological chemistry specialist has no such requirement. Adding a CGPA requirement of 2.0 to this program would bring it in line with the norm in Biological Sciences.
The addition of a CGPA requirement is also consistent with the chemistry programs on the St. George campus. Although their programs do not have a CGPA requirement, several compulsory second year courses (CHM217, CHM220, CHM225, CHM238, CHM249) require a minimum grade of 63% in first year chemistry. This, in effect, prevents the weakest students from entering into the chemistry programs by restricting access to these courses. Adopting this approach at UTSC would not work well since the biochemistry and chemistry major programs include many of the same courses as the chemistry and biological chemistry specialist students. Our goal is to keep these major programs open; therefore, imposing a CGPA requirement is a more suitable mechanism for limiting access to the specialist programs.

The large number of weak students enrolled in the biological chemistry specialist has serious consequences for the quality of students populating our C- and D-level courses. This, in turn, makes it difficult to ensure that graduates of this program are achieving the desired learning outcomes. One area in particular where these students struggle is with the critical thinking and independent thought required to carry out research. By the end of their program, graduates of the biological chemistry specialist should be able to critically evaluate open-ended research problems and propose future directions for further study. In a theoretical course, this might come in the form of a critical review written on a current research topic. In an advanced lab course, this could involve students designing and executing their own experiments. Unfortunately, the weakest students in this program are unable to meet these degree-level expectations. Having barely passed their earlier CHM courses, they lack the depth of understanding that is necessary to integrate concepts from multiple areas of study and to synthesize new ideas. Many are still struggling with fundamental concepts – both in and out of the lab. Without these foundational skills, it’s impossible for these students to progress towards higher levels of critical thought and analysis in their advanced chemistry courses.

The chemistry faculty have made numerous efforts to try and address the challenges faced by our weakest students. For students having trouble in the labs, we have added supplementary videos on the most common techniques. We also offer lab skills seminars for several of our second year courses. On the theoretical side, we have introduced facilitated study groups to many of our courses. Additionally, several faculty routinely volunteer their time to offer supplementary problem solving sessions. Unfortunately, the students taking advantage of these resources are not the ones who need it most; no improvement has been seen in the number of under achieving students populating the program.

The minimum CGPA requirement of 2.0 has been proposed for this program in order to ensure that students entering the biological chemistry specialist are capable of meeting the degree level expectations. Students who are interested in biological chemistry but who do not meet the CGPA requirement will be encouraged to enrol in the biochemistry major. This program will continue to be an unlimited enrolment program with no CGPA requirement. Importantly, there is excellent overlap between the B-level courses required by both the biochemistry majors and the biological chemistry specialists. This means that students whose CGPA improves after their second year could easily transfer into the biological chemistry specialist.
Proposed Program Requirements:

SPECIALIST PROGRAM IN BIOLOGICAL CHEMISTRY (SCIENCE)

Supervisor: W. Restivo (416-287-7222) Email: restivo@utsc.utoronto.ca

This program is intended for students who want to specialize in Chemistry, but who are also interested in the chemistry of living systems.

Admission to Biological Chemistry Specialist

Students may apply to this program after completing at least 4.0 FCE including: BIOA01H3, BIOA02H3, CHMA10H3, CHMA11H3, MATA30H3 and PHYA10H3 with a cumulative grade point average (CGPA) of at least 2.0. Application for admission to the program is made to the registrar through ROSI in April/May and July/August. See the UTSC Registrar’s website for information on program (Subject POSt) selection at www.utsc.utoronto.ca/subjectpost.

Program Requirements

The program requires the completion of the following 15.0 full credits:

First Year:

BIOA01H3 Life On Earth: Unifying Principles
BIOA02H3 Life on Earth: Form, Function and Interactions
CHMA10H3 Introductory Chemistry I: Structure and Bonding
CHMA11H3 Introductory Chemistry II: Reactions and Mechanisms
MATA30H3 Calculus I for Biological and Physical Sciences
[MATA35H3 Calculus II for Biological Sciences or MATA36H3 Calculus II for Physical Sciences or MATA37H3 Calculus II for Mathematical Sciences]
PHYA10H3 Introduction to Physics IA
PHYA21H3 Introduction to Physics IIA

Note: PSCB57H3 requires either MATA36H3 or MATA37H3 as a prerequisite. [MATA36H3 or MATA37H3] is strongly recommended over MATA35H3 in order that future course selection is not compromised.

Second Year:

BIOB10H3 Cell Biology
BIOB11H3 Molecular Aspect of Cellular and Genetic Processes
BIOB12H3 Laboratory for Cell and Molecular Biology
CHMB31H3 Introduction to Inorganic Chemistry
CHMB41H3 Organic Chemistry I
CHMB42H3 Organic Chemistry II

Second or Third Year:

CHMB16H3 Techniques in Analytical Chemistry
CHMB20H3 Chemical Thermodynamics and Elementary Kinetics
CHMB21H3 Chemical Structure and Spectroscopy

and

0.5 full credit from the following:

MATA23H3 Linear Algebra I
PSCB57H3 Introduction to Scientific Computing
STAB22H3  Statistics I

Third Year:
BIOC12H3  Biochemistry I: Proteins and Enzymes
BIOC13H3  Biochemistry II: Bioenergetics and Metabolism
BIOC23H3  Practical Approaches to Biochemistry
CHMC47H3  Bio-Organic Chemistry

Third or Fourth Year:
CHMC11H3  Principles of Analytical Instrumentation
CHMC31Y3  Intermediate Inorganic Chemistry
[CHMC41H3  Organic Reaction Mechanisms or CHMC42H3  Organic Synthesis]

Fourth Year:
CHMD79H3  Topics in Biological Chemistry
1.5 full credits in D-level or 400-level CHM courses including:
 at least 0.5 full credit from the following:
 CHMD90Y3  Directed Research
 CHMD91H3  Directed Research
 CHMD92H3  Advanced Organic Chemistry Lab Course
 and at least 0.5 full credit from the following:
 CHMD69H3  Bioinorganic Chemistry
 CHMD71H3  Pharmaceutical Chemistry

Specialist in Chemistry:

Overview:
The Specialist program in Chemistry is a program to which students apply near the end of their first
year of study at the University. The program has not traditionally had an admission requirement.
This proposal seeks approval for the imposition of an admission requirement.

The following admission requirements are proposed for this program:
1. Completion of at least 4.0 FCE including 1.0 FCE in CHM courses, 1.0 FCE in MAT courses
   and 1.0 FCE in PHY courses; and
2. A cumulative grade point average (CGPA) of at least 2.0.

NOTE: the changes will not be applied to the Specialist (Co-op) program in Chemistry because
admission requirements for the Co-op program includes a minimum CGPA of 2.5.

Rationale:
Since 2003, the number of students enrolled in this program has been steadily increasing (from 6 to
~ 20); however, we have not been attracting many high quality students. As of January 30th 2012,
40% of the students enrolled in the chemistry specialist had a cumulative grade point average
(CGPA) of less than 2.0. In 2011, that number was 39%. One likely reason for the large proportion
of below average students in this program is that other departments (most notably Biological
Sciences) have a cumulative grade point average (CGPA) requirement for entry into their programs.
In contrast, the chemistry specialist has no such requirement. Adding a CGPA requirement of 2.0 to
this program would bring it in line with the norm in Biological Sciences.

Academic Committee. 22 January 2013.
The addition of a CGPA requirement is also consistent with the chemistry programs on the St. George campus. Although their programs do not have a CGPA requirement, several compulsory second year courses (CHM217, CHM220, CHM225, CHM238, CHM249) require a minimum grade of 63% in first year chemistry. This, in effect, prevents the weakest students from entering into the chemistry programs by restricting access to these courses. Adopting this approach at UTSC would not work well since the biochemistry and chemistry major programs include many of the same courses as the chemistry and biological chemistry specialist students. Our goal is to keep these major programs open; therefore, imposing a CGPA requirement is a more suitable mechanism for limiting access to the specialist programs.

The large proportion of weak students enrolled in the chemistry specialist has serious consequences for the quality of students populating our C- and D- level courses. This, in turn, makes it difficult to ensure that graduates of this program are achieving the desired learning outcomes. One area in particular where these students struggle is with the critical thinking and independent thought required to carry out research. By the end of their program, graduates of the chemistry specialist should be able to critically evaluate open-ended research problems and propose future directions for further study. In a theoretical course, this might come in the form of a critical review written on a current research topic. In an advanced lab course, this could involve students designing and executing their own experiments. Unfortunately, the weakest students in this program are unable to meet these degree-level expectations. Having barely passed their earlier CHM courses, they lack the depth of understanding that is necessary to integrate concepts from multiple areas of study and to synthesize new ideas. Many are still struggling with fundamental concepts – both in and out of the lab. Without these foundational skills, it’s impossible for these students to progress towards higher levels of critical thought and analysis in their advanced chemistry courses.

The chemistry faculty have made numerous efforts to try and address the challenges faced by our weakest students. For students having trouble in the labs, we have added supplementary videos on the most common techniques. We also offer lab skills seminars for several of our second year courses. On the theoretical side, we have introduced facilitated study groups to many of our courses. Additionally, several faculty routinely volunteer their time to offer supplementary problem solving sessions. Unfortunately, the students taking advantage of these resources are not the ones who need it most; no improvement has been seen in the number of under achieving students populating the program.

The minimum CGPA requirement of 2.0 has been proposed for this program in order to ensure that students entering the chemistry specialist are capable of meeting the degree level expectations. Students who are interested in chemistry but who do not meet the CGPA requirement will be encouraged to enrol in the chemistry major. This program will continue to be an unlimited enrolment program with no CGPA requirement. Moreover, the proposed minor changes to our chemistry major (submitted June 2012) will ensure excellent overlap between the B-level courses required by both the chemistry majors and specialists. This means that students whose CGPA improves after their second year could easily transfer into the chemistry specialist.
Proposed Program Requirements:
SPECIALIST PROGRAM IN CHEMISTRY (SCIENCE)

Supervisor: S. Dalili (416-287-7215) Email: sdalili@utsc.utoronto.ca
This Program is meant for students who are interested in obtaining a strong background in all aspects of modern chemistry.

Admission to Chemistry Specialist
Students may apply to this program after completing at least 4.0 FCE, including CHMA10H3, CHMA11H3, PHYA10H3, PHYA21H3, and 1.0 FCE in either MATA23H3, MATA30H3 or MATA36H3 with a cumulative grade point average (CGPA) of at least 2.0. Application for admission to the program is made to the registrar through ROSI in April/May and July/August. See the UTSC Registrar’s website for information on program (Subject POSt) selection at www.utsc.utoronto.ca/subjectpost.

Program Requirements
The Program requires completion of 14.0 full credits as follows:

First Year:
CHMA10H3 Introductory Chemistry I: Structure and Bonding
CHMA11H3 Introductory Chemistry II: Reactions and Mechanisms
[[MATA30H3 Calculus I for Biological and Physical Sciences and MATA36H3 Calculus II for Physical Sciences] or [MATA31H3 Calculus I for Mathematical Sciences and MATA37H3 Calculus II for Mathematical Sciences]]
PHYA10H3 Introduction to Physics IA
PHYA21H3 Introduction to Physics IIA
and
1.0 full credit chosen from:
ASTA01H3 Introduction to Astronomy and Astrophysics I: The Sun and Planets
ASTA02H3 Introduction to Astronomy and Astrophysics II: Beyond the Sun and Planets
BIOA01H3 Life on Earth: Unifying Principles
BIOA02H3 Life on Earth: Form, Function and Interactions
EESA05H3 Environmental Hazards
EESA06H3 Introduction to Planet Earth
MATA23H3 Linear Algebra I
PSCB57H3 Introduction to Scientific Computing
STAB22H3 Statistics I

Second Year:
CHMB16H3 Techniques in Analytical Chemistry
CHMB20H3 Chemical Thermodynamics and Elementary Kinetics
CHMB21H3 Chemical Structure and Spectroscopy
CHMB31H3 Introduction to Inorganic Chemistry
CHMB41H3 Organic Chemistry I
CHMB42H3 Organic Chemistry II
CHMB62H3 Introduction to Biochemistry
MATB41H3 Techniques of Calculus of Several Variables I

Academic Committee. 22 January 2013.
Academic Committee. 22 January 2013.

Third Year:
CHMC11H3 Principles of Analytical Instrumentation
CHMC16H3 Analytical Instrumentation
[CHMC20H3 Intermediate Physical Chemistry or CHMC21H3 Topics in Biophysical Chemistry]
CHMC31Y3 Intermediate Inorganic Chemistry
[CHMC41H3 Organic Reaction Mechanisms or CHMC42H3 Organic Synthesis]

Fourth Year:
PSCD02H3 Current Questions in Mathematics and Science

and
0.5 full credit in any C-level or 300-level CHM course not already taken
and 2.0 full credits in any D-level or 400-level CHM course including at least 0.5 full credit chosen from:
CHMD90Y3 Directed Research
CHMD91H3 Directed Research
CHMD92H3 Advanced Organic Chemistry Lab Course

2. **MINOR PROGRAM MODIFICATIONS:**

Specialist Co-op in Biological Chemistry
Specialist Co-op in Chemistry
Major Co-op in Biochemistry
Major Co-op in Chemistry

*Overview of Changes:*
- Revise course admission requirements

*Proposed Program Requirements:*

**Co-operative Offerings**
*Co-op Supervisor of Studies: S. Dalili (416-287-7215) Email: s dalili@utsc.utoronto.ca*
*Co-op Contact: askcoop@utsc.utoronto.ca*

**Eligible Programs of Study:**
The following Co-operative (Co-op) programs in Chemistry are available at UTSC:

- Specialist in Biological Chemistry
- Specialist in Chemistry
- Major in Biochemistry
- Major in Chemistry

*Note: Students interested in selecting either of the Major Co-operative programs require prior approval from the Co-op Supervisor of Studies.*

The Co-op programs in Chemistry allow students to combine their chosen academic program with an integrated and complementary work experience. Students are required to complete the program requirements of any one of the above listed non-Co-op Specialist Programs, or non-Co-op Major
Programs within their 20-credit degree program. They will also complete three work terms of four months each, as well as a specially designed series of enhancement seminars. The overall purpose of these Co-op Programs is to provide students with an educational milieu that will allow them to develop as highly qualified scientists, and with excellent experience in both the academic and workplace environments.

For information on fees, work terms, and studying in the program, please see the Co-operative Programs section of this Calendar.

Prospective Applicants: For direct admission from secondary school or for students who wish to transfer to U of T Scarborough from another U of T faculty or from another post-secondary institution, see the Co-operative Programs section in this Calendar.

Current U of T Scarborough students: Application procedures can be found at the Registrar's Office website at: www.utsc.utoronto.ca/subjectpost. The minimum qualifications for entry are a cumulative GPA of at least 2.50 and the completion of all course prerequisites as noted in the Program Admission section above.

Program Admission
Students must meet the following requirements to gain entry into their desired program area:

1. Biological Chemistry (Specialist): 4.0 full credits including BIOA01H3, BIOA02H3, CHMA10H3, CHMA11H3, MATA30H3, [MATA35H3 or MATA36H3 or MATA37H3], PHYA10H3 & PHYA21H3
2. Chemistry (Specialist): 4.0 full credits including CHMA10H3, CHMA11H3, MATA30H3, [MATA36H3 or MATA37H3], PHYA10H3 & PHYA21H3
3. Biochemistry (Major): 4.0 full credits including BIOA01H3, BIOA02H3, CHMA10H3, CHMA11H3, MATA30H3 & [MATA35H3 or MATA36H3]
4. Chemistry (Major): 4.0 full credits including CHMA10H3, CHMA11H3, MATA30H3, [MATA35H3 or MATA36H3 or MATA37H3], PHYA10H3 & PHYA21H3

Specialist in Biological Chemistry

Overview of Changes:
• Delete MATA37H3 from the list of mathematics options in the First Year requirements

Proposed Program Requirements:
SPECIALIST PROGRAM IN BIOLOGICAL CHEMISTRY (SCIENCE)

Supervisor: W. Restivo (416-287-7222) Email: restivo@utsc.utoronto.ca
This program is intended for students who want to specialize in Chemistry, but who are also interested in the chemistry of living systems.

Program Requirements
The program requires the completion of the following 15.0 full credits:
First Year:
BIOA01H3 Life On Earth: Unifying Principles
BIOA02H3 Life on Earth: Form, Function and Interactions
CHMA10H3 Introductory Chemistry I: Structure and Bonding
CHMA11H3 Introductory Chemistry II: Reactions and Mechanisms
MATA30H3 Calculus I for Biological and Physical Sciences
[MATA35H3 Calculus II for Biological Sciences or MATA36H3 Calculus II for Physical Sciences
or MATA37H3 Calculus II for Mathematical Sciences]
PHYA10H3 Introduction to Physics IA
PHYA21H3 Introduction to Physics IIA

Note: PSCB57H3 requires either MATA36H3 or MATA37H3 as a prerequisite. [MATA36H3 or MATA37H3] is strongly recommended over MATA35H3 in order that future course selection is not compromised.

Second Year:
BIOB10H3 Cell Biology
BIOB11H3 Molecular Aspect of Cellular and Genetic Processes
BIOB12H3 Laboratory for Cell and Molecular Biology
CHMB31H3 Introduction to Inorganic Chemistry
CHMB41H3 Organic Chemistry I
CHMB42H3 Organic Chemistry II

Second or Third Year:
CHMB16H3 Techniques in Analytical Chemistry
CHMB20H3 Chemical Thermodynamics and Elementary Kinetics
CHMB21H3 Chemical Structure and Spectroscopy
and
0.5 full credit from the following:
MATA23H3 Linear Algebra I
PSCB57H3 Introduction to Scientific Computing
STAB22H3 Statistics I

Third Year:
BIOC12H3 Biochemistry I: Proteins and Enzymes
BIOC13H3 Biochemistry II: Bioenergetics and Metabolism
BIOC23H3 Practical Approaches to Biochemistry
CHMC47H3 Bio-Organic Chemistry

Third or Fourth Year:
CHMC11H3 Principles of Analytical Instrumentation
CHMC31Y3 Intermediate Inorganic Chemistry
[CHMC41H3 Organic Reaction Mechanisms or CHMC42H3 Organic Synthesis]

Fourth Year:
CHMD79H3 Topics in Biological Chemistry
1.5 full credits in D-level or 400-level CHM courses including:
at least 0.5 full credit from one of the following:
CHMD90Y3 Directed Research
CHMD91H3 Directed Research
CHMD92H3 Advanced Organic Chemistry Lab Course
and at least 0.5 full credit from the following:

- **CHMD69H3** Bioinorganic Chemistry
- **CHMD71H3** Pharmaceutical Chemistry

**Major in Biochemistry**

*Overview of Changes:*
- Add MATA30H3 and [MATA35H3 or MATA36H3] as requirements to the First Year requirements
- Change [CHMC41H3 or CHMC42H3] from a requirement to an option in Second and Later Years requirement
- Delete several CHM options from Second and Later Years requirement

*Proposed Program Requirements:*

**MAJOR PROGRAM IN BIOCHEMISTRY (SCIENCE)**

**Supervisor:** Alen Hadzovic (416-287-5602)  
**Email:** alen.hadzovic@utoronto.ca

This Program places a greater emphasis on the biological aspects of chemistry than does the general Chemistry Major Program. It is offered for students who are primarily interested in chemistry but also want to study the chemistry of living systems.

**Program Requirements**

Students should complete the following **8.0** full credits:

**First Year:**
- **BIOA01H3** Life on Earth: Unifying Principles  
- **BIOA02H3** Life on Earth: Form, Function and Interactions  
- **CHMA10H3** Introductory Chemistry I: Structure and Bonding  
- **CHMA11H3** Introductory Chemistry II: Reactions and Mechanisms  
- **MATA30H3** Calculus I for Biological and Physical Sciences  
- [**MATA35H3** Calculus II for Biological Sciences or **MATA36H3** Calculus II for Physical Sciences]

**Second and Later Years:**
- **BIOB10H3** Cell Biology  
- **BIOB11H3** Molecular Aspect of Cellular and Genetic Processes  
- **BIOB12H3** Cell & Molecular Biology Laboratory  
- **BIOC12H3** Biochemistry I: Proteins & Enzymes  
- **BIOC13H3** Biochemistry II: Bioenergetics & Metabolism  
- **BIOC23H3** Practical Approaches to Biochemistry  
- **CHMB16H3** Techniques in Analytical Chemistry  
- **CHMB41H3** Organic Chemistry I  
- **CHMB42H3** Organic Chemistry II  
- [**CHMC41H3** Organic Reaction Mechanisms or **CHMC42H3** Organic Synthesis]  
- **CHMC47H3** Bio-Organic Chemistry

And 0.5 credit from the following:
- **CHMB20H3** Chemical Thermodynamics and Elementary Kinetics  
- **CHMB21H3** Chemical Structure and Spectroscopy  
- **CHMB31H3** Introduction to Inorganic Chemistry
CHMB55H3 Environmental Chemistry  
CHMC11H3 Principles of Analytical Instrumentation  
CHMC16H3 Analytical Instrumentation  
CHMC21H3 Topics in Biophysical Chemistry  
CHMC31Y3 Intermediate Inorganic Chemistry  
[CHMC41H3 Organic Reaction Mechanisms or CHMC42H3 Organic Synthesis]  
CHMC41H3 Organic Reaction Mechanisms  
CHMC42H3 Organic Synthesis  

* If CHMB20H3 is selected, PHYA10H3 is required.

Specialist in Chemistry

Overview of Changes:  
• Delete MATA31H3 and MATA37H3 as options in the First Year requirements. MATA30H3 and MATA36H3 become requirements.  
• Move MATA23H3 from the list of options in the First Year requirements to a requirement.  
• Delete ASTA02H3 and BIOA02H3 as options in the First Year requirements.

Proposed Program Requirements:  
SPECIALIST PROGRAM IN CHEMISTRY (SCIENCE)  
Supervisor: S. Dalili (416-287-7215) Email: sdalili@utsc.utoronto.ca  
This Program is meant for students who are interested in obtaining a strong background in all aspects of modern chemistry.

Program Requirements  
The Program requires completion of 14.0 full credits as follows:  
First Year:  
CHMA10H3 Introductory Chemistry I: Structure and Bonding  
CHMA11H3 Introductory Chemistry II: Reactions and Mechanisms  
MATA23H3 Linear Algebra I  
[MATA30H3 Calculus I for Biological and Physical Sciences and MATA36H3 Calculus II for Physical Sciences] or [MATA31H3 Calculus I for Mathematical Sciences and MATA37H3 Calculus II for Mathematical Sciences]  
PHYA10H3 Introduction to Physics IA  
PHYA21H3 Introduction to Physics IIA  
and  
0.5 full credit chosen from:  
ASTA01H3 Introduction to Astronomy and Astrophysics I: The Sun and Planets  
ASTA02H3 Introduction to Astronomy and Astrophysics II: Beyond the Sun and Planets  
BIOA01H3 Life on Earth: Unifying Principles  
BIOA02H3 Life on Earth: Form, Function and Interactions  
EESA05H3 Environmental Hazards  
EESA06H3 Introduction to Planet Earth  
MATA23H3 Linear Algebra I  
PSCB57H3 Introduction to Scientific Computing
**STAB22H3** Statistics I

**Second Year:**
- **CHMB16H3** Techniques in Analytical Chemistry
- **CHMB20H3** Chemical Thermodynamics and Elementary Kinetics
- **CHMB21H3** Chemical Structure and Spectroscopy
- **CHMB31H3** Introduction to Inorganic Chemistry
- **CHMB41H3** Organic Chemistry I
- **CHMB42H3** Organic Chemistry II
- **CHMB62H3** Introduction to Biochemistry
- **MATB41H3** Techniques of Calculus of Several Variables I

**Third Year:**
- **CHMC11H3** Principles of Analytical Instrumentation
- **CHMC16H3** Analytical Instrumentation
- **CHMC20H3** Intermediate Physical Chemistry or **CHMC21H3** Topics in Biophysical Chemistry
- **CHMC31Y3** Intermediate Inorganic Chemistry
- **CHMC41H3** Organic Reaction Mechanisms or **CHMC42H3** Organic Synthesis

**Fourth Year:**
- **PSCD02H3** Current Questions in Mathematics and Science
  - **and**
  - 0.5 full credit in any C-level or 300-level CHM course not already taken
  - **and**
  - 2.0 full credits in any D-level or 400-level CHM course including at least 0.5 full credit chosen from one of the following:
    - CHMD90Y3 Directed Research
    - CHMD91H3 Directed Research
    - CHMD92H3 Advanced Organic Chemistry Lab Course

**Major in Chemistry**

**Overview of Changes:**
- Delete MATA35H3 and MATA37H3 as options in the First Year requirement. MATA36H3 becomes a requirement.
- Add specific CHM courses to Second and Later Years requirement.
- Increase the total fees to complete the program from 7.5 to 8.5.

**Proposed Program Requirements:**

**MAJOR PROGRAM IN CHEMISTRY (SCIENCE)**

**Supervisor:** S. Mikhaylichenko (416-287-7207)  **Email:** mikhay@utsc.utoronto.ca

This Program offers the possibility of obtaining an introduction to all of the sub-disciplines of Chemistry.

**Program Requirements**

Students should complete the following **7.5 to 8.5** full credits:

**First Year:**
- **CHMA10H3** Introductory Chemistry I: Structure and Bonding
CHMA11H3 Introductory Chemistry II: Reactions and Mechanisms
MATA30H3 Calculus I for Biological and Physical Sciences
[MATA35H3 Calculus II for Biological Sciences or MATA36H3 Calculus II for Physical Sciences
or MATA37H3 Calculus II for Mathematical Sciences]
PHYA10H3 Introduction to Physics IA
PHYA21H3 Introduction to Physics IIA
Note: PHY110Y is not an acceptable substitute for [PHYA10H3 & PHYA21H3]

Second and Later Years:
4.5 credits in Chemistry, of which 2.0 must be at the C- or D-level. One of these C- or D-level half credits must include a laboratory component.
CHMB16H3 Techniques in Analytical Chemistry
CHMB20H3 Chemical Thermodynamics and Elementary Kinetics
CHMB31H3 Introduction to Inorganic Chemistry
CHMB41H3 Organic Chemistry I
CHMB42H3 Organic Chemistry II
CHMB62H3 Introduction to Biochemistry
and
2.5 full course credits in CHM of which at least 2.0 must be at the C- or D-level and 0.5 of which must be at the D-level. One of these C- or D-level half credits must include a laboratory component.**
** Students should note that if they are going to select CHMB20H3/CHMB21H3, then MATA36H3 or MATA37H3 must be taken instead of MATA35H3. If CHMC20H3/CHMC21H3 are selected, MATB41H3 is a prerequisite. CHMC20H3/CHMC21H3, MATA23H3 and MATB41H3 will need to be taken in addition to their other program requirements.

Specialist in Environmental Biology

Overview of Changes:
- Delete EESC15H3 from the Third and Fourth Year requirement.
- Reduce the total fees to complete the program from 14.5 to 14.0.

Proposed Program Requirements:
SPECIALIST PROGRAM IN ENVIRONMENTAL BIOLOGY (SCIENCE)
Supervisor of Studies: M. Isaac (416-287-7276) Email: marney.isaac@utoronto.ca

Program Requirements
Total requirements: 14.5 14.0 full credits
First Year:
EESA01H3 Introduction to Environmental Science
EESA06H3 Introduction to Planet Earth
BIOA01H3 Life on Earth: Unifying Principles
BIOA02H3 Life on Earth: Form, Function and Interactions
CHMA10H3 Introductory Chemistry I: Structure and Bonding
CHMA11H3 Introductory Chemistry II: Reactions and Mechanisms
MATA30H3 Calculus I for Biological and Physical Sciences
[MATA35H3 Calculus II for Biological Sciences or MATA36H3 Calculus II for Physical Sciences
or MATA37H3 Calculus II for Mathematical Sciences]
Second Year:
- PHYA10H3 Introduction to Physics IA or PHYA11H3 Introduction to Physics IB
- BIBB50H3 Ecology
- BIOB51H3 Evolutionary Biology
- BIOB52H3 Ecology and Evolutionary Biology Laboratory
- EESB15H3 Earth History
- EESB16H3 Feeding Humans - The Cost to the Planet
- STAB22H3 Statistics I
- [PSCB57H3 Introduction to Scientific Computing or CSCA08H3 Introduction to Computer Programming]
and
- 1.0 full credit from the following:
  - EESB03H3 Principles of Climatology
  - EESB04H3 Principles of Hydrology
  - EESB05H3 Principles of Soil Science
  - CHMB55H3 Environmental Chemistry

Third and Fourth Years:
- 2.5 credits from:
  - EESC03H3 Geographic Information Systems and Remote Sensing
  - EESC04H3 Biodiversity and Biogeography
  - EESC05H3 Microbial Biogeochemistry
  - EESC13H3 Environmental Impact Assessment and Auditing
  - EESC15H3 Research in Environmental Science
- 2.0 credits from:
  - BIOC51H3 Tropical Biodiversity Field Course
  - BIOC52H3 Ecology Field Course
  - BIOC58H3 Biological Consequences of Global Change
  - BIOC59H3 Advanced Population Ecology
  - BIOC61H3 Community Ecology and Environmental Biology
  - BIOC65H3 Environmental Toxicology
  - BIOC62H3 The Role of Zoos in Conservation
  - BIOC63H3 Conservation Biology
  - BIOC67H3 Inter-University Biology Field Course
- 1.0 credit from:
  - EESD02H3 Contaminant Hydrogeology
  - EESD06H3 Climate Change Impact Assessment
  - EESD15H3 Cleaning Up our Mess: Remediation of Terrestrial and Aquatic Environments
  - EESC20H3 Geochemistry
  - EESD09H3 Research Project in Environmental Science
  - EESD10Y3 Research Project in Environmental Sciences
  - BIOD52H3 Special Topics in Biodiversity and Systematics
  - BIOD60H3 Spatial Ecology
  - BIOD66H3 Causes and Consequences of Biodiversity
BIOD95H3 Supervised Study in Biology
BIOD98Y3 Research Project in Biology

Specialist in Environmental Chemistry

Overview of Changes:
• Delete MATA35H3 and MATA37H3 as options from First Year requirement. MATA36H3 becomes a requirement.
• Delete EESC15H3 from Third Year requirement.
• Move EESC20H3 from Fourth Year to Third Year requirement.
• Add CHM and EES options to Fourth Year requirement.

Proposed Program Requirements:
SPECIALIST PROGRAM IN ENVIRONMENTAL CHEMISTRY (SCIENCE)
Supervisor of Studies: Myrna Simpson (416-287-7234) Email: myrna.simpson@utoronto.ca
Advisor: J. Donaldson (416-287-7213)

Program Requirements
Total requirements: 15.0 full credits

First Year:
EESA01H3 Introduction to Environmental Science
EESA06H3 Introduction to Planet Earth
BIOA01H3 Life on Earth: Unifying Principles
BIOA02H3 Life on Earth: Form, Function and Interactions
CHMA10H3 Introductory Chemistry I: Structure and Bonding
CHMA11H3 Introductory Chemistry II: Reactions and Mechanisms
MATA30H3 Calculus I for Biological and Physical Sciences
[MATA35H3 Calculus II for Biological Sciences or
MATA36H3 Calculus II for Physical Sciences or MATA37H3 Calculus II for Mathematical Sciences]
[PHYA10H3 Introduction to Physics IA or PHYA11H3 Introduction to Physics IB]

Second Year:
BIOB50H3 Ecology
CHMB20H3 Chemical Thermodynamics and Elementary Kinetics
CHMB21H3 Chemical Structure and Spectroscopy
CHMB41H3 Organic Chemistry I
CHMB42H3 Organic Chemistry II
CHMB55H3 Environmental Chemistry
STAB22H3 Statistics I

and
1.0 full credit from the following:
EESB03H3 Principles of Climatology
EESB04H3 Principles of Hydrology
EESB05H3 Principles of Soil Science
EESB15H3 Earth History
Third Year:
EESC03H3 Geographic Information Systems and Remote Sensing
EESC07H3 Groundwater
EESC13H3 Environmental Impact Assessment and Auditing
EESC15H3 Research in Environmental Science
EESC20H3 Geochemistry
CHMB16H3 Techniques in Analytical Chemistry
CHMB31H3 Introduction to Inorganic Chemistry
PSCB57H3 Introduction to Scientific Computing

Fourth Year:
EESD02H3 Contaminant Hydrogeology
EESD15H3 Cleaning Up Our Mess: Remediation of Terrestrial and Aquatic Environments
EESC20H3 Geochemistry
CHMC11H3 Principles of Analytical Instrumentation

and
0.5 1.0 credit from the following:
CHMC21H3 Topics in Biophysical Chemistry
CHMC31Y3 Intermediate Inorganic Chemistry
CHMC41H3 Intermediate Organic Chemistry
Organic Reaction Mechanisms
CHMC42H3 Organic Synthesis
CHMC47H3 Bio-Organic Chemistry
CHMD59H3 Topics in Environmental Chemistry
CHMD89H3 Introduction to Green Chemistry
EESC35H3 Mineralogy

Specialist in Environmental Physics

Overview of Changes:
- Delete EESA01H3 from First Year requirement.
- Add PHY and MAT requirement to Second Year requirement. Add EES option to Second Year requirement.
- Revise PHY requirements in Third Year requirement. Add MAT requirement in Third Year requirement. Add PHY, CHM and EES options in Third Year requirement.
- Revise PHY, EES, CHM, PSC and AST requirements and options in Fourth Year requirement.

Proposed Program Requirements:

SPECIALIST PROGRAM IN ENVIRONMENTAL PHYSICS (SCIENCE)
Supervisor of Studies: Mathew Wells (416-208-4879 or 416-287-7359 (ALT)) Email: wells@utsc.utoronto.ca
Advisor: M. Wells (416-208-4879) Email: wells@utsc.utoronto.ca
Program Requirements
Total Requirements: 15.5 full credits

First Year (4.0 credits):
PHYA10H3 Introduction to Physics IA
PHYA21H3 Introduction to Physics IIA
MATA30H3 Calculus I for Biological and Physical Sciences
MATA36H3 Calculus II for Physical Sciences
CHMA10H3 Introductory Chemistry I: Structure and Bonding
CHMA11H3 Introductory Chemistry II: Reactions and Mechanisms
EESA01H3 Introduction to Environmental Science
EESA06H3 Introduction to Planet Earth
MATA23H3 Linear Algebra I

Second Year (4.5 credits):
(PHYB20H3) Vibrations and Waves
PHYB10H3 Intermediate Physics Laboratory I
PHYB21H3 Electricity and Magnetism
PHYB52H3 Thermal Physics
PHYB54H3 Mechanics: From Oscillations to Chaos
MATB41H3 Techniques of Calculus of Several Variables I
MATB42H3 Techniques of Calculus of Several Variables II
MATB44H3 Differential Equations I
Two of:
   EESB02H3 Principles of Geomorphology
   EESB03H3 Principles of Climatology
   EESB04H3 Principles of Hydrology
   EESB05H3 Principles of Soil Science
   EESB15H3 Earth History

Third Year (4.0 credits):
PHYB10H3 Intermediate Physics Laboratory I
(PHYB11H3) Intermediate Physics Laboratory II
PHYB56H3 Introduction to Quantum Physics
PHYC11H3 Intermediate Physics Laboratory II
PHYB21H3 Electricity and Magnetism
PSCB57H3 Introduction to Scientific Computing
MATC46H3 Differential Equations II
STAB22H3 Statistics I
One of:
   PHYC50H3 Electromagnetic Theory
   PHYC54H3 Classical Mechanics
Two of:
   CHMB55H3 Environmental Chemistry
   EESC07H3 Groundwater
   EESC18H3 The Great Lakes: An Introduction to Physical Limnology
   EESC19H3 Marine Systems
EESC20H3 Geochemistry  
EESC31H3 Principles of Glacial Sedimentology and Stratigraphy  
EESB15H3 Earth History  
EESC03H3 Geographic Information Systems and Remote Sensing  
EESC15H3 Research in Environmental Science  
EESC07H3 Groundwater  
[EESC18H3 The Great Lakes: An Introduction to Physical Limnology or EESC19H3 Marine Systems]

**Fourth Year (3.0 credits):**  
EESC13H3 Environmental Impact Assessment and Auditing  
PSCD01H3 The Physical Sciences in Contemporary Society  

and  
1.5 full credits from:  
CHMB55H3 Environmental Chemistry  
EESC21H3 Urban Environmental Problems of the Greater Toronto Area  
EESD02H3 Contaminant Hydrogeology  
EESD06H3 Climate Change Impact Assessment  
EESD09H3 Research Project in Environmental Science  
EESD10Y3 Research Project in Environmental Science  
EESD11H3 Process Hydrology  
EESC20H3 Geochemistry  
PSCD10H3 Physical Sciences Project  
PHYD37H3 Introduction to Fluid Mechanics  
PHYD38H3 Nonlinear Systems and Chaos  

Four of:  
ASTC25H3 Astrophysics of Planetary Systems  
EESC03H3 Geographic Information Systems and Remote Sensing  
EESD02H3 Contaminant Hydrogeology  
EESD06H3 Climate Change Impact Assessment  
EESD09H3 Research Project in Environmental Science*  
PHYC50H3 Electromagnetic Theory  
PHYC54H3 Classical Mechanics  
PHYD01H3 Physics Research Project*  
PHYD11H3 Computational Physics Project*  
PHYD72H3 Supervised Reading in Physics*  

*no more than two of EESD10Y, PHYD01H, PHYD11H and PHYD72H may be counted as fulfilling the program requirements.

NOTE: Where any course appears on more than one option list, it may only be counted as fulfilling the requirements for one of those lists of options.
3. **DELETED COURSES:**

- EESC15H3  Research in Environmental Science
  - The course is redundant.

4. **NEW COURSES**

**CHMB43Y  Organic Chemistry I and II**

This course provides a comprehensive introduction to the field of organic chemistry. Major topics include organic acids/bases, stereochemistry, substitution/elimination mechanisms, reactions of alkenes/alkynes, radicals, aromatic compounds, carbonyl compounds, oxidation/reduction, radicals, spectroscopy, heterocycles and carbohydrates. Includes a 4 hour lab and 6 hours of lecture each week.

Prerequisite: Completion of at least 4.0 credits, including CHMA10H3 and CHMA11H3. Minimum cumulative GPA of 2.7. Permission of instructor.


Enrolment Limits: 44

Breadth Requirement: Natural Sciences

*Rationale and Fit:*

We are proposing CHMB43Y as a condensed version of the two half courses presently offered (CHMB41H and CHMB42H). The course material will be similar, however, it will be taught at a much faster pace and at a somewhat more advanced level. In particular, we are looking to augment the laboratory portion of the course, creating a richer learning experience by incorporating some of the new instrumentation available in the new TRACES facility. Because of the fast-paced nature of the course, we expect that only the strongest students will be able to handle this condensed version of our organic chemistry curriculum. Therefore, we are proposing to limit the course to students with a cumulative GPA of at least 2.7.

We anticipate that this course will appeal to students in our various chemistry co-op programs, allowing them increased flexibility in scheduling their work-terms. Finally, students from any programs requiring organic chemistry would be welcome to take the course, particularly those looking for a more enriched learning experience.

**CHMC25H3  Quantum Chemistry**

This course provides a comprehensive introduction to the field of computational quantum chemistry. It is organized to give a hands-on experience in applying modern computational methods (e.g. density functional theory) for investigating various physical properties of molecules and materials: vibrational and electronic spectroscopy, magnetic and electric field response properties.

Prerequisite: CHMB21H3 and PHYB56H3. Minimum cumulative GPA of 2.7. Permission of instructor.

Enrolment Limits: 40

Breadth Requirement: Natural Sciences
5. CONSENT AGENDA COURSE CHANGES: (REVISED)

- ASTA02H3  Introduction to Astronomy and Astrophysics II: Beyond the Sun and Planets
  o  Delete Prerequisite
- CHMA10H3  Introductory Chemistry I: Structure and Bonding
  o  Delete Corequisite; Add Recommended Preparation
- CHMA11H3  Introductory Chemistry II: Reactions and Mechanisms
  o  Delete Corequisite; Add Recommended Preparation
- CHMB16H3  Techniques in Analytical Chemistry
  o  Revise Prerequisite
- CHMB31H3  Introduction to Inorganic Chemistry
  o  Revise course content to introduce a laboratory component to course – update Description accordingly
- CHMB41H3  Organic Chemistry I
  o  Revise Prerequisite
- CHMD90Y3; CHMD91H3  Directed Research
  o  Revise Admission Requirement; Revise Exclusion
- EESD09H3  Research Project in Environmental Science
  o  Revise Prerequisite
  o  Add Recommended Preparation
- EESD10Y3  Research Project in Environmental Science
  o  Revise Prerequisite
  o  Add Recommended Preparation