YORK UNIVERSITÉ UNIVERSITY

redefine THE POSSIBLE.

*Three-year and Four-year Degrees with Special Focus on*

# Analytical Chemistry

*The traditional boundaries separating the many sub-disciplines in Chemistry have been blurring. Modern Chemistry demands a broader education and outlook. Chemists now explore multi-disciplinary areas of Science and our undergraduate programs reflect this need. Indeed, hybrid areas, such as biological chemistry, materials chemistry and analytical chemistry, are among the hottest research areas. This is truly an exciting time to study chemistry and we have devised study plans for students wishing to focus on one of these multi-disciplinary areas. The following describes one of these three areas, and the study plan is given overleaf.*

## *What is Analytical Chemistry?*

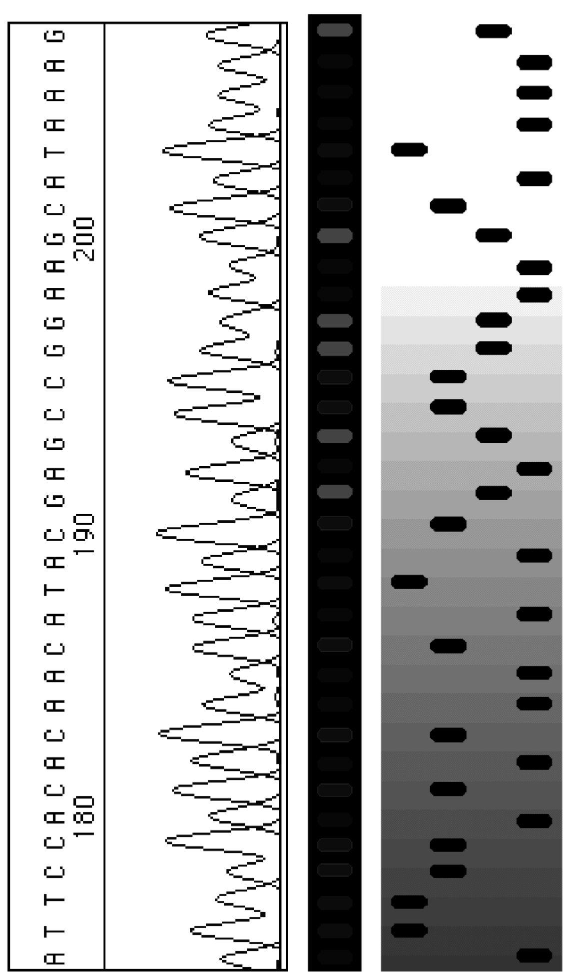
*No other area of Chemistry has more profoundly influenced the experimental sciences than has Analytical Chemistry. All experimental chemists employ the practices of Analytical Chemistry, in whichever field they work in, so as to understand what substances they are dealing with and in what quantities. Beyond the realm of Chemistry itself, experimentalists and technicians in many sciences use the tools and techniques at one time developed by analytical chemists, from the kinesiologist measuring oxygen consumption during exercise and the pharmacologist determining the biodistribution of a drug, to the ecologist monitoring air pollution levels, the Mars Explorer searching for signs of life and the petroleum engineer keeping an eye on the effluent of a cracking column. And industries of all kinds rely on analytical chemists to keep them in business. In most cases, the need is for sensitivity and accuracy, and analytical chemists deliver.*

*Beyond scientific activities, many everyday tasks are Analytical Chemistry in action. The winemaker adjusting the pH of her must, the Culligan man measuring the hardness of household water, the IOC looking for performance enhancers in athletes' urine samples, the diabetic monitoring blood glucose and the policeman testing for blood alcohol in motorists - all of these tasks were at one time problems, but are now routine and reliably performed, thanks to the ingenuity of analytical chemists.*

> *Organic and inorganic chemists produce compounds.*
> *Analytical chemists produce sensitivity, accuracy and reliability.*

*But the science does not rest on its past successes and research in Analytical Chemistry is forever pushing the limits of the possible to do the impossible. The face of Analytical Chemistry has radically changed as it has embraced the technological advances of the past half-century, becoming heavily reliant on instrumentation, miniaturization and computerization, in response to ever more demanding problems of analysis and detection, often on small samples of dilute and impure materials.*

*Always in demand, analytical chemists are equipped for the challenges of the future.*




*This picture is a composite image illustrative of the advances in molecular biology arising from Bio-analytical Chemistry. Learning the sequence of a length of DNA traditionally involved radioactive materials, gel electrophoresis, X-ray photography and visual interpretation. The mixtures of radioactive products from four separate DNA-copying reactions, one for each possible nucleotide unit, were loaded onto and run in separate lanes of an electrophoresis gel, which was then visualized by X-ray photography (with exposures sometimes lasting days) to give a black & white photograph (image at far right) that would be 'read' by eye. With subunits bearing fluorescent dyes, one for each possible nucleotide unit, replacing radioactive materials (along with their limited shelf life and safety risks), a single reaction mixture is needed and is run in a single lane of the electrophoresis gel (middle image). The dye sequence on the gel is then instantly 'read' by automated fluorescence detection to give a print-out of the corresponding DNA sequence (image at far left). Because fluorescence detection is sensitive, less material is needed. Safety, speed, accuracy and economy. These four enhancements brought by analytical chemists have enabled molecular biologists to rapidly sequence massive amounts of DNA, as best exemplified by the recent success of the Human Genome Project.*

## Who are these study plans for?

*These will appeal to students with basic interests in any sub-discipline (organic, inorganic, biological, atmospheric, physical) and a curiosity as to how substances are detected and measured, students who like to tinker, students with a fascination with instrumentation and the interfacing of instruments with computers. It will also appeal to students with a facility in statistics and numerical methods.*

*This is for students interested in the environmental sciences, Bio-analytical Chemistry, spectroscopy, chromatography, mass spectrometry or other aspects of analytically related Chemistry.*

### Need more information?

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*e-mail: chemasst@yorku.ca web site: www.chem.yorku.ca*

## What do they get me?

*These study plans provide a solid grounding in Chemistry plus a specialized exploration of the theory, methodology, technology and practice of Analytical Chemistry. The three-year version leads to a Bachelor of Science (BSc.) degree with a major in Chemistry. The four-year version leads to a fully accredited Specialized Honours BSc. degree with a major in Chemistry, one entirely suitable for the pursuit of graduate studies and one of the best preparations in Analytical Chemistry in the country. The full study plans are listed below.*

*Both include extensive, hands-on training, and both are suitable for well-paid employment in chemical industries, including the chemical manufacturing, petrochemical and pharmaceutical sectors, as well as in government agencies and other research environments. The employment opportunities after graduation are excellent, and combinations with a Seneca College diploma are unbeatable.*

*These study plans are not yet formal degree streams and neither the degree nor the transcript will bear mention of the Analytical option. Nevertheless, students completing the requirements below can obtain a letter from the Chair attesting to that fact.*

# *The Study Plans*

*Updated for 2006-2007*

### *Courses Common to Both the Three-Year and Four-Year Degrees*

YEAR 1
- SC/CHEM 1000 3.0 ¶ *Chemical Structure*
- SC/CHEM 1001 3.0 ¶ *Chemical Dynamics*
- SC/PHYS 1010 6.0 * *Physics*
  or SC/PHYS 1410 6.0 *Physical Science*
- SC/CSE 1540 3.0 ¥ *Computer Use for the Natural Sciences*
  or SC/CSE 1020 3.0 ¥ *Introduction to Computer Science I*
  or SC/CSE 1520 3.0 ¥ *Introduction to Computer Use I*
  or SC/CSE 1530 3.0 ¥ *Introduction to Computer Use II*
- SC/MATH 1013 3.0 *Applied Calculus I*
- SC/MATH 1014 3.0 *Applied Calculus II*

YEAR 2
- SC/CHEM 2010 3.0 *Symmetry, Electronic Structure & Bonding*
- SC/CHEM 2011 3.0 *Introduction to Thermodynamics*
- SC/CHEM 2020 6.0 ¶ *Organic Chemistry*
- SC/CHEM 2030 3.0 ** *Basic Inorganic Chemistry*
- SC/CHEM 2080 4.0 *Analytical Chemistry*

YEAR 3
- SC/CHEM 3070 3.0 *Industrial & Green Chemistry*
- SC/CHEM 3080 4.0 *Instrumental Methods of Chemical Analysis*

IN ADDITION
- GENERAL EDUCATION - 12 credits
- Additional 1000-level SC credits as needed for a minimum total of 24 1000-level SC credits.† SC/BIOL 1010 6.0 is strongly recommended for students lacking OAC Biology.

### *For the Three-Year BSc. in Chemistry Degree*

YEAR 3 (In Addition To The Common Courses)
- 14 other 3000-level CHEM credits

IN ADDITION
- Additional SC courses needed for a minimum total of 66 SC credits. SC/CHEM 2050 4.0 ‡ is strongly advised, particularly for students contemplating a later transfer to a Spec. Hon. degree.
- Additional courses needed for a minimum overall total of 90 credits.

### *For the Four-Year Specialized Honours BSc. in Chemistry Degree*

YEAR 3 (In Addition To The Common Courses)
- SC/CHEM 3010 4.0 *Physical Chemistry*
  or SC/CHEM 3011 4.0 *Physical Chemistry*
- SC/CHEM 3020 4.0 *Organic Chemistry II*
- SC/CHEM 3030 4.0 *Transition Metal Chemistry*

YEAR 4
- SC/CHEM 4080 3.0 *Advanced Analytical Separation Methods*
- SC/CHEM 4000 8.0 ¶ *Research Project*

IN ADDITION
- SC/CHEM 2050 4.0 ‡ *Introduction to Biochemistry*
- 12 additional CHEM credits at the 3000 or 4000 levels, of which at least 6 ‡ must be at the 4000 level.
- Additional SC courses needed for a minimum total of 90 SC credits.
- Additional courses needed for a minimum overall total of 120 credits.

** Requires SC/MATH 1025 3.0 or equivalent as co-requisite.*
*¥ SC/CSE courses were formerly labelled SC/COSC.*
*† Certain courses are not eligible: SC/CHEM 1500 4.0, SC/CHEM 1550 3.0, SC/MATH 1510 6.0, SC/MATH 1515 3.0 and all NATS courses.*
*¶ Usually also available in summer terms. Other departments also offer summer courses.*
*** Students having taken SC/CHEM 2030 4.0 (before Fall 2006) will need one fewer elective credit for a 90- or 120-credit degree.*
*‡ Starting Fall 2006, strongly advised but not required for students in the three-year progression. Students in the four-year progression enrolled before Fall 2006 can opt to follow the above requirementss (including SC?CHEM 2050 4.0) or the older, pre-2006 requirements. If SC/CHEM 2050 4.0 is not taken, a MATH Elective (SC/MATH 1025 3.0, 1021 3.0, 2015 3.0, 2221 3.0 or 2310 3.0) must be taken and, normally, at least seven (7) additional 4000-level CHEM elective credits are required. However, the Department of Chemistry will waive the requirement for 7 additional 4000-level CHEM elective credits for those students having only 6 and lacking SC/CHEM 2050 4.0, but otherwise having met all other pre-2006 requirements and eligible to graduate. This waiver will be issued after graduating students apply to graduate. Consult the Undergraduate Program Assistant (124 CB) for details and procedure.*