

Department of Chemistry Course Outline

Winter 2023-2024, CHEM 4050, Bioanalytical Chemistry, 3.0


[Land Acknowledgement](#)Course Instructor: Sergey Krylov  Hear my name

Class Times: Monday, 14:00 – 17:30

How to address me: Professor Krylov

Class Location: Chemistry Bld, Rm 115

My personal pronouns: (they/them/their)

Course TA: Quan Le (he/him/his)  Hear my name

E-mail: quan1504@yorku.ca

Note: If you have a question or would like to talk with me, you are welcome to (i) approach me after class, (ii) send a message on eClass (this option can be found at the top right of the screen, or (iii) visit me during student hours

"Student Hours" time: Friday, 13:00 – 15:00

"Student Hours" Location: Petrie Bld, Rm 348

I would appreciate if you drop me a message in eClass about your planning to see me during student hours

What are 'Student Hours'?

Student hours are dedicated time for the course instructor and/or TA to meet with YOU. Pop in to introduce yourself, ask questions about the course, or discuss content from the course.

Note: If this time doesn't work for you, send me a message on eClass and we can arrange an alternate time to meet.

Course Format: in-person

Prerequisites: BIOL 2020 or BCHM 2020 or CHEM 2050; BIOL 2021 or BCHM 2021; CHEM 2021

Welcome to "Bioanalytical Chemistry – Quantitative Science" !

More and more of our decisions are based on "quantities". For example, I decide when to start and finish a class based on time. We decide on whether we should take a fever medication based on our body temperature. Pharmaceutical companies decide on whether a molecule can be a "drug lead" based on its K_d value. Bioanalytical Chemistry is a branch of science that deals with quantitative description of everything that happens with biological molecules.

Course Calendar Description: This course describes modern methods of Bioanalytical Chemistry in their application to the analysis of biological polymers: proteins, nucleic acids, carbohydrates and lipids. Analytical aspects of genomics and proteomics are considered.

Topics:

1. Optical detection
 - Optical detection in context of remote sensing
 - Light absorption, Lambert-Beer law, electronic transitions, Frank-Condon principle, absorption spectra, component analysis using linear equations, spectrophotometers
 - Luminescence, Jabłoński diagram, fluorescence and phosphorescence, time-scales of processes, fluorescence lifetime, quantum yield
 - Quenching of fluorescence, dynamic quenching, Stern-Volmer equation, static quenching
 - Fluorescence polarization and anisotropy, sources of fluorescence depolarization, experimental setup for anisotropy measurements
 - Determination of K_d using anisotropy and other additive functions
 - Fluorescence energy transfer, efficiency and Förster radius
 - Types of intermolecular interactions
 - Light sources, objectives, filters, mirrors, detectors
2. Biopolymers
 - Physico-chemical characteristics and levels of structural organization - Amino acids and proteins
 - Nucleotides and DNA and RNA
3. Separation by capillary electrophoresis
 - Principles of sample injection, separation, and detection
 - Electrophoretic mobility, electroosmotic flow
 - Efficiency and resolution
 - Modes of capillary electrophoresis
 - DNA- and RNA-binding proteins as modulators of separation in hybridization analyses - Polymerase chain reaction and DNA sequencing
4. Affinity methods in selection of affinity probes and pharmaceutical hits
 - Combinatorial libraries: collections and mixtures
 - Oligonucleotide libraries as most diverse ones
 - Mathematics of partitioning of binders from nonbinders
 - Multi-round partitioning and SELEX
5. Affinity methods for characterization of affinity probes and pharmaceutical hits
 - General procedure for finding K_d , Fundamental source of inaccuracy of K_d
 - General approach to finding k_{on} and k_{off}
 - Classification of affinity methods, the issue of accuracy and precision
 - Kinetic separation by capillary electrophoresis
 - "Accurate constant by transient incomplete separation (ACTIS)"

Course level learning objectives:

Understand fundamental and quantitative aspects of:

- 1) analytical separation, optical detection, identification and quantitation of biological molecules
- 2) processes in which biological molecules interact
- 3) processes which are key to modern drug development

Upon successful completion of this course, students should be equipped with fundamental and applied knowledge required to solve many practical problems, such as:

1. Analysis of light-absorption and fluorescence spectra and performing quantitative component analysis
2. Operating with quantities of signal, background, noise, analytical sensitivity, limit of detection, limit of quantitation, diagnostic sensitivity, diagnostic specificity, etc.
3. Determination of rate constants and equilibrium constants of binding reactions
4. Quantitative characterization of drug screening

Lecture schedule

January 8	Lecture 1
January 15	Lecture 2
January 22	Lecture 3
January 29	Lecture 4
February 5	Lecture 5
February 12	1 st Midterm exam (30%)
<i>February 19</i>	<i>No classes – Family Day</i>
February 26	Lecture 6
March 4	Lecture 7
March 11	Lecture 8
March 18	2 nd Midterm exam (30%)
March 25	Lecture 9
April 1	Lecture 10
April 8	Lecture 11
April 15 or later	Final exam, (40%)

Missed exams: Doctor's note is required for any exam missed for medical reason. Missing any exam without a legitimate reason leads to a zero mark on the exam. Weight of missed midterms will be transferred to the final exam provided that the reason for missing midterms is legitimate.

Healthy teaching/learning environment: I am committed to fostering a healthy and fair learning/learning environment. All students in the class, the instructor, and any guests should be treated with respect during all interactions.-I welcome creativity and sharing opinions.

Community Guidelines

The following values are fundamental to academic integrity and are adapted from the International Center for Academic Integrity*. In our course, we will seek to behave with these values in mind.

	As students, we will...	As a teaching team, we will...
Honesty	<ul style="list-style-type: none"> Honestly demonstrate our knowledge and abilities on assignments and exams Communicate openly without using deception, including citing appropriate sources 	<ul style="list-style-type: none"> Provide honest feedback on your demonstration of knowledge and abilities on assignments and exams Communicate openly and honestly about the expectations and standards of the course via the syllabus, and with respect to assignments and exams
Responsibility	<ul style="list-style-type: none"> Complete assignments on time and in full preparation for class Show up to class on time, and be mentally/physically present Participate fully and contribute to team learning and activities 	<ul style="list-style-type: none"> Provide timely feedback on your assignments and exams Show up to class on time, and be mentally and physically present Create relevant assessments and class activities
Respect	<ul style="list-style-type: none"> Speak openly with one another, while respecting diverse viewpoints and perspectives Provide sufficient space for others to voice their ideas 	<ul style="list-style-type: none"> Respect your perspectives even while we challenge you to think more deeply and critically Help facilitate respectful exchange of ideas
Fairness	<ul style="list-style-type: none"> Contribute fully and equally to collaborative work, so that we are not freeloading off others Not seek unfair advantage over fellow students in the course 	<ul style="list-style-type: none"> Create fair assignments and exams, and grade them in a fair, and timely manner Treat all students equitably
Trust	<ul style="list-style-type: none"> Not engage in personal affairs while on class time Be open and transparent about what we are doing in class Not distribute course materials to others without authorization 	<ul style="list-style-type: none"> Be available to all students when we say we will be Follow through on our promises Not modify the expectations or standards without communicating with everyone in the course

	As students, we will...	As a teaching team, we will...
Courage	<ul style="list-style-type: none"> Say or do something when we see actions that undermine any of the above values Accept a lower or failing grade or other consequences of upholding and protecting the above values 	<ul style="list-style-type: none"> Say or do something when we see actions that undermine any of the above values Accept the consequences (e.g., lower teaching evaluations) of upholding and protecting the above values

² This class statement of values is adapted from Tricia Bertram Gallant, Ph.D.

Learning Materials

Helpful textbooks:

1. [Bioanalytical Chemistry by Susan R. Mikkelsen and Eduardo Corton](#)

2. [Bioanalytical Chemistry by Andreas Manz et al.](#)

Website (eClass): <https://eclass.yorku.ca/course/view.php?id=95569>

Technology required: An internet-enabled computer to access eClass and materials

Note: If you don't have access to a computer, consider [borrowing a laptop from York U](#), [financial aid from York](#), and [single workspaces available for student use on campus at the library](#).

Assessment in this Course

Research about learning strongly suggests that the most important factor in learning is doing the work of reading, reproducing, solving, synthesizing, and analyzing. Learning happens best when people actively engage material on a consistent basis, and that is why we have high standards in this course. We are confident that, with appropriate effort, you all can meet those standards.

When possible, we also try to reduce unintentional bias in grading by, for example, grading assignments one question at a time (grading all of question 1 before grading any of question 2), grading anonymously, and using rubrics. These also help improve consistency in marking.

Regrading/Reappraisal Procedures

For all re-grading requests, please, submit your request via the reappraisal form on eClass. In this form you'll be asked to include (i) your name and student number, (ii) a summary of your request (e.g., the total was miscounted), and (iii) a copy of your assessment. We will strive to review all re-grading requests within 3 weeks.

University Policies

Important Dates

Drop Deadline: March 11 (last day to drop without course on transcript)

Course Withdrawal Deadline: April 8 (course still appears on transcript with 'W')

Grading Scheme

In accordance with the York University Undergraduate Calendar Regulations, the letter grades assigned in undergraduate courses at York conform to the descriptions and grade ranges shown here: <https://calendars.students.yorku.ca/2022-2023/grades-and-grading-schemes>

Academic Honesty and Integrity

Academic misconduct undermines the values of honesty, trust, respect, fairness, and responsibility that we expect in this class. York University provides supports such as academic integrity workshops to ensure that all students understand the norms and standards of academic integrity that we expect you to uphold.

York students are required to maintain the highest standards of academic honesty and they are subject to the Senate Policy on Academic Honesty (<http://secretariat-policies.info.yorku.ca/policies/academic-honesty-senate-policy-on/>). The Policy affirms the responsibility of faculty members to foster acceptable standards of academic conduct and of the student to abide by such standards. Please review and familiarize yourself with the policy.

There is also an academic integrity website with comprehensive information about academic honesty and how to find resources at York to help improve your research and writing skills, and cope with University life. Students are expected to review the materials on the Academic Integrity website:

Examples of actions that do not adhere to York's Academic Integrity Policy include:

- Plagiarism (passing off someone else's work as your own)
- Accessing unauthorized sites for assignments or tests
- Unauthorized collaboration on assignment and exams
- Uploading work to third party repository sites (e.g., Course Hero, One Class, etc.)
- Scanning, sharing, uploading, or publishing exams, tests, or scholarly work

For more information on what academic integrity is and why it is important see:

<https://spark.library.yorku.ca/academic-integrity-what-is-academic-integrity/>. Information on the process of investigations into breaches of academic honesty:

<https://spark.library.yorku.ca/academic-integrity-breach-of-policy-on-academic-honesty/>

Important Note from the FSc Committee on Examinations & Academic Standards (CEAS): Numerous students in Faculty of Science courses have been charged with academic misconduct when materials they uploaded to third party repository sites (e.g., Course Hero, One Class, etc.) were taken and used by unknown students in later offerings of the course. Whenever a student submits work obtained through an external site (e.g., Course Hero, Chegg), the submitting student will be charged with plagiarism and the uploading student will be charged with aiding and abetting. To avoid this risk, students are urged not to upload their work to such sites.

Assistance for Students (Academic and Well-Being)

Academic Advising*: <https://www.yorku.ca/science/academic-advising/> * Departments also offer program-specific advising. Check with your Department's Undergraduate Office.

Centre for Human Rights, Equity, and Inclusion: <https://rights.info.yorku.ca>

Centre for Indigenous Students Services: <https://aboriginal.info.yorku.ca/>

Good2Talk 24-hour Ontario Student Helpline: 1-866-925-5454 /Text: GOOD2TALKON to 686868

Keep.meSAFE: <https://myssp.app/keepmesafe/ca/home>

Learning Commons (general academic learning supports including library research, time management, study skills, career planning, etc.): <https://learningcommons.yorku.ca/>

Peer Assisted Study Sessions (PASS): <https://www.yorku.ca/colleges/bethune/get-help/pass/>

Peer Tutoring: <https://www.yorku.ca/colleges/bethune/get-help/peer-tutoring/>

Sexual Violence Response and Support: <https://thecentre.yorku.ca>

Student Counselling, Health & Well-being: <https://counselling.students.yorku.ca/>

Support Services for International Students: <https://yorkinternational.yorku.ca/international-student-support/>

Writing Services: <https://www.yorku.ca/colleges/bethune/get-help/writing/>

York University Student Services: <https://family.yorku.ca/student-services/#SCD>

York University Student Well-being Resources: <https://www.yorku.ca/well-being/resources/students/>

Accessibility

York University is committed to principles of respect, inclusion, and equality of all persons with accessibility needs across campus. The University provides services for students with accessibility needs (including physical, medical, learning, and psychiatric needs) needing accommodation related to teaching and evaluation methods/materials. These services are made available to students in all Faculties and programs at York University.

Students in need of these services are asked to register with accessibility services as early as possible to ensure that appropriate academic accommodation can be provided with advance notice. You are encouraged to schedule a time early in the term to meet with each professor to discuss your accommodation needs. Please note that registering with accessibility services and discussing your needs with your professors is necessary to avoid any impediment to receiving the necessary academic accommodations to meet your needs.

Additional information is available at the following websites:

Student Accessibility Services: <https://accessibility.students.yorku.ca>

York Accessibility Hub: <http://accessibilityhub.info.yorku.ca/>

Religious Observance Accommodation

York University is committed to respecting the religious beliefs and practices of all members of the community and making accommodations for observances of special significance to adherents. The list of such dates can be found here: <https://registrar.yorku.ca/enrol/dates/religious-accommodation-resource-2023-2024>. Should any of the dates specified in this syllabus for an in-class test or examination pose such a conflict for you, contact the Course Director within the first three weeks of class. Similarly, should an assignment to be completed in a lab, practicum placement, workshop, etc., scheduled later in the term pose such a conflict, contact the Course Director immediately. To arrange an alternative date or time for an examination scheduled in the formal examination periods (December and April/May), students must complete and submit an accommodation request form at least 3 weeks before the exam period begins. <https://secure.students.yorku.ca/pdf/religious-accommodation-agreement-final-examinations.pdf>

Student and Instructor Conduct in Academic Situations

Students and instructors are expected to maintain a professional relationship characterized by courtesy and mutual respect. Moreover, it is the responsibility of the instructor to maintain an appropriate academic atmosphere in the classroom and other academic settings, and the responsibility of the student to cooperate in that endeavour. Further, the instructor is the best person to decide, in the first instance, whether such an atmosphere is present in the class. The policy and procedures governing disruptive and/or harassing behaviour by students in academic situations is available at <http://secretariat-policies.info.yorku.ca/policies/disruptive-andor-harassing-behaviour-in-academic-situations-senate-policy/>.

Academic accommodation refers to educational practices, systems and support mechanisms designed to accommodate diversity and difference. The purpose of accommodation is to enable students to perform the essential requirements of their academic programs. At no time does academic accommodation undermine or compromise the learning objectives that are established by the academic authorities of the University.

University rules regarding registration, withdrawal, appealing marks, and most anything else you might need to know can be found on the university's website, here:

<https://calendars.students.yorku.ca/2021-2022/policies-and-regulations>