BIOC*3570 Analytical Biochemistry

Fall 2023
Section(s): C01

Department of Molecular and Cellular Biology
Credit Weight: 0.75
Version 1.00 - August 29, 2023

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1 Course Details

1.1 Calendar Description

This course covers the tools and techniques by which biological molecules are isolated, separated, identified, and analyzed. Detailed discussion of experimental methods for macromolecule purification and characterization is included.

Pre-Requisites: BIOC*2580, (CHEM*2400 or CHEM*2480)

1.2 Course Description

Students must pass (mark of 50% or better) **both** the laboratory component (35%) **and** the theory component (65%) to obtain a final passing mark in the course. In cases where this standard is not reached, the final mark assigned will be either the mark calculated as given above or 47%, whichever is *less*. College policy precludes changes to the marking scheme for individual students, except in case of illness.

Introductory biochemistry is a prerequisite for this course. The following aspects of the subject are important background, and familiarity with them will be assumed: basic aspects of protein and nucleic acid structure, including structures of all amino acids and nucleotides; flow of genetic information; basic enzymology. Please take some time to review this material carefully, especially if some time has passed since you took intro. biochemistry.

1.3 Timetable

Tue. - 11:30 a.m. - 12:50 p.m., Lecture in THRN 1307

Thur. - 11:30 a.m. - 12:50 p.m., Lecture in THRN 1307

Labs - 1:30 p.m. - 5:20 p.m. SSC 4111 on your scheduled day of the week

1.4 Final Exam

The Final Exam is scheduled for Dec 6, 2023 at 11:30 AM (2 hours long). See WebAdvisor for room assignments later in the semester.

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2 Instructional Support

2.1 Instructional Support Team

Instructor:	Siavash Vahidi Prof.
Email:	svahidi@uoguelph.ca
Telephone:	+1-519-824-4120 x53833
Office:	SSC 2253
Office Hours:	Most content-related discussions will occur over discussions in CourseLink Office hours will be scheduled one week before midterms, exams, and on an one-to-one basis by appointment where needed.
Lab Co-ordinator:	Colin Cooper Dr.
Email:	ccoope08@uoguelph.ca
Office:	SSC 3502
Office Hours:	Appointments by request.

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3 Learning Resources

3.1 Required Resources

Lab Manual and Lab Notebook (Lab Manual)

A lab manual will be required for the course and will be available for purchase at the campus bookstore.

A non-spiral-bound lab notebook will be required.

Lab coat and safety glasses (Equipment)

3.2 Recommended Resources

Principles and Techniques of Biochemistry and Molecular Biology (Textbook)

Principles and Techniques of Biochemistry and Molecular Biology, by K. **Wilson and J. Walker**, 8th edition, **2018**.

This is an excellent reference text for a wide variety of standard experimental techniques. It is relatively inexpensive (roughly $60 for >900 pages), and should be a useful reference for any future experimental work; in addition to biochemistry, it also it covers a wide variety of biophysics, molecular biology and cell biology methods, and has an extensive (200 page) section on bioinformatics.

Lehninger et al. (Textbook)

Any reasonably recent edition of the text by Lehninger *et al.*

This text book is useful for general biochemical background you may need to brush up on.

Youtube (Website)

https://youtube.com

Search: enzyme techniques, electrophoresis molecular biology, recombinant, mass spectrometry, proteomics, fluorescence.

3.3 Additional Resources

Biochemistry Lab: Modern Theory and Techniques (Textbook)

Biochemistry Lab: *Modern Theory and Techniques*, by R. Boyer, 2nd edition, 2011.

Available on Reserve.

Fundamental Laboratory Approaches for Biochemistry and Biotechnology (Textbook)

Fundamental Laboratory Approaches for Biochemistry and Biotechnology, 2nd edition, by A. Ninfa & D. Ballou, 2010

Available on Reserve.

Bioanalytical Chemistry (Textbook)

Bioanalytical Chemistry, by Mikkelsen & Corton, 2004

Available on Reserve.

Experimental Biochemistry (Textbook)

Experimental Biochemistry, by Switzer and Garrity, 1999

Available on Resrerve.

Analytical Biochemistry (Textbook)

Analytical Biochemistry, 2nd edition, by D.J. Holme and H. Peck, Longman, 1993

Available on Reserve.

Physical Biochemistry (Textbook)
Physical Biochemistry (2nd edition, 1982) D. Freifelder (QH 345.F72).

This is a particularly good reference text for spectroscopy, centrifugation, electrophoresis, and other physical techniques.

Available on Reserve.

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4 Learning Outcomes

4.1 Course Learning Outcomes

By the end of this course, you should be able to:

1. understand the theoretical underpinnings and practical aspects of applying biochemical analysis methods.
2. understand modern approaches to protein quantitation and characterization, including using chromogenic dyes, UV-Visible and fluorescence spectroscopy, electrophoresis, enzymatic assays, and mass spectrometry.
3. understand how proteins are purified from biological or recombinant sources, including diverse centrifugation approaches, and chromatographic methods that rely on ion-exchange, size-exclusion, hydrophobic exchange or affinity resins.

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5 Teaching and Learning Activities

5.1 Lecture

Lecture 1

Topics: Introduction to Analytical Biochemistry

Lectures 2 - 3

Topics: Protein properties, handling and reagents

Lecture 4

Topics: Protein detection and quantitation 1: colorimetric stains

lecture 5

Topics: Protein detection and quantitation 2: antibodies

Lectures 6 - 7

Topics: Centrifugation: theory, instrumentation, differential centrifugation, density gradients, analytical ultracentrifugation

Guest Lecturer: Prof. Robert Harkness (Department of Molecular and Cellular Biology)

Lecture 8

Topics: Protein purification: introduction, protein expression and differential solubility

Lecture 9 - 11

Topics: Protein chromatography: principles and instrumentation, ion exchange, hydrophobic exchange, size exclusion and affinity chromatography

Lecture 12 - 13

Topics: Electrophoresis: theory, materials, native electrophoresis, SDS PAGE, Western blotting, isoelectric focussing, 2D electrophoresis

Lecture 14 - 15

Topics: UV visible spectroscopy: theory, instrumentation and applications

Lecture 16 - 17

Topics: Fluorescence spectroscopy: theory, instrumentation and applications

Lecture 18 - 22

Topics: Mass spectrometry: theory, isotopes, instrumentation,

MALDI and ESI, and proteomics

5.2 Laboratory

Labs will be held in SSC 4111, see WebAdvisor and CourseLink for more details.

The laboratory portion of the course is worth 35% of the course grade. A breakdown of activities will be available on CourseLink.

Assessments will be monitored using anti-plagiarism software.

Under no circumstances are students permitted to use Artificial Intelligence (AI) to aid in the generation of laboratory reports or other coursework. Exceptions may be made if protein modelling or prediction software is used, however, permission must be granted by an instructor. As per a University statement:

"Submission of materials completed by AI, without permission of the instructor, constitutes an offence under the University's academic misconduct policies, either as a form of plagiarism or the use of unauthorized aids."

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6 Assessments

6.1 Assessment Details

Laboratory (35%)

See CourseLink for more details.

Assessments will include written responses to questions and a weekly record of lab activities in a lab notebook (10%), and two lab reports (10% and 15%).

Midterm (25%)

Date: Tue, Nov 7, In class
First midterm exam

This midterm exam will take approximately 90 minutes at the beginning of class. Students will write the exam in class. Please consult with the instructor if you need accommodations.

This midterm is worth 25 % of your final grade

Final Examination (Cumulative) (40%)

Date: Wed, Dec 6, 11:30 AM - 2:00 PM, TBD

A final exam will be held for this course. This exam will be two hours long, and will be cumulative, with more weight on the material not previously tested in the midterm.

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7 Course Statements

7.1 Policy on Missed Examinations

Only valid medical or compassionate reason will prevent a grade of zero for any missed examination. It is the student's responsibility to obtain the necessary documentation from Medical or Psychological Services or the Director of Student Affairs. *Make-up tests will not be given.*

7.2 Course Evaluation

As part of the faculty evaluation process in the Department of Molecular and Cellular Biology, students are reminded that written comments on the teaching performance of the lecturer may be sent to the Chair at any time. Such letters must be signed; a copy, with the signature removed, will be made available to the instructor. Your comments and feedback are always appreciated.

7.3 Online Behaviour

Inappropriate online behaviour will not be tolerated. Examples of inappropriate online behaviour include:

- Posting inflammatory messages about your instructor or fellow students
- Using obscene or offensive language online
- Copying or presenting someone else's work as your own
- Adapting information from the Internet without using proper citations or references
- Buying or selling term papers or assignments
- Posting or selling course materials to course notes websites
- Having someone else complete your quiz or completing a quiz for/with another student
- Stating false claims about lost quiz answers or other assignment submissions
- Threatening or harassing a student or instructor online
- Discriminating against fellow students, instructors and/or TAs
- Using the course website to promote profit-driven products or services
- Attempting to compromise the security or functionality of the learning management system
- Sharing your user name and password
- Recording lectures without the permission of the instructor

7.4 Plagiarism and Use of Artificial Intelligence

Assessments will be monitored using anti-plagiarism software.

Under no circumstances are students permitted to use Artificial Intelligence (AI) to aid in the generation of laboratory reports or other coursework. Exceptions may be made if protein

modelling or prediction software is used, however, permission must be granted by an instructor. As per a University statement:

"Submission of materials completed by AI, without permission of the instructor, constitutes an offence under the University's academic misconduct policies, either as a form of plagiarism or the use of unauthorized aids."

8 Department of Molecular and Cellular Biology Statements

8.1 Academic Advisors

If you are concerned about any aspect of your academic program:

- Make an appointment with a program counsellor in your degree program. B.Sc. Academic Advising or Program Counsellors

8.2 Academic Support

If you are struggling to succeed academically:

- Learning Commons: There are numerous academic resources offered by the Learning Commons including, Supported Learning Groups for a variety of courses, workshops related to time management, taking multiple choice exams, and general study skills. You can also set up individualized appointments with a learning specialist. http://www.learningcommons.uoguelph.ca/
- Science Commons: Located in the library, the Science Commons provides support for physics, mathematic/statistics, and chemistry. Details on their hours of operations can be found at: http://www.lib.uoguelph.ca/get-assistance/studying/chemistry-physics-help and http://www.lib.uoguelph.ca/get-assistance/studying/math-stats-help

8.3 Wellness

If you are struggling with personal or health issues:

- Counselling services offers individualized appointments to help students work through personal struggles that may be impacting their academic performance. https://www.uoguelph.ca/counselling/
- Student Health Services is located on campus and is available to provide medical attention. https://www.uoguelph.ca/studenthealthservices/clinic
- For support related to stress and anxiety, besides Health Services and Counselling

Services, Kathy Somers runs training workshops and one-on-one sessions related to stress management and high performance situations.
http://www.selfregulationskills.ca/

8.4 Personal information

Personal information is collected under the authority of the University of Guelph Act (1964), and in accordance with Ontario's Freedom of Information and Protection of Privacy Act (FIPPA) http://www.e-laws.gov.on.ca/index.html. This information is used by University officials in order to carry out their authorized academic and administrative responsibilities and also to establish a relationship for alumni and development purposes.

For more information regarding the Collection, Use and Disclosure of Personal Information policies please see the Undergraduate Calendar.
(https://www.uoguelph.ca/registrar/calendars/undergraduate/current/intro/index.shtml)

8.5 Course Offering Information Disclaimer

Please note that course delivery format (face-to-face vs online) is subject to change up to the first-class day depending on requirements placed on the University and its employees by public health bodies, and local, provincial and federal governments. Any changes to course format prior to the first class will be posted on WebAdvisor/Student Planning as they become available.

9 University Statements

9.1 Email Communication

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

9.2 When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Graduate Calendar - Grounds for Academic Consideration
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions
https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml

9.3 Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml

Graduate Calendar - Registration Changes
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml

Associate Diploma Calendar - Dropping Courses
https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml

9.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

9.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required; however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to make a booking at least 14 days in advance, and no later than November 1 (fall), March 1 (winter) or July 1 (summer). Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.

For Guelph students, information can be found on the SAS website
https://www.uoguelph.ca/sas

For Ridgetown students, information can be found on the Ridgetown SAS website
https://www.ridgetownc.com/services/accessibilityservices.cfm

9.6 Academic Integrity

The University of Guelph is committed to upholding the highest standards of academic integrity, and it is the responsibility of all members of the University community-faculty, staff, and students-to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff, and students have the responsibility of supporting an environment that encourages academic integrity. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

Undergraduate Calendar - Academic Misconduct
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

Graduate Calendar - Academic Misconduct
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

9.7 Recording of Materials

Presentations that are made in relation to course work - including lectures - cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

9.8 Resources

The Academic Calendars are the source of information about the University of Guelph’s procedures, policies, and regulations that apply to undergraduate, graduate, and diploma programs.

Academic Calendars
https://www.uoguelph.ca/academics/calendars

9.9 Disclaimer

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings, changes in classroom protocols, and academic schedules. Any such changes will be announced via CourseLink and/or class email.

This includes on-campus scheduling during the semester, mid-terms and final examination schedules. All University-wide decisions will be posted on the COVID-19 website

(https://news.uoguelph.ca/2019-novel-coronavirus-information/) and circulated by email.

9.10 Illness

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g.. final exam or major assignment).

9.11 Covid-19 Safety Protocols

For information on current safety protocols, follow these links:

- https://news.uoguelph.ca/return-to-campuses/how-u-of-g-is-preparing-for-your-safe-return/
- https://news.uoguelph.ca/return-to-campuses/spaces/#ClassroomSpaces

Please note, these guidelines may be updated as required in response to evolving University, Public Health or government directives.
