Schulich MEDICINE & DENTISTRY

Western Science

Bachelor of Medical Sciences (BMSc) Program

Biochemistry
4420A Molecular Biology of Proteins

Course Syllabus for Fall 2025

THRIVE together

Western University is committed to a **thriving campus**; therefore, your health and wellness matter to us! The following link provides information about the resources available on and off campus to support students: https://www.uwo.ca/health/ Your course coordinator can also **guide you** to resources and/or services should you need them.

1. Technical Requirements:

Stable internet connection

Laptop or computer

2. Important Dates:

Classes Begin	Reading Week	Classes End	Study day(s)	Exam Period
September 4	November 3–9	December 9	December 10	December 11–22

September 30, 2025, is National Day for Truth and Reconciliation and is a non-instructional day
December 1, 2025: Last day to withdraw from a first-term half course without academic penalty

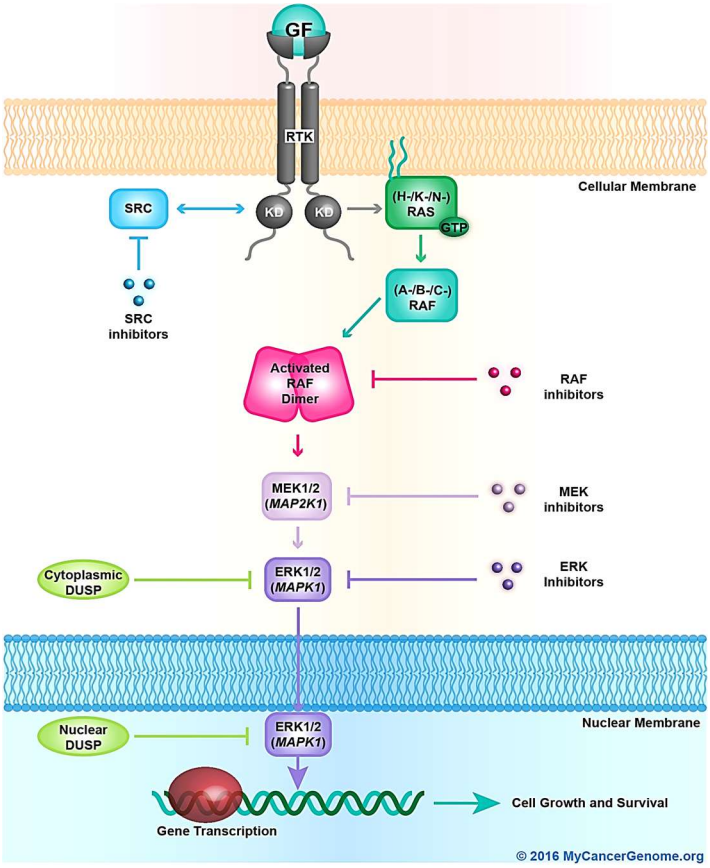
3. Contact Information

Course Coordinator	Contact Information
Dr. Wing-Yiu (James) Choy	jchoy4@uwo.ca

Instructor(s) or Teaching Assistant(s)	Contact Information
Dr. Brian Shilton (Instructor)	bshilton@uwo.ca
Dr. Gary Shaw (Instructor)	gshaw1@uwo.ca
Viveka Pimenta (TA)	vpiment2@uwo.ca
Jahdiel DeNobrega (TA)	jdenobre@uwo.ca

4. Course Description and Design

Biochemistry is a discipline focused on achieving a molecular-level understanding of how macromolecules function in biological systems. Proteins are often represented in textbooks and scientific literature as various simple shapes. For example, the MAP kinase signalling pathway can be illustrated as follows:



Cartoon diagrams with squares, circles, or triangles representing proteins can show the connections between molecules in a pathway; however, these diagrams offer little information about what is actually happening at an atomic and molecular level. For example, it is not clear why certain mutations in the receptor tyrosine kinase (RTK) can cause it to signal in an unregulated and inappropriate manner. Other questions concern the nature of the interactions that result in the "activation" of signalling molecules. For example, in the diagram above, how does the interaction between the RTK and RAS allow RAS to activate RAF?

For a biochemist, diagrams such as the one above are unsatisfying because they do not explain why or how these processes occur at the molecular level. Characterization of events at the molecular level allows one to understand why certain ligands or mutations have particular effects. Knowledge of the molecular structure, chemistry and driving forces facilitates drug design and discovery, and opens the door for molecular engineering.

Given the vast number of protein-mediated interactions, processes, and pathways in living systems, it is daunting to consider actually being able to understand them all at a detailed molecular level. The good news is that we have sufficient knowledge of how proteins work that their functions can be framed and understood using general principles. The aim of this course is to uncover and discuss the general principles that govern protein structure, folding, and stability; their interactions with other molecules; their ability to catalyze complex chemical reactions; and their biogenesis and degradation.

Delivery Mode: in-person

Topics to be considered at an advanced level will include: folding and assembly, targeting, turnover, structure, dynamics and motifs. **Prerequisite(s):** Biochemistry 3381A.

Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

Timetabled Sessions

Component	Date(s)	Time
Lecture	Tuesdays and Thursdays	9:30-10:30 AM
Tutorial / Quiz	Thursdays	4:30-5:30 PM

All course material will be posted to OWL: https://westernu.brightspace.com/d2l/login. Any changes will be indicated on the OWL site and discussed with the class.

If students need assistance, they can seek support on the OWL Brightspace Help. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800.

Current versions of all popular browsers (e.g., Safari, Chrome, Edge, Firefox) are supported with OWL Brightspace; what is most important is that you update your browser frequently to ensure it is current. All JavaScript and cookies should be enabled.

5. Learning Outcomes

Upon successful completion of this course, students will be able to:

- Relate molecular properties of proteins to their biological functions.
- Explain the molecular mechanism of ubiquitination and the roles ubiquitination plays in protein degradation and neurological disease.
- Describe how changes in protein structure, stability, and dynamics can contribute to disease.
- Understand the role of energy in protein stability, conformational dynamics, catalysis, and binding.
- Explain the fundamental differences between folded and intrinsically disordered proteins.

6. Course Content and Schedule

Dates	Topic	Instructor
Sept 4	Course Introduction Discovery Ubiquitination	Choy & Shaw
Sept 9	Identification of the Enzymes I	Shaw
Sept 11	Identification of the Enzymes II	Shaw
Sept 16	The N-end Rule	Shaw
Sept 18	Ubiquitin and polyubiquitin chain recognition	Shaw
Sept 23	Measuring Ubiquitination Activity	Shaw
Sept 25	Identification of Ubiquitin Sites and Chain Types	Shaw
Sept 30	**The National Day for Truth and Reconciliation**	No Class
Oct 2	Ubiquitination and Neurological Disease	Shaw
Oct 7	Therapeutic Opportunities in Ubiquitin Pathway	Shaw
Oct 9	Ligand Binding and Conformation	Shilton
Oct 14	Energetic Barriers and Transition States	Shilton
Oct 16	Protein Dynamics	Shilton
Oct 21	Dynamic Energy Landscape in DHFR Catalysis	Shilton
Oct 23	Allostery and Equilibrium	Shilton
Oct 28	Dynamics and Mechanism	Shilton
Oct 30	Allostery in Hemoglobin	Shilton
Nov 3-9	**Reading Week**	No Class
Nov 11	Allostery, Catalysis, and Energetic Landscapes	Shilton
Nov 13	Evolution of Kinase Energetic Landscapes	Shilton
Nov 18	Introduction to Intrinsically Disordered Proteins	Choy
Nov 20	Functions of Intrinsically Disordered Proteins	Choy
Nov 25	Coupled Folding and Binding I	Choy
Nov 27	Coupled Folding and Binding II	Choy
Dec 2	Intrinsically Disordered Proteins as Drug Targets	Choy
Dec 4	Protein Misfolding & Diseases I	Choy
Dec 9	Protein Misfolding & Diseases II	Choy

7. Participation and Engagement

- ☑ Students are expected to participate and engage with content as much as possible
- ☑ Students can also participate by interacting in the forums with their peers and instructors

8. Assessment and Evaluation

Below is the evaluation breakdown for the course. Any deviations will be communicated.

Assessment	Format	Weighting	Released Date	Due Date
Quiz #1 (Shaw section)	Mixed format	15%*		Oct 2
Assignment #1 (Shaw section)	Written	15%	Sept 26	Oct 10
Quiz #2 (Shilton section)	Mixed format	15%*		Oct 30
Assignment #2 (Shilton section)	Written	15%	Oct 24	Nov 14
Quiz #3 (Choy section)	Mixed format	15%*		Dec 4
Assignment #3 (Choy section)	Written	10%	Nov 21	Dec 5
Final Exam (All sections)	Mixed format	30%		TBA

*Quizzes #1, #2, and #3 will be administered in person on the dates listed above, during the scheduled tutorial time (4:30-5:30 pm; DSB 2016). Only the best 2 of the 3 quiz marks will be counted toward your final grade.

Designated Assessment: Instructors are permitted to designate one assessment per course per term as requiring supporting documentation to receive academic consideration. See below for information on academic consideration policy and missed course work. For this course no assessment has been designated as requiring supporting documentation.

Information about flexibility in assessment

- ☑ Flexibility in assessment has been applied to this course; therefore, academic consideration requests may be denied on the assessments where flexibility is included.
- ☑ Only the best 2 of the 3 quiz marks will be counted toward the final grade. Academic consideration will not be granted for missed quizzes. There will be no make-up quizzes. Students will receive a grade of zero for any missed quizzes within the required 2 quizzes.
- ☑ This course employs flexible deadlines for assignments. The assignment deadlines can be found above in the course outline. For each assignment, students are expected to submit the assignment by the deadline listed. Should illness or extenuating circumstances arise, students are permitted to submit their assignment up to 48 hours past the deadline without a late penalty. Should students submit their assessment beyond 48 hours past the deadline, a late penalty of 5% per day will be subtracted from the assessed grade. Requests for academic consideration supported by documentation must be submitted within 48 hours of the original deadline. The instructor reserves the right to deny such academic considerations, given the deadline flexibility provided. If you have a long-term academic consideration or an accommodation for disability that allows greater flexibility than provided here, please reach out to your instructor at least one week prior to the posted deadline.

General information about assessments

- ☑ All assignments are due at 11:59 pm EST unless otherwise specified
- ☑ Students are responsible for ensuring that the correct file version is uploaded; incorrect submissions including corrupt files could be subject to late penalties (see below) or a 0
- ☑ Written assignments will be submitted to Turnitin (statement in policies below)
- ☑ Students will have 1 submission to Turnitin
- ☑ Rubrics will be used to evaluate assessments and will be posted with the instructions

☑ After an assessment is returned, students should wait 24 hours to digest feedback before contacting their evaluator; to ensure a timely response, reach out within 7 days

☑ Any grade appeals on assignments must be received within 3 weeks of the grade being posted.

Click here for a detailed and comprehensive set of policies and regulations concerning examinations and grading. The table below outlines the University-wide grade descriptors.

A+	90-100	One could scarcely expect better from a student at this level
A	80-89	Superior work which is clearly above average
B	70-79	Good work, meeting all requirements, and eminently satisfactory
C	60-69	Competent work, meeting requirements
D	50-59	Fair work, minimally acceptable
F	below 50	Fail

Information about late or missed assessments:

☑ Late assignments without academic consideration will be subject to a late penalty 5%/day

☑ An assessment cannot be submitted after it has been returned to the class

INC (Incomplete Standing): If a student has been approved by the Academic Advising Office (in consultation with the instructor/department) to complete term work at a later date, an INC will be assigned. Students with INC will have their course load in subsequent terms reduced to allow them to complete outstanding course work. Students may request permission from Academic Advising to carry a full course load for the term the incomplete course work is scheduled.

SPC (**Special examination):** If a student has been approved by the Academic Advising Office to write a Special Examination and the final exam is the only outstanding course component, an SPC will be assigned. If the class has a makeup exam, the student is expected to write the makeup exam. If the class doesn't have a makeup exam or the student misses the makeup exam for reasons approved by the Academic Advising Office, the student will write the exam the next time the course is offered. Outstanding SPCs will reduce the course load for the term the exam is deferred as outlined in Types of Examinations policy.

9. Communication

☑ Students should check the OWL Brightspace site every 24–48 hours

☑ Students should email their instructor(s) and teaching assistant(s) using UWO email

☑ Emails will be monitored daily; students will receive a response in 24–48 hours

☑ This course will use discussions on OWL Brightspace

☑ Students should post all course-related queries on the discussion forum so that everyone can access the questions and responses

10. Office Hours

☑ Regular office hours are not scheduled. For questions or discussion, students should contact the instructors or teaching assistants to arrange an appointment. The teaching assistants will schedule office hours in the weeks prior to assignment due dates.

11. Resources

☑ All resources will be posted in OWL Brightspace

☑ There is no single text that provides adequate coverage of the course material; however, much of the material is covered in the following chapters of three recent books:

The Molecules of Life (John Kuryan, Boyana Konforti, David Wemmer)
Chapter 4 Protein Structure 4.1 - 4.44
Chapter 10 Chemical Potential and the Drive to Equilibrium 10.19 - 10.29

Chapter 12 Molecular recognition 12.1 - 12.11
Chapter 13 Specificity of macromolecular recognition 13.10 - 13.21
Chapter 14 Allostery
Chapter 18 Folding 18.1-18.12, 18.17-18.22

How Proteins Work (Mike Williamson)
Chapter 4 Protein Interactions in vivo 4.3 and 4.5
Chapter 6 Protein Flexibility and Dynamics

Proteins: Concepts in Biochemistry (Paulo Almeida)
Chapter 1 Statistical Thermodynamics of Biological Macromolecules
Chapter 6 Binding, Allostery, and Cooperativity.

These texts are available from the Taylor Library and can be obtained as electronic or hard-copy versions:
The Molecules of Life
https://books.google.ca/books?id=jwcPBAAAQBAJ

How Proteins Work (free PDF download from within university)
https://www.taylorfrancis.com/books/9780429061844

Proteins: Concepts in Biochemistry (free PDF download from within university)
https://www.taylorfrancis.com/books/9780429258817 Required study guide (put the $$)

☑ Additional reading material will be specified by the instructors and will either be available through Western Libraries or made available through the 4420A OWL Brightspace page.

12. Professionalism & Privacy

Western students are expected to follow the Student Code of Conduct. Additionally, the following expectations and professional conduct apply to this course:

- ☑ All course materials created by the instructor(s) are copyrighted and cannot be sold/shared (e.g., Must Knows Facebook group, Course Hero, Chegg, etc.)
- ☑ Recordings are not permitted (audio or video) without explicit permission
- ☑ Permitted recordings are not to be distributed
- ☑ Students will be expected to take an academic integrity pledge before some assessments

Western is committed to providing a learning and working environment that is free of harassment and discrimination. All **students**, staff, and faculty have a role in this commitment and have a responsibility to ensure and promote a safe and respectful learning and working environment. Relevant policies include Western's Non-Discrimination/Harassment Policy (M.A.P.P. 1.35) and Non-Discrimination/Harassment Policy – Administrative Procedures (M.A.P.P. 1.35). Any **student,** staff, or faculty member who experiences or witnesses' behaviour that may be harassment or discrimination **must report the behaviour** to the Western's Human Rights Office. Harassment and discrimination can be human rights-based, which is also known as EDI-based, (sexism, racism, transphobia, homophobia, islamophobia, xenophobia, antisemitism, and ableism) or non-human rights-based (personal harassment or workplace harassment).

13. How to Be Successful in this Class

Students enrolled in this class should understand the level of autonomy and self-discipline required to be successful.

1. Invest in a planner or application to keep track of your courses. Populate all your deadlines at the start of the term and schedule your time throughout the course.

2. Make it a daily habit to log onto OWL Brightspace to ensure you have seen everything posted to help you succeed in this class.
3. Follow checklists created on OWL Brightspace or create your own to help you stay on track.
4. Take notes as you go through the lesson material. Keeping handwritten notes or even notes on a regular Word document will help you learn more effectively than just reading or watching the videos.
5. Connect with others. Try forming an online study group and try meeting on a weekly basis for study and peer support.
6. Do not be afraid to ask questions. If you are struggling with a topic, check the online discussion boards or contact your instructor(s) and or teaching assistant(s).
7. Reward yourself for successes. It seems easier to motivate ourselves knowing that there is something waiting for us at the end of the task.

14. Western Academic Policies/Procedures and Statements

A. Absence from Course Commitments

Medical, Compassionate, or Extenuating Circumstances

Students missing course work for medical, compassionate, or extenuating circumstances can request academic consideration by completing a request at the central academic consideration portal. Students are permitted one academic consideration request per course per term **without** supporting documentation. Note that supporting documentation is **always** required for academic consideration requests for examinations scheduled by the office of the registrar (e.g., December and April exams) and for practical laboratory and performance tests (typically scheduled during the last week of the term).

Students should also note that the instructor may **designate** one assessment per course per term that requires supporting documentation. This designated assessment is described elsewhere in this document. Academic consideration requests may be denied when flexibility in assessment has already been included. Examples of flexibility in assessment include when there are assessments not required for calculation of the final grade (e.g. 8 out of 10 quizzes) or there is flexibility in the submission timeframe (e.g. 72 hour no late penalty period).

Please note that any academic considerations granted in this course will be determined by the instructor of this course, in consultation with the academic advisors in your Faculty of Registration, in accordance with information presented in this course syllabus. Supporting documentation for academic considerations for absences due to illness should use the Student Medical Certificate or, where that is not possible, equivalent documentation by a health care practitioner.

Policy: Academic Consideration – Undergraduate Students in First Entry Programs
Procedures: Student Medical Certificate

Religious Holidays

Students should review the policy for Accommodation for Religious Holidays (Appendix 1). Where a student will be unable to write examinations and term tests due to a conflicting religious holiday, they should inform their instructors as soon as possible but not later than two weeks prior to writing the examination/term test. In the case of conflict with a midterm test, students should inform their instructor as soon as possible but not later than one week prior to the midterm.

Policy: Accommodation for Religious Holidays

Special Examinations
A Special Examination is any examination other than the regular examination, and it may be offered only with the permission of the Dean of the Faculty in which the student is registered, in consultation with the instructor and Department Chair. Permission to write a Special Examination may be given on the basis of compassionate or medical grounds with appropriate supporting documents. To provide an opportunity for students to recover from the circumstances resulting in a Special Examination, the University has implemented Special Examinations dates.

Policy: Definitions of Types of Examinations

B. Academic Appeals and Scholastic Offenses

Students can file a **request for relief from academic decisions** if the request is based on one or more grounds listed in the policy. Requests for relief generally fall into three categories, which are also listed in the policy. All requests for relief must be supported by evidence. A request for relief from academic decisions process was formally referred to as an appeal. Refer to the policy and procedures about further details and timelines.

Policy: Requests for Relief from Academic Decisions
Procedures: Undergraduate Student Academic Requests for Relief

Scholastic offences are taken seriously, and students are directed to read the appropriate policy, specifically, the definition of what constitutes a scholastic offence.

Policy: Scholastic Offences
Procedures: Undergraduate Scholastic Offences

Students may **appeal** some academic and scholastic disciplinary decisions by a Dean or their designate, to the Senate Review Board Academic (SRBA).

Policy: Senate Review Board Academic Appeals
Procedures: Senate Review Board Academic Appeals

C. Accessibility Statement

Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Accessible Education (AE) at 661-2111 x 82147 for any specific question regarding an accommodation.

Policy: Academic Accommodation for Students with Disabilities

D. Correspondence Statement

The centrally administered **e-mail account** provided to students will be considered the individual's official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at his/her official university address is attended to in a timely manner.

E. Discovery Credit Statement

Students are permitted to designate up to 1.0 Discovery Credit course (or equivalent) for pass/fail grading that can be counted toward the overall course credits required for their degree program.

Policy: Undergraduate Course Credit
Procedures: Discovery Credits

F. Statement on the Use of Generative Artificial Intelligence (AI)

Use of AI tools is not forbidden in this course, except that students may not use generative AI when writing the reflections or completing the quizzes. The reflections are supposed to represent your personal thoughts, which by definition cannot be generated by generative AI tools. The quizzes are intended as primarily formative assessments to help you assess your own understanding while preparing for the midterm test or final exam.

If you choose to use gen AI tools for the assignment, keep in mind that information produced by such tools is necessarily limited by the data used to train the software. Therefore, AI tools may produce inaccurate, biased, or constrained output. Despite continuous improvements, such tools are notoriously prone to confidently making illogical or factually incorrect statements. Therefore, you should always critically evaluate AI output and exercise independent thinking when doing academic work.

Students should document any use they make of AI software while preparing the team assignment in this course by saving the submitted prompts and the software's responses, including dates. For both team assignment submissions, to uphold academic integrity you must include with your references a statement describing whether and how generative AI contributed to the finished product.

Ultimately, students are responsible for the work they submit, including any false, biased, plagiarized, or otherwise inappropriate content produced by AI tools. Using generative AI tools outside the terms communicated in this syllabus will be considered a scholastic offense.

G. Turnitin and other similarity review software

All required papers may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between Western University and Turnitin.com.

Computer-marked multiple-choice tests and/or exams may be subject to submission for similarity review by software that will check for unusual coincidences in answer patterns that may indicate cheating.

15. BMSUE Academic Policies and Statements

A. Cell Phone and Electronic Device Policy (for in-person tests and exams)

The Schulich School of Medicine & Dentistry is committed to ensuring that testing and evaluation are undertaken fairly across all our departments and programs. For all tests and exams, it is the policy of the School that any electronic devices, e.g., cell phones, tablets, cameras, smart glasses, smart watch or iPod are strictly prohibited. These devices MUST be left either at home or with the student's bag/jacket at the front of the room and MUST NOT be at the test/exam desk or in the individual's pocket. Any student found with one of these prohibited devices will receive a grade of zero on the test or exam and this will be documented as a Scholastic Offence. Non-programmable calculators are only allowed when indicated by the instructor. The program is not responsible for stolen/lost or broken devices.

B. Copyright and Audio/Video Recording Statement

Course materials produced by faculty are copyrighted and to reproduce this material for any purposes other than your own educational use contravenes Canadian Copyright Laws. You must always ask permission to record another individual and you should never share or distribute recordings.

C. Rounding of Marks Statement

Across the Basic Medical Sciences Undergraduate Education programs, we strive to maintain high standards that reflect the effort that both students and faculty put into the teaching and learning experience during this course. All students will be treated equally and evaluated based only on their actual achievement. ***Final grades*** in this course are rounded to the nearest whole number based on the first decimal place. For example, a grade of 74.49 or lower will be rounded to 74, whereas 74.50 or higher will be rounded to 75.

Marks WILL NOT be arbitrarily increased to the next grade or GPA, e.g., a 79 will NOT be increased to an 80, and 84 WILL NOT be increased to an 85, etc. The mark attained is the mark you achieved, and the mark assigned; requests for arbitrary mark increasing will be denied. Marks will be assigned based on assessments in the syllabus and no extra work or tasks will be assigned to increase a mark.

Course grade rounding provisions, as described above, differ from cumulative and term averages. Cumulative and term averages will be calculated to two decimal places and rounded to the nearest whole number with .45 rounded up, for the purposes of admission to and progression in modules, scholarship retention, and Dean's Honour List.

Policy: Marks/Grades; Definitions of Grades; Grading Scale for Undergraduate Students

16. Support Services

Students who are in emotional/mental distress should refer to Mental Health @Western https://www.uwo.ca/health/ for a complete list of options about how to obtain help.

Statement on Gender-Based and Sexual Violence

Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced sexual or gender-based violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts at the following website:

https://www.uwo.ca/health/student_support/survivor_support/get-help.html

To connect with a case manager or set up an appointment, please contact support@uwo.ca.

Other important links:

- Academic Advising (Science and Basic Medical Sciences)
- Learning Development and Success
- Office of the Registrar
- Wellness & Wellbeing
- Western USC Services

Appendix 1: Western University Academic Policies and Procedures

The policies and procedures listed in this syllabus are outlined in the table below. In some cases, a policy does not include an accompanied procedures document.

Academic Policy	Name of Policy/Procedure	Links
General Policy	Marks/Grades; Definitions of Grades; Grading Scale for Undergraduate Students	Policy
General Policy	Structure of the Academic Year	Policy
Registration, Progression, Graduation	Course Numbering Policy, Essay Courses, and Hours of Instruction	Policy
Registration, Progression, Graduation	Undergraduate Course Credit	Policy • Procedures
Examinations	Definitions of Types of Examinations	Policy
Examinations	Evaluation of Academic Performance	Policy
Examinations	Examination Conflicts	Policy
Rights and Responsibilities	Academic Accommodation for Students with Disabilities	Policy
Rights and Responsibilities	Accommodation for Religious Holidays	Policy
Rights and Responsibilities	Policy on Academic Consideration – Undergraduate Students in First Entry Programs	Policy • Procedures
Rights and Responsibilities	Requests for Relief from Academic Decisions (Undergraduate)	Policy • Procedures
Rights and Responsibilities	Requests for Relief from Academic Decisions (Graduate)	Policy • Procedures
Rights and Responsibilities	Scholastic Offences (Undergraduate)	Policy • Procedures
Rights and Responsibilities	Senate Review Board Academic Appeals	Policy • Procedures