Master of Medical
BIOTECHNOLOGY

MMB Graduate Handbook

Department of Chemistry & Biochemistry

University of Windsor

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Welcome

A warm welcome to all new students in the Master of Medical Biotechnology (MMB) Program at the University of Windsor! The unique and innovative Master of Medical Biotechnology program brings together courses in biotechnology and business to provide students with a solid foundation for employment and entrepreneurship in the rapidly growing biotechnology sector. Biotechnology is a global industry that has given us novel protein and nucleic acid-based drugs as well as crucial innovations in agriculture, diagnostics, forensic science, and environmental remediation. It generates hundreds of billions of dollars of revenue annually and employs hundreds of thousands of people.

This Graduate Handbook has been developed keeping in mind the varied levels of understanding and needs of International students. The aim is to prepare International students for a seamless transition to the MMB Program by providing the information about various courses and required resources for their success in the program. We hope that with the help of this handbook, students will be ready to deliver at their best throughout their studies at the University of Windsor.

Contents of the handbook

This Graduate Handbook includes:

- Information about the MMB program and suggested course sequence,
- Program degree requirements,
- MMB Program course descriptions, format, and/or textbooks for these courses,
- Important academic policies, rules and regulations.
- Statements on students with disabilities and on equity, inclusivity, and diversity,
- Other useful links and available resources,
- Open educational resources including terminologies/glossary frequently used in courses.

For more details, please visit the MMB website: https://www.uwindsor.ca/science/chemistry/510/master-medical-biotechnology-mmb

About the program

We offer a unique program developing key skills in business alongside state-of-the-art expertise in biotechnology. The MMB program comprises ten courses taken over four consecutive semesters starting each Fall and comprises foundation courses in biochemistry/biotechnology and business with the opportunity to specialize through a range of electives in both business and biochemistry. In addition, Biotechnology laboratory allows students to gain hands-on experience and current knowledge in state-of-the-art biotechnology techniques.

(a) seven core MMB courses:

BIOC-8700 Human Physiology and Mechanisms of Diseases

BIOC-8730 Drugs: From Discovery to Market

BIOC-8740 Protein Structure and Function

BIOC-8760 Clinical Biochemistry

BIOC-8780 Biotechnology Entrepreneurship

BIOC-8790 Biotechnology Laboratory

BSMM-8140 Marketing

(b) two Science electives chosen from:

BIOC-8020 Structural Proteomics and Its Applications

BIOC-8030 Integrative Biological Mass Spectrometry

BIOC-8203 Scattering Techniques in Biochemistry

BIOC-8408 Computational Enzymology

BIOC-8580 Non-Animal Methods in Biomedical Research and Toxicology

BIOC-8640 Advanced DNA Science

BIOC-8684 Applications of Natural Products in Health

CHEM-8520 Free Radical in Chemistry and Biology

CHEM-8641 Bio- and Sustainable Materials

CHEM-8650 Membrane Biochemistry

(c) one elective Business course chosen from:

BSMM-8310 International Business

BSMM-8340 Leadership and Organizational Change

Program course sequence

Suggested course sequence is as below:

First semester: three courses

BIOC-8700 Human Physiology and Mechanisms of Diseases

BIOC-8740 Protein Structure and Function

BSMM-8140 Marketing

Second semester: three courses

BIOC-8730 Drugs: From Discovery to Market

BIOC-8760 Clinical Biochemistry

One Science elective course*.

Third semester: two courses

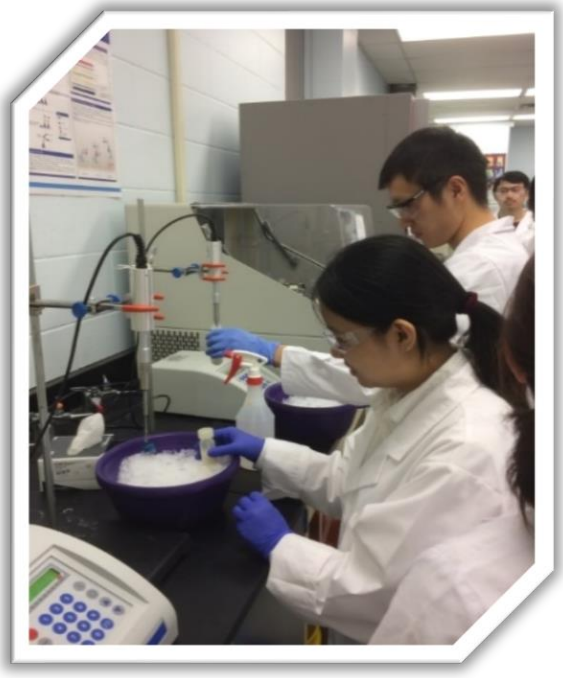
BIOC-8790 Biotechnology Laboratory

One Business elective course*.

Fourth semester: two courses

BIOC-8780 Biotechnology Entrepreneurship

One Science elective course*.



* Please seek academic advising for discussion of appropriate course electives.

Degree requirement

Academic Standing Requirement for Continuation in the Program and for Graduation

Students must have a cumulative average of not less than 70% to remain “in good standing” and continue in the program.

Courses in which a grade of 70% or lower is received will be reviewed by the Faculty of Graduate Studies. Up to a maximum of two courses in which a grade of 60 – 69% has been obtained may be considered as credit towards the degree provided the cumulative average remains not less than 70%.

Source: https://www.needpix.com/photo/download/1768074/graduation-university-college-graduate-degree-diploma-student-success-academic

Course descriptions, format and resources

Course details for the MMB core courses are provided below. Recommended texts are listed and are available at the University library or online.

BIOC 8700. Human Physiology and Mechanisms of Disease

Format : Lectures, Online Discussions

Assessment: Assignments, Papers, Presentations, Tests, Exams

Course description: This course will cover the field of physiology as it relates to the further understanding, diagnostics, treatment, and human disease-mechanisms of disease. The course is taught from a holistic approach that provides key insights into cellular physiology and associated molecular aspects of biology related to human disease. The course will outline the principles and practice of cell and molecular physiology, pathological pathways, molecular pathogenesis, and molecular mechanisms of disease. It will be followed by investigations and discussion on the practice of molecular medicine and the translational aspects of molecular pathology: molecular diagnostics, molecular assessment, and personalized medicine. Students will be engaged in presentations and discussions of current and future industry trends, medical and research discoveries that are translational by enhancing the identification, diagnosis, and treatment of human diseases. Topics will include molecular and cellular mechanisms of cancer; inflammation and immunology; cell death and regulation; stem cell and developmental biology; neurobiology; and gene regulation.

Recommended Textbooks:

- L. Pecorino. Molecular Biology of Cancer: Mechanisms, Targets, and Therapeutics, Oxford University Press.
- M. A. Knowles and P. J. Selby. Introduction to the Cellular and Molecular Biology of Cancer, Oxford University Press.
- B. Alberts. Molecular Biology of the Cell, Garland Science.
- J. H. Wilson and T. Hunt. Molecular Biology of the Cell: The Problems Book, Garland Science.
- D. W. Rosales, Q. N. Mullen. Pluripotent Stem Cells. Hauppauge, Nova Science.

BIOC-8730. Drugs: From Discovery to Market

Format: Lectures, Computational activities

Assessment: Assignments, Presentations, Tests, Exams

Course description: The path of any new drug from its inception (design and discovery) to its approval in market and thereafter is a challenging task. This course will introduce students to the relevant concepts and chemical characterization that lead to the discovery and rational/irrational design of therapeutic agents. Students will learn from discussions on real life case studies in drug discovery and development which will not only foster self-learning but will also lay the foundation for the overall drug discovery to market process. In addition, the course will cover the fundamentals of the clinical trials process and best regulatory practices in pharmaceutical industries.

Recommended Textbooks:

- G. L. Patrick. An Introduction to Medicinal Chemistry, 6th Edition, Oxford University Press (this is the required textbook for the course).
- R. Ng. Drugs: From Discovery to Approval, 2nd Edition, John Wiley & Sons.
- R. Baron (Ed.) Computational Drug Discovery and Design, E-Book. New York, Humana Press, Springer.
- H. G. Vogel (Ed.) Drug Discovery and Evaluation: Pharmacological Assays, E-Book. New York, Springer.

BIOC-8740. Protein Structure and Function

Format: Lectures/Lab

Assessment: Tests, Exams

Course description: This course will review and examine the principles of protein structure and how it applies to protein function. Moreover, how protein function is controlled and functional genomics will also be considered. Methodologies used in protein structure determination including mass spectrometry and its applications will be highlighted. The laboratory section of the course will focus on web-based computational programs as they apply to protein structure and function.

Recommended Textbooks:

- D. Voet, J.G. Voet and C.W. Pratt. Fundamentals of Biochemistry, Life at the Molecular Level, 3rd edition, Wiley publ.
- G.A. Petsko and D. Ringe. Protein Structure and Function, Primers in Biology, Oxford University Press

- D. W. Mount. Bioinformatics Sequence and Genome Analysis, 2nd edition. Cold Spring Harbor.
- D. Whitford, Proteins: Structure and Function, Wiley.
- C. Branden and J. Tooze, Introduction to Protein Structure, 2nd edition. NY Garland Publishing.

BIOC-8760. Clinical Biochemistry

Format: Lectures and Case Studies

Assessment: Assignments, Presentations, Papers

This course will review and examine the principles of clinical biochemistry and will introduce the student to clinical testing, automation, clinical enzymology, and biomarkers. The course will also cover areas of design, testing, and commercialization of specific tests for liver function, abnormalities in lipid metabolism, thyroid diseases, diabetes and related metabolic disorders, fertility/reproduction, cancer, and therapeutic drug monitoring. This course will provide a broad overview of the current state of the technology for the analysis of clinical samples as well as learning the fundamental principles in design and testing of clinical assays for a wide range of analytes.

Recommended Textbook:

- N. Ahmed, Clinical Biochemistry, Oxford University Press.

BIOC-8790. Biotechnology Laboratory

Format: Lectures, Laboratories

Assessment: Assignments, Lab Reports, Tests, Exams

This intensive hands-on laboratory course will primarily simulate the discovery and rapid characterization of genes and gene products (i.e. proteins). Laboratory experiments will include cutting edge biotechnology techniques and traditional biochemical methodology. Students will be introduced to techniques including nucleic acid isolation and amplification (i.e. PCR), regulation of gene expression, cloning, protein isolation and purification, enzyme functional assays and characterization (2-D electrophoresis, mass spectrometry).

Recommended Textbooks:

- D. P Clark and N. J. Pazdernik, Biotechnology, Elsevier.
- R. R Burgess and M. P. Deutscher (Eds.) Guide to protein purification, Elsevier.
- R.I. Freshney, Culture of animal cells: a manual of basic technique, Wiley.

- J.D. Watson et al. Molecular Biology of the Gene, 6th edition, Cold Spring Harbor.

BIOC-8780. Biotechnology Entrepreneurship

Format: Lectures, Discussions, Case Studies

Assessment: Assignments, Papers, Presentations, Exams

Entrepreneurship in Biotechnology will provide students an introduction to the complexities and unique problems facing the biotechnology industry. Students will be exposed to the topics most critical for successfully founding, financing and operating a life science company, and will be expected to perform many of the same tasks that founders would normally undertake. Discussions with life-science entrepreneurs, evaluation of existing biotechnology firms, case studies based on recent companies and hands-on work developing entrepreneurial endeavors all will be utilized.

Recommended Textbook:

- C. Shimasaki (Ed.) Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies, Elsevier.
- D. Hine and J. Kapeleris, Innovation and Entrepreneurship in Biotechnology, An International Perspective, Edward Elgar Publishing

BSMM-8140 Marketing

Format: Lectures

Assessment: Class test, Team projects, Exams

Course Description: An introduction of marketing management concepts, and techniques that can be applied to private sector business as well as to not-for-profit organizations' marketing ad communication activities. Emphasis will be placed on the marketing mix elements of product, price, place and promotion.

Recommended Textbook:

- Crane, Kerin, Hartley and Rudelius (2017), Marketing, 10th Canadian Edition, McGraw-Hill: Toronto, Ont.

Useful information and links

The University of Windsor, located in Windsor, Ontario, Canada is situated near the Detroit River only a four-hour drive from Toronto, Ontario, and six hours from Ottawa, the capital of Canada. For more details, you may visit **University of Windsor Virtual Tour:** http://www.uwindsor.ca/174375/virtual-tour#virtualtour.

Please check out a wonderful and free resource after you arrive here at the University of Windsor: **Your Guide to Succeed in University (**http://www.succeedinuniversity.com/index.php/uoft-your-guide-to-success**)**

Windsor is a small city that attracts large events, such as the FINA diving competition, as well as tourists and students from around the world. For more on the City of Windsor visit: **www.cityofwindsor.ca or visit windsorstar.com** to read our local newspaper.

As part of your admission conditions you may be required to write an English proficiency exam or English lessons, for information on ELIP visit: **www1.uwindsor.ca/celd** or for more information on requirements contact the Centre for Executive and Professional Education (CEPE) **www1.uwindsor.ca/cep**.

If you would like to be a part of the soft-landing program or have any questions about work or study permits contact the International Student Centre **www1.uwindsor.ca/isc.**

At the Department of Chemistry and Biochemistry, and University of Windsor, students have several opportunities to join various clubs and activities. The “Chem Club” is a graduate student operated group that organizes various departmental social activities such as Chem Prom, Halloween party, and Christmas party. Graduate Students’ Society (GSS) is an autonomous organization on campus representing graduate students **(https://uwindsorgss.ca)**. MMB Students' Association is a platform to allow every student opportunity to utilize University life outside academics. The main goal of MMB club is to create connections among students and with other departments, share meaningful experiences, and exhibit hidden talents. For more information, please contact, MMB Graduate Club at **mmb@uwindsorgss.ca.**

MMB Rules and Regulations

MMB program follows rules and regulations of University of Windsor and at the Department of Chemistry and Biochemistry.

Information about student code of conduct, grading and academic evaluation procedures can be found in the links provided below:

Senate Bylaw 55: Academic Evaluation Procedures for Graduate Students
Senate policy on Conduct of Exams and Tests
Senate Policy on Student Code of Conduct (Academic Integrity)
Senate Policy on Grading and Calculation of Averages

Statement for Students with Disabilities

Students with recognized disabilities who require academic accommodations in this course must contact an Advisor in the Student Accessibility Services (SAS) to complete SAS Registration and receive the necessary Letters of Accommodation. After registering with Student Accessibility Services, you must present your Letter of Accommodation and discuss your needs with your course Instructor as early in the term as possible. Please note that deadlines for the submission of documentation and completed forms to Student Disability Services are available on their website: **https://www.uwindsor.ca/studentaccessibility/**

Statement on Equity, Diversity, and Inclusivity

MMB program at the Department of Chemistry and Biochemistry, University of Windsor is committed to a community and learning environment that embraces equity, diversity, and inclusivity including gender and gender-identity, sexuality, ethnicity, religion, culture, and national origins. This commitment is underscored by the University of Windsor being a signatory to the Dimensions Program and Charter. Our community and learning are enhanced and enriched when diverse perspectives and experiences are recognized and respected, and all are able to contribute. In this class I hold that each student has the right to be addressed "in accordance with their personal identity" (e.g., name, personal pro-nouns).[1] Please let me know how you wish to be addressed and how I can help to support you during this class, and I will do my best to do so.

1. University of Michigan, Center for Research on Teaching and Learning

Conclusion

We hope you are not feeling overwhelmed by the large amount of information provided in this booklet. We recognize our graduate students on this program come from a variety of disciplines which is both a challenge and a strength of the program. Recognizing your academic diversity and those of your colleagues is important. The development of a common scientific language necessary to communicate with people from a diversity of disciplines is important, especially if English has not been your first language of instruction. Some of the key concepts outlined here will be familiar to you but some may be topics which you are reading about for the first time. Do not feel overwhelmed! The purpose is not for you to learn everything before you take the courses but to give you a chance to familiarize yourselves with the concepts and appropriate terminology before arrival in order to maximize your success.

We hope that this guide will ease your transition into the MMB program and we look forward to welcome you personally once more into the University of Windsor's Masters of Medical Biotechnology Program!

Appendix: Key Terminologies

The following are key terminologies with which you should be familiar for the following MMB courses.

BIOC 8700. Human Physiology and Mechanisms of Disease

- Apoptosis
- Adenovirus
- Anti-angiogenesis therapy
- By-stander effect
- Caspases
- Clustered regularly interspaced short palindromic repeats (CRISPR)
- Cyclins and cyclin dependent kinases (cdk)
- Direct Reprogramming
- Death-inducing signaling complex (DISC)
- Fas-associated death domain (FADD)
- Gene Therapy (viral/ non-viral)
- Humoral Immunity
- Molecular chemotherapy/Suicide Gene Therapy
- Neurodegenerative diseases
- Oncofactor inhibition
- Pluripotency
- Pyknosis
- Prions
- Tumor immunotherapy

BIOC-8720. Biochemistry and Cell Biology of Lipids and Membranes

- Gradient
    - Electrical
    - Chemical
- Hydrophobic
- Hydrophillic
- Lipid
- Lipoprotein
- Permeability
- Signalling Cascade
- Viscosity (fluidity)

BIOC-8730. Drugs: From Discovery to Market

- Agonist
- Antagonist
- Adverse Events

- Biologics
- Biosimilar
- Efficacy
- ED50
- Fast Drug Approval
- Generic
- Half-Life
- High Throughput Screening
- LD50
- New Drug Application
- New Biologic License
- Orphan Drug
- Patent
- Potency
- QT Interval
- Small molecule drug
- Sensitization
- Tolerance

BIOC-8740. Protein Structure and Function

- Allosteric
- Competitive Binding
- Cooperativity (positive and negative)
- Domain
- Primary/Secondary/ Tertiary/ Quaternary Structure
- Proximity
- Redox Environment
- Mass Spectrometry
- Methylation/ N-Acetylation/Sumoylation/Nitrosylation/ Glycosylation
- Motif
- NMR
- Ramachandran plot
- Steric Interactions
- TIM Barrels
- Ubiquitination
- X-ray crystallography

BIOC-8760. Clinical Biochemistry

- False Positive/Negative
- Quality Control
- Quality Assurance
- Organizational Chart
- Medical Device

- FDA
- Standard Operating Procedure
- Precision versus Accuracy
- ACTH: Adrenocorticotrophic Hormone
- ADH: Antidiuretic Hormone
- ALP: Alkaline Phosphatase
- ALT: Alanine Aminotransferase
- CK: Creatine Kinase
- CKD: Chronic Kidney Disease
- DDAVP: 1-Deamino, 8-D-Arginine Vasopression
- DIT: Diiodotyrosine
- DKA: Diabetic Ketoacidosis
- eGFR: Estimated Glomerular Filtration Rate
- FSH: Follicle Stimulating Hormone
- GFR: Glomerular Filtration Rate
- GTT: Glucose Tolerance Test
- hCG: Human Chorionic Gonadotrophin
- HDL: High Density Lipoprotein
- IDL: Intermediate Density Lipoprotein
- IGT: Impaired Glucose Tolerance
- INR: International Normalised Ratio
- LDH: Lactate Dehydrogenase
- LDL: Low Density Lipoprotein
- LH: Luteinising Hormone
- MIT: Monoiodotyrosine
- NAFLD: Nonalcoholic Fatty Liver Disease
- OGTT: Oral Glucose Tolerance Test
- PKU: Phenylketonuria
- POCT: Point of Care Testing
- PSA: Prostate Specific Antigen
- PT: Prothrombin Time
- ROC: Receiver Operating Characteristic
- T3: Triiodothyronine
- T4: Thyroxine
- TBG: Thyroxine Binding Globulin
- TRH: Thyrotrophin Releasing Hormone
- VLDL: Very Low Density Lipoprotein

Appendix - Academic preparation prior to commencing the MMB Program

Success on the MMB program builds upon firm foundations in biochemistry and related fields. We recognize that students come from a diversity of backgrounds and differing disciplines. Appropriate preparation is important to remain on the good academic standing and for success on the program. The list below is a series of key pre-requisites for our core and elective courses. Many of these may be familiar to you, whereas others may be 'dormant' or perhaps were just not a component of your previous education. Diversity of background is an important component of our program, so do not feel daunted if you have not covered all the topics; many of you will have different cultural backgrounds and expertise in different disciplines. Some self-study before you arrive is helpful so that you and our instructors can all work from the same platform. We have listed some key topics in Chemistry and Biochemistry which we have found from our experience to sometimes be challenging areas for our MMB students. **Please take some time before arrival to review the following topics:**

Fundamentals of Organic Chemistry: Functional group identification; orbital hybridization and bonding; stereochemistry; acid-base chemistry; resonance, induction and other related effects that determine charge stabilization; basics of mmechanistic organic chemistry and knowledge of "curly-arrow" notation; familiarity with nucleophiles and electrophiles.

Fundamentals of DNA and Proteins: Structures of proteins and amino acids; protein properties and chemistry; protein purification and characterization; protein DNA sequencing and genomics; protein purification and characterization; recombinant protein engineering; enzyme kinetics, binding and environment (inside and outside the protein).

Fundamentals of Life Sciences and Laboratory-Related concepts: Basic understanding of nucleic acids; cell signaling pathways; biochemical test parameters; definitions of key terminologies (see Appendix A); identification of key organic functional groups which make up basic drug structures (acid, amine, amide, ester, ether, ketone etc); fundamental lab techniques required comprise: use of pipettes, principles of chromatography and SDS-Page electrophoresis.

Summer (2020) we have developed online educational resources (OER) to assist you with reviewing your knowledge base and linking different key concepts together. This resource has been shared separately to the MMB students, and hoping you find this resource highly useful.

We look forward to having you with us at the Department of Chemistry and Biochemistry, University of Windsor!