

DEPARTMENT *of*
MEDICAL AND MOLECULAR SCIENCES

MASTER OF SCIENCE
IN APPLIED MOLECULAR BIOLOGY
AND BIOTECHNOLOGY
Program Policies



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I. Program History and Description

The MS in AMBB program is a “locked step,” 51-credit blended (i.e., having online, hybrid, and face-to-face instruction) master’s degree for individuals holding a Bachelor of Science in biology, chemistry, or a related major; who do not hold a Bachelor’s degree in Biotechnology or Applied Molecular Biology; and who lack the skills set to pursue a career as a laboratory scientist in the biotechnology, biopharmaceutical, or molecular diagnostic sectors. Through this degree, students will gain specialized, in-depth professional hands-on skills and leadership competencies preparing them to succeed within the increasingly competitive biomedical sciences sector. In today’s employment market, individuals seeking positions in the laboratory-based professions require a tangible skill set, as employers can no longer “pay to train.” The MS in AMBB will allow students to gain defined “bench-focused” technical competency, in addition to training in regulatory and fiscal affairs that impact laboratory management. Following graduation, students can apply their knowledge to meet specific career goals whether it be laboratory practice in biotechnology, molecular diagnostic, or academic research settings.

Benefits of pursuing MS in AMBB include:

- Gaining workforce ready, well-rounded, and marketable technical skills geared for future employment
- Exposure to regulatory, fiscal, and management aspects of laboratory practice
- Rapid and fixed timeframe of degree completion (12 months)
- Internships integrated into the curriculum that offer a leg up in the job market upon graduation
- Preparation to sit for the molecular diagnostics board of certification exam offered through the American Society of Clinical Pathology, MB(ASCP)

Outcomes for the MS-AMBB include the expectation that students will be able to:

- Apply the advanced knowledge and technical skills needed to serve as active contributors and/or leaders in the laboratory science professions
- Critically review, appraise, and synthesize the biomedical sciences literature
- Identify and systematically investigate research questions pertinent to laboratory practice
- Synthesize new concepts, models, and theories through the appropriate application of empirical knowledge and the scientific method to help resolve clinical laboratory and health sciences issues or problems
- Apply current knowledge to evaluate or design more effective ways to deliver clinical laboratory and health-related services
- Use a variety of information technologies to address both theoretical and practical problems, enhance communication, and disseminate knowledge to applicable audiences and interest groups

- Demonstrate proficiency in both oral and written communication, using both scholarly and technical formats
- Work collaboratively with others to advance the scientific bases of knowledge in laboratory science via ongoing scholarship
- Integrate basic principles of ethics and cultural sensitivity within all interpersonal and professional activities

II. Admission

Admission to the graduate program is competitive. Those who meet stated minimum requirements are not guaranteed admission, nor are those who fail to meet all of those requirements necessarily precluded from admission if they offer appropriate strengths.

The MS in Applied Molecular Biology program is not intended for those who already hold a Bachelor's degree in Applied Molecular Biology and Biotechnology. Such individuals should consider enrolling in the MS in Medical Sciences offered through the Department of Medical and Molecular Sciences, which is intended for those who have already completed a BS degree in a Biotechnology laboratory-based discipline.

Questions regarding which MS degree program is appropriate should be directed to the Program Director for the MS in AMBB.

Admission Requirements

Admissions decisions are made by the Department of Medical and Molecular Sciences' Master's Program Committee. Students will be admitted to the program based on enrollment availability and their ability to meet the following minimum recommended entrance requirements:

- Successful completion of a Bachelor's degree, from an accredited academic institution, in a biomedical science-based discipline, including, but not limited to: Biology, Chemistry, Biochemistry, Nutrition, or Exercise Science
- Students not having completed a BS in a science-based discipline may be considered for admission provided they have completed the following science and math prerequisite course work: 16 credits Biological Sciences including one semester of Microbiology and one semester of Immunology; 16 credits Biological Sciences including one semester of Microbiology and one semester of Immunology; 3 credits of college level math which includes elementary statistics
- Application is competitive and a minimum cumulative GPA of 3.0 is recommended
- The GRE is not required
- Completion of the TOEFL requirements, which are described in detail below, for international applicants

- Written statement of goals and objectives (the personal statement) that clearly identifies the applicant's research and curriculum interests and explains how admission to the program will facilitate his/her professional object
- Current résumé and two academic or professional letters of recommendation

All students will be expected to be sufficiently conversant in English and knowledgeable in the written word to convey clear, logical, and complex written expressions.

Admission Procedures

Applicants must submit all of the following items directly to the Graduate College (<https://www.udel.edu/academics/colleges/grad/>) using the online admission process before admission can be considered.

- A nonrefundable application fee must be submitted with the application. Credit card payment is accepted with the online application. Checks must be payable to the University of Delaware. Applications received without the application fee will not be processed. International students paying by check must use a check drawn on a US bank or an International Postal Money Order.
- Applicants must submit responses to specific questions asked on the application, a résumé, and a statement of professional goals and objectives.
- Applicants must submit at least two letters of recommendation. All letters of recommendation should be mailed directly to the Graduate College.
- One official transcript of all US colleges and universities attended must be sent directly from the institution to the Graduate College or be provided in a sealed envelope with the application packet. Students who have attended the University of Delaware need not supply a transcript from Delaware.
- One official transcript of all non-US based college and university records is required. The transcript must list all classes taken and grades earned. If the transcript does not state that the degree has been awarded, send a degree certificate that states that the degree has been awarded. If the degree has not been awarded or the degree certificate has not been issued, evidence of the awarded degree must be provided prior to the first day of classes in the term of admission. For institutions that issue documents only in English, send the English original. For institutions that issue documents both in English and a foreign language, send both the English language original and the foreign language original. For institutions that issue documents only in a foreign language, send the foreign language original and a certified translation in English. The translation must be certified by an official of the issuing institution, a state- or court-appointed translator, or the Embassy of the issuing country in the United States. If it is necessary to send non-original documents: a.) The documents must be original "attested copies," officially attested to by the issuing institution or the Embassy of the using country in the United States, and b.) Certified translations must be originals; no copies will be accepted.

- International student applicants must demonstrate a satisfactory level of proficiency in the English language if English is not the first language. The Test of English as a Foreign Language (TOEFL) is offered by the ETS in test centers throughout the world. The University requires an official paper-based TOEFL score of at least 550 or at least 79 on the Internet-based TOEFL for an applicant to be considered for admission. TOEFL scores more than two years old cannot be validated or considered official.
- International students must be offered admission to the University and provide evidence of adequate financial resources before a student visa will be issued. The University has been authorized under federal law to enroll non-immigrant alien students. International students are required to purchase the University-sponsored insurance plan or its equivalent.
- All first-time international students are required to attend the Orientation Day for new international students, which takes place before classes begin.
- It is a Delaware State Board of Health regulation and a University of Delaware mandate that all graduate students with a birth date after January 1, 1957, be immunized for measles, mumps, and rubella (MMR). Also, students may be required to provide evidence of PPD (Mantoux) Tuberculosis Screening Test within 6 months prior to beginning classes. Students who are admitted beginning January 2002 are required to show proof of vaccination against meningococcal disease unless granted a waiver. Students should refer to and complete the Student Health Service Immunization Documentation form upon admission.

Admission Application Processing

Applications will be processed as they are submitted. The admission process is completed as follows: First, completed applications consisting of the application form, academic transcripts, letters of recommendations, résumé, and written statement of goals and objectives are reviewed by the Medical and Molecular Sciences' Master's Program Committee.

The Program Committee arrives at an admission decision after reviewing the completed application. Students are notified in writing of the admissions decision within two weeks of the decision. It should be noted, admission to the MS in Applied Molecular Biology and Biotechnology does not confer admission to the Ph.D. in Medical Sciences, which is a distinct graduate program offered through the College of Health Sciences.

Application Deadlines

Applications will be taken on a rolling basis to allow for admittance in the Fall semester (only). Note: International applicant deadlines precede Domestic, US citizen applicants, due to additional timing requirements for obtaining an appropriate student visa.

June 1 (International applicants)

August 1 (Domestic applicants, US citizens)

III. Academic Requirements

Course Requirements

Category	Credit Hours
Core AMBB Curriculum	30
Additional Required Courses	9
Experiential Learning	12
Total Credits	51

Biotechnology Laboratory Science Core Curriculum (27 credit hours)

27 credits of subjects specific to the practice of applied molecular biology and biotechnology will be completed by students as part of the curriculum. This is necessary both for the student to be sufficiently knowledgeable about the profession to practice in a biotechnology laboratory setting and to select a Capstone Project.

These courses are predominately laboratory courses. Competency in the various laboratory techniques is necessary to function within the biotechnology/molecular diagnostics laboratory. This requires that the student be able to attend courses at the UD campus.

Additional Required Courses (12 credit hours)

Students are required to complete 9 credits of graduate level coursework which includes courses in research design, regulatory and fiscal issues in laboratory management, and completion of a capstone project.

Masters Capstone (Contemporary Topics Research - MMSC 615): The student will complete a rigorous capstone project that 1) constructs a focused investigation of a biotechnology laboratory science problem in real-world setting, 2) applies problem solving methodologies for development and execution of solutions, 3) investigates and applies theory through practical implementation of a project, and 4) evaluates and reports this research project in a clear, professional manner using the guidelines set forth in the course syllabus.

Experiential Learning (12 credit hours)

Supervised practical internships in biotechnology workplace settings will involve 40 hours/week for 5 weeks per specialty area specified above for a total of 200 hours.

Curriculum

Course Number	Required Courses	SCH
Fall - Semester 1		
MMSC 603	Research Design	3
MMSC 608	Molecular Prep Techniques	2
MMSC 625	Basic Molecular Techniques	4
MMSC 690	Clinical and Molecular Cell Biology (online)	3
MMSC 635	Practical Bioinformatics, Genomics and Proteomics	3
Total Credits		15
Winter - Semester 2		
MMSC 691	Human Molecular Genetics (online)	3
Total Credits		3
Spring - Semester 3		
MMSC 626	Protein Purification and Characterization	3
MMSC 627	Flow Cytometry	2
MMSC 815	Contemporary Topics Research I	3
MMSC 651	Cell and Tissue Culture Techniques	4
MMSC 605	Regulatory and Fiscal Issues in Laboratory Management	3
MMSC 692	Application of Molecular Diagnostic Techniques	3
Total Credits		18
Summer - Semester 4		
MMSC 641	Biotech Practicum I	3
MMSC 642	Biotech Practicum II	3
MMSC 643	Biotech Practicum III	3
MMSC 644	Biotech Practicum IV	3
MMSC 815	Contemporary Topics Research II	3
Total Credits		15
Credits for Degree		51

Residency Requirement

Four semesters of consecutive graduate work are required for the MS degree. This residency requirement, by design will be for the MS degree be fulfilled using a fall, winter, spring, summer semester combination.

Course Substitutions

Courses in the core curriculum may not be substituted. Transfer graduate coursework cannot count towards the degree.

Time Limit for Completing the Degree

The time limit for completion of degree requirements begins with the date of matriculation and is specifically detailed in the student's letter of admission. Students entering the program are given 4 consecutive semesters, in the specific sequence outlined in the curriculum table, to complete the program requirements. An extension of the time limit may be granted for circumstances beyond the student's control. Requests for time extensions must be made in writing and approved by the director of the MS in Applied Molecular Biology & Biotechnology Program. The director will forward the request to the Graduate College.

Submission of Required University Forms

To initiate the process for degree conferral, candidates must submit an "Application for Advanced Degree" to the Graduate College. The application deadline is March 15 for Summer candidates. The application must be signed by the program director and department chair. There is an application fee of for master's degree candidates that is published by the university. Payment is required when the application is submitted. Upon completion of the audit, the Graduate College notifies students in writing when they have met all degree requirements.

Definition of Satisfactory Academic Progress

Failure to satisfactorily progress in the program will be based on the University Graduate Policy as noted below: The Graduate College monitors the academic progress of all graduate students and notifies students in writing of all academic deficiencies. The cumulative GPA after each 9-hour increment determines academic standing. The University's Academic Probation Policy is expressed in the following chart –

If a student on	Earns a GPA of	The status becomes
Any status	3.0 or above	Clear
Clear	2.99-2.5	Warning
Clear	2.49-2.	Probation
Warning	Below 3.0	Probation

Probation	Below 3.0	Dismissal
Any status	Below 2.0	Dismissal

Reasons for Dismissal/Termination from the Program

The Graduate College notifies students when they are dismissed from graduate programs without completing a degree. Dismissals usually take place at the end of a term. Students may be dismissed for the following reasons:

- Upon the expiration of the one-year time limit required for students to complete their degree
- Upon the failure to meet the grade point average requirements as stated in the policy on Academic Deficiency and Probation

IV. Learning Outcomes

Four Learning Outcomes have been identified for the program. Upon completion of the program, all students will:

- Employ research methods to assess a problem in the field of medical science in an ethical manner. Course Assessed: MMSC 603 *Research Design*
- Communicate research findings in an effective manner. Course Assessed: MED815 *Contemporary Topics Research*
- Demonstrate the ability to quantitatively analyze data using several different statistical procedures. Courses Assessed: MMSC 603 *Research Design* and MMSC 815 *Contemporary Topics Research*
- Evaluate and assess regulatory and fiscal situations encountered in laboratory settings and make best-practice, evidence-based recommendations. Course Assessed: MMSC 605 *Regulatory and Fiscal Issue in Laboratory Practice*

Field Experience Supervisor Surveys

Upon completion of the field experience(s), the field experience supervisor will complete a rubric designed to assess the affective skills demonstrated by the student.

V. Financial Aid

Tuition remission and/or stipends are not offered. Graduate students in this program are eligible to apply for financial aid as applicable.

VI. Departmental Operations

Current Faculty Affiliated with the Program

Name	Rank	Specialty
Esther Biswas-Fiss, MS, Ph.D.	Professor & Chair	Molecular Diagnostics & Biotechnology
Leslie Allshouse, M.Ed., M.B.A.	Senior Instructor	Immunohematology
Mona Batish, Ph.D.	Associate Professor	Applied Molecular Biology
Subhasis Biswas, Ph.D.	Professor	Applied Molecular Biology
Virginia Hughes, Ph.D.	Associate Professor	Hematology, Public Policy & Research Design
Vijay Parashar, Ph.D.	Assistant Professor	Applied Molecular Biology

Graduate Coordinator

The MLS department chair will appoint a graduate coordinator for the Applied Molecular Biology & Biotechnology Master's Program from among the department faculty. The term of service for the graduate coordinator is three years, with no limit on the number of consecutive terms that may be served. The graduate coordinator serves as the program representative and point person and is responsible for the following:

- Corresponding with prospective students
- Maintaining program records
- Holding elections for members of the Program Committee
- Chairing Program Committee meetings
- Admitting students to the program following approval of the Program Committee
- Chairing meetings of the Medical Sciences faculty as necessary for review/revision of program policies and curriculum
- Final approval of degree granting

Program Committee

The Medical Sciences Graduate Program Committee will consist of an affiliated faculty member from the department, serving in staggered, three-year terms. The graduate program coordinator

will serve as chair of the Program Committee. Responsibilities of the Program Committee shall include:

- Admission of students into the program
- Approval of changes to the graduate curriculum
- Oversight of student progress in the program, including dismissal of students who fail to make satisfactory progress

MS in AMBB Students

Student Organization. Students in the program will be encouraged to periodically meet as a group so that the student representative can pass on any pertinent information from program meetings and so the group can discuss any issues or concerns they might have. Concerns can be brought to the attention of the program faculty by the elected student representative.

Laboratory Safety and Research Regulations and Standards of Student Conduct. Graduate students performing laboratory research are subject to all University regulations regarding safety, human subjects, animal use, and hazardous and radioactive material use and disposal. These guidelines may be found in the University of Delaware Policies and Procedures Manual. Additional information can be obtained from the UD Research and Graduate Studies website: <http://www.udel.edu/research/> All training and regulatory authorizations must be updated at the time of proposal submission.

Travel. Students will be encouraged to attend regional scientific meetings and symposia. Funding will be sought from available University/College/departmental funds should a student attend a conference for the purpose of presenting a peer-reviewed poster or to play a leadership role in the conference.