DEPARTMENT *of* MEDICAL AND MOLECULAR SCIENCES

4+1 DEGREE PROGRAM

BS IN APPLIED MOLECULAR BIOLOGY AND BIOTECHNOLOGY
MS IN MEDICAL SCIENCES
Program Policies

May 2023

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Mission Statement

The Department of Medical and Molecular Sciences is committed to providing skilled, critically thinking practitioners equipped to be future leaders in health sciences. In this pursuit, the Department is committed to active engagement of undergraduate and graduate students in experiential learning, to forming collaborative partnerships with educational, clinical, industrial, and research experts locally and globally, to discovering innovative breakthroughs in research that contribute to the health and basic sciences body of knowledge, and to provide a cadre of leaders in the laboratory-based professions.

Program History and Description

This accelerated degree program provides high performing students with the opportunity to complete a bachelor's degree in Applied Molecular Biology & Biotechnology and a master's degree in Medical Sciences in less time and at less cost than completing both programs individually. With a combined degree, students will have specialized, in-depth professional skills knowledge and will be prepared to succeed within the increasingly complex biotechnology sector. In today's competitive employment market, individuals seeking management and leadership positions in the laboratory-based professions require a graduate level degree. The 4+1, BS/MS in AMBB/MMS will allow students to specifically tailor their graduate program of study to meet their specific career goals, whether it be laboratory administration, research settings or laboratory science education.

While completing the BS in Applied Molecular Biology & Biotechnology degree, students will take six (6) credits of graduate-level courses in lieu of regularly required undergraduate courses in the major. The six credits will be counted toward both the Bachelor of Science degree and the Master of Science.

Benefits of pursuing an accelerated 4+1 BS/MS, AMBB/MMS student include:

- Completing both degrees in less time
- Graduate credits taken in undergraduate junior & senior years may apply toward both the bachelor's and master's degrees.
- Completion of a full-time master's degree without interrupting your professional career.
- A leg up in the job market upon graduation.
- Opportunities to engage in advanced study
- Better preparation for professional credentialing such as the MB(ASCP) exam.

An overachieving goal of this program is to provide a cadre of leaders in the laboratory-based professions. The new program aligns with the vision of the University of Delaware as a center for graduate level professional education and training.

Outcomes for the MMS include the expectation that students will be able to:

- Critically review, appraise, and synthesize the biomedical sciences literature
- Identify and systematically investigate research questions pertinent to biomedical laboratory practice
- Synthesize new concepts, models, and theories through the appropriate application of empirical knowledge and the scientific method to help resolve laboratory and biomedical sciences issues or problems
- Apply the advanced knowledge to evaluate or design more effective ways to deliver 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 biomedical laboratory science via ongoing scholarship
- Integrate basic principles of ethics and cultural sensitivity within all interpersonal and professional activities

Admission

University Policy on 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.

Admission Requirements

Admissions decisions are made by the Masters in Medical Sciences Program Committee. Students will be admitted to the program based on enrollment availability and their ability to meet the following minimum recommended entrance requirements:

- Cumulative GPA of 3.2
- Written statement of goals and objectives (the personal statement) that clearly

explains how admission to the program will facilitate his/her professional objectives

- Two letters of recommendation, one of which must be from an MLS faculty member who is familiar with the applicant

- Submission of a Graduate Course Completion Form (https://www1.udel.edu/gradoffice/forms-new/4+1.pdf) as part of the application process

Only current UD students can apply to the 4+1 program.

The GRE is not required as strong successful progress towards completion of a rigorous, standards based (hence uniform) BS degree in the laboratory-based professions is a reliable indicator of success in the MS in Medical Sciences.

Admissions Procedures

Students apply for admission to the Masters in Medical Sciences by May 15 of their sophomore year and are provisionally admitted as juniors. Application is competitive and a minimum cumulative GPA of 3.2 is required for consideration.

The admission application fee will be waived.

Following provisional admission, students must maintain a 3.0 GPA throughout their remaining undergraduate studies. Students who fail to demonstrate satisfactory academic progress may be restricted from progressing to the graduate phase of the program. Once students complete their baccalaureate degree, the provisional status is removed.

Special Requirements – Immunizations

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. Following submission, the application materials are reviewed by the Program Committee of the Medical Sciences Program. 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 BS/MS in Medical Sciences does not confer admission to the Ph.D. in Medical Sciences, which is a distinct graduate program offered through the College of Health Sciences.

Academic Requirements

Degree Requirements

Undergraduate Phase: Students will complete all the required credits for the bachelors in AMBB. Students will also take two (2) 600-level courses as part of the requirements for the AMBB degree. These courses are to be chosen from the course requirements for the MMS and will also count towards their AMBB degree requirements.

Table 1 - Recommended 4+1 Graduate Courses to be Completed in the Undergraduate Phase

Traditional AMBB BS Degree Curriculum	**4+1 BS/MS Degree Curriculum**
MMSC490 Clinical and Molecular Cell Biology	*MMSC690 Clinical and Molecular Cell Biology*
MMSC375 Biostatistics for the Biological and Health Sciences	*MMSC603 Research Design and Statistics*

Note: After choosing the two 6xx-level courses (as mentioned above), if you have room in your schedule for courses that do not apply to your undergraduate degree, consider dual-listed, 4xx/6xx, courses and take the course(s) as a 6xx-level. These courses may possibly count toward your Master's degree, with prior approval from the Graduate College.

Students enrolled in MMSC 690 will have different expectations than those enrolled in MMSC490, the undergraduate counterpart. Specifically, examination questions for MMSC 690 will require demonstration of a higher degree of synthesis and application of learning objectives in the course. MMSC 690 students will be required to complete an out-of-class project which demonstrates their ability to build and integrate basic concepts with those available in the current scientific literature.

Graduate Phase: Students will complete an additional 26 credits of coursework to meet the course requirements for the MMS degree. Students must achieve a 3.0 GPA (B average) in their graduate work to earn the MMS. Coursework begins the summer immediately after senior year.

MS in Medical Sciences: Curriculum

CORE COURSES (12 credits)	**SEMESTER CREDITS**
MMSC 603 Research Design	3
MMSC 604 Methods in Bioscience Education	3
MMSC 605 Regulatory and Fiscal Issues in Laboratory Management	3
MMSC 803 Seminar (3 total, 1 per term – 1.0 credit each)*	3

FIELDWORK EXPERIENCES (8 credits)[1]	
MMSC 610 Advanced Practicum I	2
MMSC 611 Advanced Practicum II	2
or MMSC 631 Laboratory Education Administration and Instruction**	2
MMSC 613 Advanced Practicum III	2
MMSC 614 Advanced Practicum IV	2
or MMSC 632 Laboratory Administration and Management	2

SCHOLARLY PRODUCT & CONCENTRATION ELECTIVES(12-14)[2,3]	
MMSC 868 Research (2 total, 3 credits each)	6
or MMSC 815 Contemporary Topics Research (2 total, 3 credits each)	6
Concentration Elective(s)[3]	6-8

Total Credits for the Master of Science in Medical Sciences	minimum 32

[1]Students must earn 8 credits in the fieldwork experiences category through an individualized combination of the following courses: Advanced Practica, Laboratory Education and Administration, Laboratory Administration and Management.

[2]To meet the scholarly product requirement, students may take a literature review / health services / outcomes-based research project course (MMSC 815) or engage in a wet-bench research project with a selected PI (MMSC 868). Students must meet with the MMS program director to determine which course best meets their educational needs.

[3]See Table 2 for a list of potential concentration elective courses. Selections are tailored to meet each student's educational goals. Support from affected departments was obtained during the initial approval process for the MS in Medical Sciences (16-17 Senate Cycle).

*MMSC 803 and MMSC 815 or 868 begin the summer immediately after senior year.

**MMSC 631 Laboratory Education Administration and Instruction can be repeated for additional credit.

Table 2 - POTENTIAL CONCENTRATION ELECTIVE COURSES

MMSC 608	Molecular Preparatory Techniques	2
MMSC 625	Basic Molecular Techniques	4
MMSC 690	Genetics and Molecular Diagnostics	3
MMSC 691	Molecular Diagnostics	3
MMSC 692	Application of Molecular Diagnostic Techniques	3
MMSC 651	Cell and Tissue Culture Techniques	4
MMSC 627	Introduction to Flow Cytometry	2
MMSC 635	Practical Genomic, Proteomics and Bioinformatics	3
MMSC 626	Protein Purification & Characterization	3
KAAP 655	Advanced Physiology of Exercise	3
KAAP 680	Exercise, Nutrition and Bone Health	3
KAAP 802	Human Cardiovascular Control	3
KAAP 840	Advanced Human Anatomy	3
MMSC 805	Biomarker Development	3
MMSC 810	Evidence Based Practice	3
NTDT 610	Overweight/Obesity Prevention and Management	3
NTDT 611	Advanced Nutrition	3
NTDT 630	Trace Minerals & Vitamins	3
NTDT 640	Nutrition and Aging	3
NTDT 655	Issues in International Nutrition	3
NURS 621	Advanced Pathophysiology	3
NURS 812	Responsible Conduct of Research	1 (online, fall)
BINF 644	Bioinformatics	3
CISC 636	Bioinformatics	3
CHEM 641	Biochemistry	3
CHEM 642	Biochemistry	3
EDUC 856	Introduction to Statistical Inference	3

Course Substitutions

Courses in the core curriculum may not be substituted. Concentration electives will be chosen in consultation with the program director in accordance with the student's career goals. Transfer graduate coursework cannot count towards the degree.

Grade Minimums

Students must achieve a 3.0 GPA (B average) in their graduate work to earn their MMS.

Expectations of Facility of Expression in English (Oral and Written)

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

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 3 consecutive semesters, beyond completion of the undergraduate curriculum, to complete the program requirements. An extension of 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 Graduate Program Director. 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 Office of Graduate Studies. The application deadlines are February 15 for Spring candidates, March 15 for Summer candidates, September 15 for Fall candidates, and December 15 for Winter 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 semester determines academic standing. The University's Academic Probation Policy is expressed in the following chart:

Table 3 - Consequence for Failure to Make Satisfactory Progress

If a student is on	Earns a GPA of	The status becomes
Any status	3.0 or above	Clear
Clear	2.99-2.5	Warning
Clear	2.49-2.0	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 three-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

Costs and Financial Aid

During your first four years in the AMBB program, you pay undergraduate tuition and fees. During the fifth year of study, and any subsequent period if it becomes necessary, applicable tuition and fees are those for MMS graduate students.

There are no additional costs for the students in this program other than traditional graduate student tuition and fee expenses.

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

Departmental Operations

Table 4 - Current Faculty Affiliated with the Program

Name and Degree	Rank	Specialty
Leslie Allshouse, MEd, MBA	Senior Instructor	Immunohematology
Mona Batish, PhD	Assistant Professor	Applied Molecular Biology
Subhasis Biswas, PhD	Professor	Applied Molecular Biology
Esther Biswas-Fiss, MS, PhD	Professor and Dept Chair	Molecular Diagnostics & Biotechnology
Virginia Hughes, PhD	Associate Professor	Hematology and Public Policy
Vijay Parashar, PhD	Assistant Professor	Applied Molecular Biology

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

Medical Sciences 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.

Appendix 1. Suggested Schedule of Course Completion

Undergraduate Phase (6 credits)

MMSC 603 Research Design	3 (satisfies MS core)
MMSC 690 Clinical and Molecular Cell Biology	3 (satisfies concentration elective)

Graduate Phase (26 credits)

Summer (4 credits)

MMSC 803 Seminar	1
MMSC 868 Research	3
or MMSC 815 Contemporary Topics Research	3

Fall (12 credits)

MMSC 868 Research	3
or MMSC 815 Contemporary Topics Research	3
MMSC 604 Methods in Bioscience Education	3
MMSC 803 Seminar	1
Concentration Elective	3
Fieldwork Experiences Selective*	2

Spring (10 credits)

MMSC 605 Regulatory & Fiscal Issues in Lab Mgmt.	3
MMSC 803 Seminar	1
Fieldwork Experiences Selectives*	6

*Students must earn 8 credits in the fieldwork experiences category through an individualized combination of the following courses: Advanced Practica; Laboratory Education Administration and Instruction; Laboratory Administration and Management.