DEPARTMENT OF MOLECULAR MICROBIOLOGY AND IMMUNOLOGY

Mission Statement
The Department of Molecular Microbiology and Immunology connects outstanding research programs to the academic mission of preparing students for professional careers in microbiology and immunology, medical and public health service fields, education, research, and industry. The Department of Molecular Microbiology and Immunology is committed to providing students with foundations to link their educational experience to basic and translational biomedical research activities built by department faculty with expertise in the areas of vaccine development, microbial pathogenesis, and molecular mechanisms that determine immune responses in health and disease.

The Department of Molecular Microbiology and Immunology offers a Master of Science (M.S.) degree in Biotechnology and a Doctor of Philosophy (Ph.D.) degree in Molecular Microbiology and Immunology. The Ph.D. in Molecular Microbiology and Immunology program of study is structured around a comprehensive core curriculum that includes MMI 5553 Principles of Immunology and MMI 5573 Principles of Microbiology and a "primer" core class MMI 5513 Genes, Microbes and Disease that intends to bridge areas of research at the molecular and cellular level with various research topics currently pursued by members of the Department. Core courses on MMI 7143 Principles of Scientific Writing and MMI 7113 Teaching in Life Sciences are structured to provide formal training in writing grants/research publications and effective tools for developing learning environments in life sciences, respectively. Supporting prescribed electives include specialized courses that focus on advanced topics in immunology, mycology, bacteriology, virology, and informatics, among others, designed to provide in-depth knowledge at the frontiers of the areas of research to be pursued by prospective students. The collective goal of core and elective courses in the curriculum is to provide both foundational and specialized knowledge in the areas of Molecular Microbiology and Immunology to guide doctoral students toward a field of study of their choice. Doctoral and Dissertation Research courses are intended to provide robust hands-on and minds-on research-based training to generate significant findings advancing the student’s field of study and resulting in peer-reviewed publications.

The mission of the Department of Molecular Microbiology and Immunology is to conduct outstanding research and provide exceptional educational experiences in a collegial, diverse, and inclusive environment. At the same time, we transform academic experiences from classroom to careers by merging scholarly activities with practical skills in fundamental and translational aspects of science in conjunction with a general and discipline-specific Professional Development Program intended to guide students into various career paths.

Core Values
Integrity in academic studies and research.
Respect, diversity, and inclusion.
Responsibility and accountability.
Foster a culture of community and communication.

Master of Science Degree in Biotechnology
The Master of Science degree in Biotechnology offers opportunities for rigorous, advanced study and research in biotechnology, in order to prepare students for employment and research in this rapidly advancing and expanding field. A broad common base of knowledge for biotechnology is provided in the Master’s degree by a comprehensive core curriculum that includes key areas in biochemistry, cell and molecular biology, and immunology. All students receive practical training through the completion of at least two laboratory courses. Additional coursework is selected from a list of approved lecture-based and laboratory courses and can include up to 9 hours of biomedical engineering lectures or 12 hours on aspects of management of biotechnology. The opportunity to gain research experience or develop further technical expertise is also possible through an internship in a biotechnology-based company or by producing a Master’s thesis.

Program Admission Requirements
To be considered for degree-seeking status, applicants must submit, along with the application, two letters of recommendation, a Statement of Future Plans for a career in Biotechnology, and scores from the Graduate Record Examination (GRE). In addition to satisfying the University-wide graduate admission requirements, applicants are expected to have completed an undergraduate major in the sciences with coursework comparable to the core required for the Bachelor of Science degree in Biology at UTSA. In particular, incoming students are required to have taken upper-division undergraduate lecture and laboratory courses in cell biology and biochemistry, earning a grade of at least "B" in all of them; undergraduate coursework in microbiology and immunology is recommended. Students whose undergraduate preparation is deficient in one of these required areas, but who meet the remaining standards for admission, may be conditionally admitted and required to complete specific undergraduate course(s) as a condition of admission. In such cases, students should anticipate that additional time will be required to complete the degree. A minimum grade point average of 3.0 (on a 4.0 scale) is required for admission. Students who are denied admission to this M.S. program must reapply if interested in acceptance as a special graduate student.

Degree Requirements
Degree-seeking students are required to complete a minimum of 36 semester credit hours that must be approved by the student’s Graduate Advisor and Comprehensive Examination Committee, as well as the Graduate Advisor of Record. Students are expected to meet with their assigned Graduate Advisor early in the first semester of study to prepare a course degree plan and organize a Committee as early as possible. Students must work closely with their Advisor and Committee to gain maximum benefit from this program.

Program of Study

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>Biotechnology lectures – core curriculum:</td>
<td>10</td>
</tr>
<tr>
<td>BIO 5001</td>
<td>Ethical Conduct in Research</td>
<td></td>
</tr>
<tr>
<td>or NDRB 5001</td>
<td>Ethical Conduct in Research</td>
<td></td>
</tr>
<tr>
<td>NDRB 5123</td>
<td>Principles of Molecular Biology</td>
<td></td>
</tr>
</tbody>
</table>
Department of Molecular Microbiology and Immunology

**Management of Biotechnology:**

- **E. Biomedical Engineering**
  - MOT 5133 Principles of Cell Biology
  - or BIO 5133 Principles of Cell Biology
  - BIO 5213 Principles of Chemical Biology
  - or NDRB 5213 Principles of Chemical Biology
  - MMI 5553 Principles of Immunology

- **B. 3 semester credit hours in basic laboratory techniques are required:**
  - BIO 5033 Biotechnology Laboratory
  - or NDRB 5033 Biotechnology Laboratory

- **C. A minimum of 3 semester credit hours of additional organized laboratory experience are required from the following:**
  - BIO 5143 Advanced Nucleic Acids Laboratory
    - or NDRB 5143 Advanced Nucleic Acids Laboratory
  - BIO 5163 Recombinant Protein Biotechnology Laboratory
    - or NDRB 5163 Recombinant Protein Biotechnology Laboratory

- **D. Applications of Biotechnology electives. Other 5000-7000 BIO/MMI/NDRB courses that are not listed below can be taken as electives if approved by the Graduate Advisor of Record:**
  - BIO 5003 Epigenetics and Metabolism
  - BIO 5233 Medicinal Plants
  - BIO 5543 Pharmacology and Toxicology
  - BIO 5643 Introduction to Bioinformatics
    - or NDRB 5643 Introduction to Bioinformatics
  - BIO 5663 Applications of Recombinant DNA Technology
  - BIO 5783 Introduction to Good Manufacturing Practices and Good Laboratory Practices
  - BIO 5971 Directed Research
  - BIO 5972 Directed Research
  - BIO 5973 Directed Research
  - BIO 6323 Essentials of Biostatistics for Biotechnology
  - BIO 6513 Drug Development
  - BIO 6983 Master's Thesis (repeated for a total of 6 hours)
  - BIO 7041 Biology Colloquium (students can take up to 2 credit hours)
  - BIO 7563 Practicum in Biotechnology
  - MMI 5513 Genes, Microbes and Disease
  - MMI 6543 Vaccine Development
  - MMI 6923 Advanced Microbial Bioinformatics
  - NDRB 5813 Frontiers in Human Pluripotent Stem Cells

- **E. Biomedical Engineering**
  - BME 6923 Tissue Engineering
  - BME 6933 Tissue-Biomaterials Interactions
  - BME 6943 Biomaterials and Cell Signaling

- **F. Management of Biotechnology:**
  - MOT 5163 Management of Technology
  - MOT 5173 Technology Transfer: The Theory and Practice of Knowledge Utilization
  - MOT 5223 Management of Professional Personnel

---

**Biotechnology Internship**

(Subject to availability.) The internship (Practicum in Biotechnology BIO 7563) will require prior arrangement with biotechnology-based companies and approval of the Graduate Advisor of Record. May be repeated for credit, but no more than 9 hours will be approved and applied toward program of study. Students may not take an internship if they select the thesis option.

**Thesis Option**

Students electing the thesis option must complete 6 semester credit hours of BIO 5973 Directed Research and 6 semester credit hours of BIO 6983 Master's Thesis.

**Comprehensive Examination**

As specified by University regulations, degree candidates must pass a comprehensive examination administered by the student’s Graduate Committee. Students electing to do a thesis must successfully defend their thesis research before their Graduate Committee prior to the submission of the thesis to the Dean of the Graduate School for approval. Certain rules must be adhered to concerning the composition of the Master’s Comprehensive Examination Committee and the Master’s Thesis Committee. Only tenured or tenure-track faculty members from UTSA can chair the Committee, and no more than one member of the Committee may be fixed-term track faculty or from another institution. Students who do not achieve the criteria (or necessary expectations) to pass the Comprehensive Examination can retake the comprehensive exam one additional time.

**Doctor of Philosophy Degree in Molecular Microbiology and Immunology**

The Department of Molecular Microbiology and Immunology offers opportunities for advanced study and research leading to the Doctor of Philosophy degree.

The goals of the program are:

- To educate, mentor, and sponsor the next generation of scientists specialized in the study of mechanisms leading to diseases caused by microorganisms, host immune response to infectious and non-pathogenic microorganisms, and diseases arising from immune dysfunction.
- To advance multi-disciplinary training and research portfolios within UTSA and other research entities in San Antonio.
- To meet the workforce needs of academic institutions and also of industries specialized in biotechnology, biodefense, and healthcare.
- To guide students toward a variety of career paths with general and discipline-specific Professional Development Plans.

**Student Learning Outcomes**

Upon completion of the Molecular Microbiology and Immunology Degree, students will be proficient in:

- Demonstrating knowledge and comprehension of the foundations of the immune systems in various hosts, microbial pathogenesis, host-
pathogen interactions, microbial and host genomics, and biology of diseases of the immune system.

- Designing and executing experiments and applying the scientific method.
- Applying cutting-edge knowledge and experimental tools in microbiology and immunology to solve current health challenges.
- Effectively communicating molecular microbiology and immunology concepts, methods, and results from basic research in written and oral forms.

### Admission Requirements

Applicants must satisfy the University-wide graduate admission requirements described in the graduate catalog. In addition, they must satisfy one of the following MMI Ph.D. Program-specific requirements.

1. Hold a Bachelor of Arts or a Bachelor of Science degree in STEM with a minimum grade point average of 3.0 in upper-division courses in Microbiology or Biosciences with course curriculum including, but not limited to, biology, genetics, microbiology, or immunology.
2. A master's degree in STEM, preferably in Biology, Microbiology and Immunology, Biotechnology, or related field.

Admission to the program is decided based on a holistic approach that includes the applicant’s personal statement, course work, letters of reference, evidence of research experience, and one or more online or in-person interviews.

Complete applications must include:

1. Official transcripts.
2. Three letters of recommendation from persons familiar with the applicant’s academic potential.
3. A statement of research/specialization interest and description of prior research experience.
4. Résumé/curriculum vita with a list of publications or scholarly products.
5. For International Applicants only: Test of English as a Foreign Language (TOEFL) iBT with minimum score of 100 is recommended.

### Degree Requirements

The degree requires 75 semester credit hours (SCH) for students entering with a Bachelor of Arts or a Bachelor of Science degree, or 66 SCH for students entering with a Master's Degree. The curriculum consists of core courses, courses in scientific writing and scientific teaching, elective courses, seminars, and dissertation research. Any grade lower than “B” in graduate courses or in leveling coursework at the undergraduate level will not count toward the Ph.D. degree.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Core Curriculum (15 semester credit hours required)</strong></td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>MMI 5513</td>
<td>Genes, Microbes and Disease</td>
<td></td>
</tr>
<tr>
<td>MMI 5553</td>
<td>Principles of Immunology</td>
<td></td>
</tr>
<tr>
<td>MMI 5573</td>
<td>Principles of Microbiology</td>
<td></td>
</tr>
<tr>
<td>MMI 7113</td>
<td>Teaching in Life Sciences</td>
<td></td>
</tr>
<tr>
<td>MMI 7143</td>
<td>Principles of Scientific Writing</td>
<td></td>
</tr>
<tr>
<td><strong>B. Electives (15 semester credit hours required)</strong></td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>MMI 6323</td>
<td>Biostatistics</td>
<td></td>
</tr>
<tr>
<td>MMI 6643</td>
<td>Introduction to Bioinformatics</td>
<td></td>
</tr>
<tr>
<td>MMI 7413</td>
<td>Advanced Virology</td>
<td></td>
</tr>
<tr>
<td>MMI 6153</td>
<td>Drug Development</td>
<td></td>
</tr>
<tr>
<td>MMI 6543</td>
<td>Vaccine Development</td>
<td></td>
</tr>
<tr>
<td>MMI 6613</td>
<td>Introduction to Clinical Medicine and Pathology</td>
<td></td>
</tr>
<tr>
<td>MMI 6713</td>
<td>Advanced Clinical Medicine and Pathology</td>
<td></td>
</tr>
<tr>
<td>MMI 6803</td>
<td>Advanced Immunology</td>
<td></td>
</tr>
<tr>
<td>MMI 6883</td>
<td>Bacterial Pathogenesis</td>
<td></td>
</tr>
<tr>
<td>MMI 6733</td>
<td>Advanced Medical Mycology</td>
<td></td>
</tr>
<tr>
<td>MMI 6923</td>
<td>Advanced Microbial Bioinformatics</td>
<td></td>
</tr>
<tr>
<td>MMI 6933</td>
<td>Data Analysis and Visualization for Biologists</td>
<td></td>
</tr>
<tr>
<td>MMI 6973</td>
<td>Special Topics</td>
<td></td>
</tr>
</tbody>
</table>

### C. Colloquia (5 semester credit hours required) | 5 |
| MMI 7001 | Professional & Leadership Development      |              |
| MMI 7031 | Graduate Student Seminar: Acquiring Presentation Skills | |
| MMI 7041 | Molecular Microbiology and Immunology Colloquium (Microbiology) | |
| MMI 7041 | Molecular Microbiology and Immunology Colloquium (Highlights in Immunology) | |
| MMI 7041 | Molecular Microbiology and Immunology Colloquium (Neuroimmunology) | |
| MMI 7041 | Molecular Microbiology and Immunology Colloquium (Vector-Borne diseases) | |
| MMI 7041 | Molecular Microbiology and Immunology Colloquium (Biofilms) | |
| MMI 7041 | Molecular Microbiology and Immunology Colloquium (Antifungal Drugs) | |
| MMI 7051 | Molecular Microbiology and Immunology Seminar | |

### D. Doctoral Research (40 semester credit hours required) | 40 |
| MMI 7571 | Doctoral Rotation                          |              |
| or MMI 7572 | Doctoral Rotation                          |              |
| MMI 7211 | Doctoral Research                          |              |
| or MMI 7212 | Doctoral Research                          |              |
| or MMI 7213 | Doctoral Research                          |              |
| or MMI 7214 | Doctoral Research                          |              |
| or MMI 7215 | Doctoral Research                          |              |
| or MMI 7216 | Doctoral Research                          |              |
| MMI 7311 | Doctoral Dissertation                      |              |
| or MMI 7312 | Doctoral Dissertation                      |              |
| or MMI 7313 | Doctoral Dissertation                      |              |
| or MMI 7314 | Doctoral Dissertation                      |              |
| or MMI 7315 | Doctoral Dissertation                      |              |
| or MMI 7316 | Doctoral Dissertation                      |              |

### Advancement to Candidacy

Advancement to candidacy requires a student to complete all the program requirements and to pass written and oral qualifying examinations following completion of core and a majority of elective work.
courses. The written qualifying exam is administered in connection with the Principles of Immunology and Principles of Microbiology core courses. The oral qualifying exam is based on the dissertation research proposal and is administered by a five-member Oral Qualifying Exam Committee made up of tenured, tenure-track, or adjunct faculty. The qualifying exam is conducted as outlined in the Handbook of Academic Policies and Procedures for the Ph.D. Program in Molecular Microbiology and Immunology. Students are allowed two additional attempts to pass their oral qualifying examination. Results of the written and oral examinations must be reported to the Doctoral Studies Committee and the Dean of the Graduate School. Admission into the Doctoral program does not guarantee advancement to candidacy.

**Dissertation**

Candidates must demonstrate their ability to conduct independent research by completing and defending an original dissertation. The research topic is determined by the student in consultation with their supervising professor and a Dissertation Committee. The Dissertation Committee is selected by the student and supervising professor and approved following guidelines of the UTSA Graduate School. The Dissertation Committee guides and critiques the candidate’s research. The Committee is composed of four program faculty and one outside member. The Dissertation Committee must approve the completed dissertation.

**Final Oral Examination**

Following an open presentation of the dissertation findings, the Dissertation Committee conducts a closed oral examination dealing primarily with the relation of the dissertation to the general field of specialty. Results of the oral examination must be reported to the Dean of the Graduate School. Awarding of the degree is based on the approval of the Dissertation Committee, which is approved by the relevant Doctoral Studies Committee, the Department Chair, and the Dean of the Graduate School. The Dean of the Graduate School certifies the completion of all University-wide requirements.

### Molecular Microbiology and Immunology (MMI) Courses

**MMI 5513. Genes, Microbes and Disease. (3-0) 3 Credit Hours.**
Prerequisite: BIO 3513 or equivalent. Primer course that bridges molecular and cell biology, molecular structure and function of genes and nucleic acids, in the focused area of host-pathogen interactions. Genome projects, functional genomics, and the genetic control of development will also be covered. Differential Tuition: $150. Course Fees: GS01 $90; IUB2 $10.

**MMI 5553. Principles of Immunology. (3-0) 3 Credit Hours.**
Prerequisite: BIO 3513 or equivalent. A study of cellular and molecular interaction between cells and molecules of the immune system and principles of immune system function. Topics include immune system development, humoral and cell-mediated immunity, disease and treatments, immunization, immunodeficiency, and autoimmunity. Differential Tuition: $150. Course Fees: GS01 $90; IUB2 $10.

**MMI 5573. Principles of Microbiology. (3-0) 3 Credit Hours.**
Prerequisite: BIO 3513 and BIO 3713, or equivalents. A study of the cellular and molecular mechanisms by which bacterial, eukaryotic, parasitic and viral pathogens cause disease and the host immune responses against these pathogens. (Credit cannot be earned for both MMI 5573 and BIO 6573.) This course is available to Master and Doctoral students. Differential Tuition: $150. Course Fees: GS01 $90; IUB2 $10.

**MMI 5971. Directed Research. (0-0) 1 Credit Hour.**
The directed research course may involve either a laboratory or a theoretical problem. May be repeated for credit, but not more than 6 hours, regardless of discipline, in combination with MMI 6951, MMI 6952, and MMI 6953 (Independent Study), will apply to the Master's degree. Differential Tuition: $50. Course Fees: GS01 $30; IUB2 $10.

**MMI 5972. Directed Research. (0-0) 2 Credit Hours.**
The directed research course may involve either a laboratory or a theoretical problem. May be repeated for credit, but not more than 6 hours, regardless of discipline, in combination with MMI 6951, MMI 6952, and MMI 6953 (Independent Study), will apply to the Master's degree. Differential Tuition: $100. Course Fees: GS01 $60; IUB2 $10.

**MMI 5973. Directed Research. (0-0) 3 Credit Hours.**
The directed research course may involve either a laboratory or a theoretical problem. May be repeated for credit, but not more than 6 hours, regardless of discipline, in combination with MMI 6951, MMI 6952, and MMI 6953 (Independent Study), will apply to the Master's degree. Differential Tuition: $150. Course Fees: GS01 $90; IUB2 $10.

**MMI 6323. Biostatistics. (3-0) 3 Credit Hours.**
This course involves basic, intermediate, and advanced statistical vocabulary, concepts, and methods commonly used in the biomedical research. Concepts and appropriate selections of test/study design using power analyses and estimations of sample sizes; also for clinical trials. Analytical calibration curves, frequency distributions, descriptive statistics, measures of central tendency and dispersion/error, probability, paired and unpaired, one-tailed and two-tailed t-tests, correlations, regression, one-way and two-way analysis of variance with repeated measures, parametric and nonparametric tests, post hoc tests for significance, reporting and interpretations of statistical results, validations of clinical tests for specificity, sensitivity, predictive values, likelihood ratios, and receiver operating characteristic curves. Differential Tuition: $150. Course Fees: GS01 $90; IUB2 $10.

**MMI 6513. Drug Development. (3-0) 3 Credit Hours.**
This course will provide students with an overview of the early drug discovery process, including target identification, validation, assay development, and high throughput screening up to pre-clinical trials. (Same as BIO 6513. Credit cannot be earned for both MMI 6513 and BIO 6513.) This course is available to Master and Doctoral students. Differential Tuition: $150. Course Fees: GS01 $90; IUB2 $10.

**MMI 6543. Vaccine Development. (3-0) 3 Credit Hours.**
This course will provide students with an overview of issues about the roles of vaccines in the control of infectious diseases, vaccine development, clinical trials, and implementation of vaccine programs. (Same as BIO 6543. Credit cannot be earned for both MMI 6543 and BIO 6543.) This course is available to Master and Doctoral students. Differential Tuition: $150. Course Fees: GS01 $90; IUB2 $10.

**MMI 6613. Introduction to Clinical Medicine and Pathology. (3-0) 3 Credit Hours.**
Prerequisite: Graduate standing. Introduction to concepts of human disease, diagnosis, and underlying pathology. This course is available to Master and Doctoral students. Generally offered: Fall. Differential Tuition: $150. Course Fees: GS01 $90; IUB2 $10.
MMI 6643. Introduction to Bioinformatics. (3-0) 3 Credit Hours.
The ability to sequence and analyze genomes has transformed biology. The
genomic revolution has been made possible by the development of
bioinformatics tools that combine computation with principles of
molecular biology. In this course, students will learn how to use some of
the major bioinformatics tools and will examine a few genomes to
understand the vast amount of information present in them. This course
is available to Master and Doctoral students. Differential Tuition: $150.
Course Fees: GS01 $90; IUB2 $10.

MMI 6713. Advanced Clinical Medicine and Pathology. (3-0) 3 Credit
Hours.
Prerequisite: MMI 3013 or MMI 6613. Advanced concepts of human
disease, diagnosis, and underlying pathology. This course is available
to Master and Doctoral students. Generally offered: Spring. Differential
Tuition: $150. Course Fees: GS01 $90; IUB2 $10.

MMI 6733. Advanced Medical Mycology. (3-0) 3 Credit Hours.
Prerequisite: BIO 3522 and BIO 3722 or equivalents. A comprehensive
study of the etiological agents and host factors that lead to fungal
disease in humans. This course is available to Master and Doctoral
students. (Same as BIO 5733. Credit cannot be earned for both MMI 6733
and BIO 5733.) Differential Tuition: $150. Course Fees: GS01 $90; IUB2
$10.

MMI 6743. Advanced Virology. (3-0) 3 Credit Hours.
Prerequisite: Graduate standing. A study of the diversity of animal viruses
with emphasis on the molecular details of genome replication, gene
expression, and pathogenesis. (Same as BIO 5743. Credit cannot be
earned for both MMI 5743 and BIO 5743.) This course is available to

MMI 6803. Advanced Immunology. (3-0) 3 Credit Hours.
Prerequisite: BIO 4743 or consent of instructor. Advanced applications
of current molecular and cellular concepts of humoral and cell-mediated
immunity, with emphasis on host-pathogen interactions, experimental
design, and immunological technologies. This course is available to
Master and Doctoral students. (Same as BIO 6803. Credit cannot be
earned for both MMI 6803 and BIO 6803.) Differential Tuition: $150.
Course Fees: GS01 $90; IUB2 $10.

MMI 6883. Bacterial Pathogenesis. (3-0) 3 Credit Hours.
Prerequisite: BIO 3713 and BIO 4743, or consent of instructor. This course
will present a selection of topics in the field of bacterial pathogenesis.
Lectures will cover regulation of virulence, colonization and host tissue
damage, vaccines, antibiotics, and novel antimicrobials, evasion of the
immune system, intracellular pathogens, pathogenic mechanisms of
Gram-negative and Gram-positive bacteria, pathogenic mycobacteriology,
and experimental tools in bacterial pathogenesis. (Same as BIO 6883.
Credit cannot be earned for both MMI 6883 and BIO 6883.) Differential
Tuition: $150. Course Fees: GS01 $90; IUB2 $10.

MMI 6923. Advanced Microbial Bioinformatics. (3-0) 3 Credit Hours.
Prerequisite: BIO 2313 or equivalent; MMI 6643, enrollment in Molecular
Microbiology and Immunology Ph.D. program required, or permission of
the Molecular Microbiology and Immunology Department or instructor.
With the advent of next generation sequencing (NGS), genomes and
transcriptomes are being added at ever growing rates to the public
sequence repositories, which poses challenges for comprehensive
data analyses and mining. In this course, students will learn and apply
bioinformatics tools and strategies - from the profiling of individual
 genomes to large-scale multi-isolate comparisons - to harvest the rich
information content that can be found in big sequence data. This course
focuses on microbial genomics/transcriptomics/evolution with focus on pathogens. Differential Tuition: $150. Course Fees: GS01 $90; IUB2 $10.

MMI 6933. Data Analysis and Visualization for Biologists. (3-0) 3 Credit
Hours.
An introduction to modern techniques used by data scientists; including
data organization, manipulation, analysis, visualization, and in silico
experimentation. Students will be taught how to use an open-source data
science platform (KNIME) to design a workflow specific to their research

MMI 6951. Independent Study. (0-0) 1 Credit Hour.
This course involves independent reading, research, discussion, and/
or writing under the direction of a faculty member. This course is for
students needing specialized work not normally or not often available
as part of the regular course offerings. May be repeated for credit, but
not more than 6 hours, regardless of discipline, in combination with MMI
5971, MMI 5972, and MMI 5973 (Independent Study), will apply to the
Master's degree. Differential Tuition: $50. Course Fees: GS01 $30; IUB2
$10.

MMI 6952. Independent Study. (0-0) 2 Credit Hours.
This course involves independent reading, research, discussion, and/
or writing under the direction of a faculty member. This course is for
students needing specialized work not normally or not often available
as part of the regular course offerings. May be repeated for credit, but
not more than 6 hours, regardless of discipline, in combination with MMI
5971, MMI 5972, and MMI 5973 (Independent Study), will apply to the
Master's degree. Differential Tuition: $100. Course Fees: GS01 $60; IUB2
$10.

MMI 6953. Independent Study. (0-0) 3 Credit Hours.
This course involves independent reading, research, discussion, and/
or writing under the direction of a faculty member. This course is for
students needing specialized work not normally or not often available
as part of the regular course offerings. May be repeated for credit, but
not more than 6 hours, regardless of discipline, in combination with MMI
5971, MMI 5972, and MMI 5973 (Independent Study), will apply to the
Master's degree. Differential Tuition: $150. Course Fees: GS01 $90; IUB2
$10.

MMI 6973. Special Topics. (3-0) 3 Credit Hours.
Prerequisite: Consent of instructor. An organized course offering the
opportunity for specialized study not normally or not often available
as part of the regular course offerings. Special Topics courses may be
repeated for credit if the topics vary. Differential Tuition: $150. Course
Fees: GS01 $90; IUB2 $10.

MMI 6981. Master's Thesis. (0-0) 1 Credit Hour.
Corequisites: Enrollment in MMI 6981, MMI 6982, or MMI 6983 is required
each term in which the thesis is in progress. Thesis research and
preparation. May be repeated for credit, but not more than 6 hours will
apply to the Master's degree. Credit will be awarded upon completion of
MMI 6982. Master's Thesis. (0-0) 2 Credit Hours.
Corequisites: Enrollment in MMI 6981, MMI 6982, or MMI 6983 is required each term in which the thesis is in progress. Thesis research and preparation. May be repeated for credit, but not more than 6 hours will apply to the Master's degree. Credit will be awarded upon completion of the thesis. Differential Tuition: $100. Course Fees: GS01 $60; IUB2 $10.

MMI 6983. Master's Thesis. (0-0) 3 Credit Hours.
Corequisites: Enrollment in MMI 6981, MMI 6982, or MMI 6983 is required each term in which the thesis is in progress. Thesis research and preparation. May be repeated for credit, but not more than 6 hours will apply to the Master's degree. Credit will be awarded upon completion of the thesis. Differential Tuition: $150. Course Fees: GS01 $90; IUB2 $10.

MMI 7001. Professional and Leadership Development. (1-0) 1 Credit Hour.
This course focuses on building individual development plans and integration of professional and leadership skills. Differential Tuition: $50. Course Fees: GS01 $30; IUB2 $10.

MMI 7031. Graduate Student Seminar: Acquiring Presentation Skills. (1-0) 1 Credit Hour.
This course includes oral presentations, discussions, critical evaluation of students' research in progress, or support preparation of manuscripts/reviews by students to publish their data sets. May be repeated for credit. Differential Tuition: $50. Course Fees: GS01 $30; IUB2 $10.

MMI 7041. Molecular Microbiology and Immunology Colloquium. (1-0) 1 Credit Hour.
Prerequisite: Graduate standing. This course includes oral presentations, discussions, critical evaluation of students' research in progress, or discussions of current journal articles or reviews of recent scientific advances. May be repeated for credit if topic varies. Differential Tuition: $50. Course Fees: GS01 $30; IUB2 $10.

MMI 7051. Molecular Microbiology and Immunology Seminar. (1-0) 1 Credit Hour.
Prerequisite: Graduate standing. This course includes formal presentations of research by outside authorities in the biological sciences. May be repeated for credit. Differential Tuition: $50. Course Fees: GS01 $30; IUB2 $10.

MMI 7113. Teaching in Life Sciences. (3-0) 3 Credit Hours.
Prerequisite: Admission to candidacy for the Doctoral degree. Required course for Molecular Microbiology and Immunology doctoral students. The student will be responsible for all aspects of leading a discussion section or laboratory course. Differential Tuition: $150. Course Fees: GS01 $90; IUB2 $10.

MMI 7143. Principles of Scientific Writing. (3-0) 3 Credit Hours.
Prerequisite: Admission to candidacy for the Molecular Microbiology and Immunology Doctoral degree. This course will provide an overview of scientific grant and manuscript preparation. The class will be directed toward producing a Ph.D. dissertation proposal and a predoctoral fellowship application. Differential Tuition: $150. Course Fees: GS01 $90; IUB2 $10.

MMI 7211. Doctoral Research. (0-0) 1 Credit Hour.
Prerequisite: Admission to Molecular Microbiology and Immunology Doctoral program. May be repeated for credit, but no more than 27 hours may be applied to the Doctoral degree. Differential Tuition: $50. Course Fees: GS01 $30; IUB2 $10.

MMI 7212. Doctoral Research. (0-0) 2 Credit Hours.
Prerequisite: Admission to Molecular Microbiology and Immunology Doctoral program. May be repeated for credit, but no more than 27 hours may be applied to the Doctoral degree. Differential Tuition: $100. Course Fees: GS01 $60; IUB2 $10.

MMI 7213. Doctoral Research. (0-0) 3 Credit Hours.
Prerequisite: Admission to Molecular Microbiology and Immunology Doctoral program. May be repeated for credit, but no more than 27 hours may be applied to the Doctoral degree. Differential Tuition: $150. Course Fees: GS01 $90; IUB2 $10.

MMI 7214. Doctoral Research. (0-0) 4 Credit Hours.
Prerequisite: Admission to either the Molecular Microbiology and Immunology, Neuroscience, or Cell and Molecular Biology Doctoral program. May be repeated for credit, but no more than 27 hours may be applied to the Doctoral degree. Differential Tuition: $200. Course Fees: GS01 $120; IUB2 $10.

MMI 7215. Doctoral Research. (0-0) 5 Credit Hours.
Prerequisite: Admission to either the Molecular Microbiology and Immunology, Neuroscience, or Cell and Molecular Biology Doctoral program. May be repeated for credit, but no more than 27 hours may be applied to the Doctoral degree. Differential Tuition: $250. Course Fees: GS01 $150; IUB2 $10.

MMI 7216. Doctoral Research. (0-0) 6 Credit Hours.
Prerequisite: Admission to Molecular Microbiology and Immunology Doctoral program. May be repeated for credit, but no more than 27 hours may be applied to the Doctoral degree. Differential Tuition: $300. Course Fees: GS01 $180; IUB2 $10.

MMI 7311. Doctoral Dissertation. (0-0) 1 Credit Hour.
Prerequisite: Admission to candidacy for the Molecular Microbiology and Immunology Doctoral degree and completion of at least 1-6 semester credit hours of MMI 7211, MMI 7212, MMI 7213, MMI 7214, or MMI 7215. May be repeated for credit, but no more than 45 hours may be applied to the Doctoral degree. Differential Tuition: $50. Course Fees: GS01 $30; IUB2 $10.

MMI 7312. Doctoral Dissertation. (0-0) 2 Credit Hours.
Prerequisite: Admission to candidacy for the Molecular Microbiology and Immunology Doctoral degree and completion of at least 1-6 semester credit hours of MMI 7211, MMI 7212, MMI 7213, MMI 7214, or MMI 7215. May be repeated for credit, but no more than 45 hours may be applied to the Doctoral degree. Differential Tuition: $100. Course Fees: GS01 $60; IUB2 $10.

MMI 7313. Doctoral Dissertation. (0-0) 3 Credit Hours.
Prerequisite: Admission to candidacy for the Molecular Microbiology and Immunology Doctoral degree and completion of at least 1-6 semester credit hours of MMI 7211, MMI 7212, MMI 7213, MMI 7214, or MMI 7215. May be repeated for credit, but no more than 45 hours may be applied to the Doctoral degree. Differential Tuition: $150. Course Fees: GS01 $90; IUB2 $10.

MMI 7314. Doctoral Dissertation. (0-0) 4 Credit Hours.
Prerequisite: Admission to candidacy for the Molecular Microbiology and Immunology Doctoral degree and completion of at least 1-6 semester credit hours of MMI 7211, MMI 7212, MMI 7213, MMI 7214, or MMI 7215. May be repeated for credit, but no more than 45 hours may be applied to the Doctoral degree. Differential Tuition: $200. Course Fees: GS01 $120; IUB2 $10.
MMI 7315. Doctoral Dissertation. (0-0) 5 Credit Hours.
Prerequisite: Admission to candidacy for the Molecular Microbiology and Immunology Doctoral degree and completion of at least 1-6 semester credit hours of MMI 7211, MMI 7212, MMI 7213, MMI 7214, MMI 7215, or MMI 7216. May be repeated for credit, but no more than 45 hours may be applied to the Doctoral degree. Differential Tuition: $250. Course Fees: GS01 $150; IUB2 $10.

MMI 7316. Doctoral Dissertation. (0-0) 6 Credit Hours.
Prerequisite: Admission to candidacy for the Molecular Microbiology and Immunology Doctoral degree and completion of at least 1-6 semester credit hours of MMI 7211, MMI 7212, MMI 7213, MMI 7214, MMI 7215, or MMI 7216. May be repeated for credit, but no more than 45 hours may be applied to the Doctoral degree. Differential Tuition: $300. Course Fees: GS01 $180; IUB2 $10.

MMI 7571. Doctoral Rotation. (0-0) 1 Credit Hour.
Prerequisite: Admission to the Molecular Microbiology and Immunology Ph.D. program. This course allows students to perform laboratory-based research under the direction of a Molecular Microbiology and Immunology faculty member. Students will receive mentoring and training in the areas of experimental design, experimentation, data acquisition, data analysis, and presentation (oral/written). May be repeated for credit, but no more than 6 hours may be applied to the Doctoral degree. Differential Tuition: $50. Course Fees: GS01 $30; IUB2 $10.

MMI 7572. Doctoral Rotation. (0-0) 2 Credit Hours.
Prerequisite: Admission to the Molecular Microbiology and Immunology Ph.D. program. This courses allows students to perform laboratory-based research under the direction of a Molecular Microbiology and Immunology faculty member. Students will receive mentoring and training in the areas of experimental design, experimentation, data acquisition, data analysis, and presentation (oral/written). May be repeated for credit, but no more than 6 hours may be applied to the Doctoral degree. Differential Tuition: $100. Course Fees: GS01 $60; IUB2 $10.