BIOLOGY, MS

Banner Code: SC-MS-BIOL

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Science and Technology Campus
Phone: 703-993-4263
Email: biologygrad@gmu.edu
Website: ssb.gmu.edu

This program provides advanced training for college graduates or professionals seeking careers in the biomedical research, biotechnology, neuroscience or biodefense, as well as evolutionary and animal biology, animal biology and biology teaching. Master's level concentrations are available in microbiology and infectious disease, molecular biology, neuroscience, evolutionary biology, and translational and clinical research. Alternatively, students may choose the program in general biological sciences, which allows flexibility to build a degree program tailored to a specific research or career interest.

Admissions & Policies

Admissions

University-wide admissions policies can be found in the Graduate Admissions Policies section of this catalog.

To apply for this program, please complete the George Mason University Admissions Application (https://www2.gmu.edu/admissions-aid/apply-now).

While each applicant's qualifications are reviewed as a whole, the following are provided: Applicants to the program must have a bachelor's degree in biology or its equivalent. Additionally, all MS concentrations require a GPA of 3.00 in biology coursework or in the last 60 credits of undergraduate study. Students must also submit three letters of recommendation and scores on the GRE general exam. Exam scores should be in the 45th percentile or above. Admission is contingent on acceptance by a faculty research advisor.

Microbiology and Infectious Disease (MID) Concentration

Students who choose the Microbiology and Infectious Disease Concentration (MID) must have a lecture and lab course in microbiology and a lecture course in biochemistry.

Translational and Clinical Research (TCR) Concentration

Students who choose the Translational and Clinical Research Concentration may submit MCAT scores in place of GRE general exam scores.

Evolutionary Biology (EB) Concentration

Students who choose the Evolutionary Biology Concentration must also submit a personal statement/statement of interest consistent with at least one faculty member's research program. GRE score should be approximately 303.

Policies

For policies governing all graduate programs, see AP.6 Graduate Policies.

Requirements

Degree Requirements

Total credits: 30

Students should refer to the Admissions & Policies tab for specific policies related to this program.

Program of Study

The faculty advisor and the student work together to develop a program of study that best fits the student's background and interests. The student must submit a program of study to the program director for approval within the first 12 credits of coursework. By the end of the second semester of coursework, students will form a graduate committee made up of three faculty members. At least two committee members must be faculty in the School of Systems Biology.

Concentration Options

Candidates for the Biology, MS focus their study in one of five approved concentrations below, or by completing coursework for the program in biological sciences in an area of study chosen in consultation with the student's advisor and program director.

Research Options

Students have the option to complete a 3-6 credit master's thesis (BIOL 799 Thesis) or a 1-3 credit research project (BIOL 798 Master's Research Project). In accordance with AP6 Graduate Policies, the same quality of work is expected of students regardless of which option they choose.

- Thesis: In general, the MS thesis is most appropriate for students planning or considering a research career. Students pursuing the thesis option must write a formal thesis that meets the requirements of the school and must defend their thesis and present their results in a public seminar.
- Research Project: The MS project is most appropriate for students who have scheduling commitments, such as a full-time job, that may preclude performing a complete series of laboratory experiments. Students pursuing the project option must successfully complete written and oral comprehensive exams.

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<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BIOL 799</td>
<td>Thesis</td>
<td>3-6</td>
</tr>
<tr>
<td>BIOL 798</td>
<td>Master's Research Project</td>
<td>1-3</td>
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MS without Concentration

Program in Biological Sciences

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<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>BIOL 690</td>
<td>Introduction to Graduate Studies in Biology or BIOS 702</td>
<td>1-3</td>
</tr>
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</table>

Code Title Credits
Select a Master's Thesis or Research Project
BIOL 799 Thesis 3-6
BIOL 798 Master's Research Project 1-3
Biology, MS

Seminar 2

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BIOL 692</td>
<td>Seminar in Biology</td>
<td>2</td>
</tr>
<tr>
<td>or BIOL 695</td>
<td>Seminar in Molecular, Microbial, and Cellular Biology</td>
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</tbody>
</table>

Research 1-6

Select one from the following:

- BIOL 798 Master’s Research Project
- BIOL 799 Thesis (3-6 credits)

Electives 7-14

Select 7-14 credits from the following:

- BIOL 564 Techniques in Virology
- BIOL 553 Advanced Topics in Immunology
- BIOL 682 Advanced Eukaryotic Cell Biology
- BIOS 743 Genomics, Proteomics, and Bioinformatics
- BIOS 710 Current Topics in Bioscience

Or relevant graduate level coursework selected in consultation with the advisor

Total Credits: 30

MS with Concentration in Molecular Biology (MOB)

Research Methodology 1-3

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<tbody>
<tr>
<td>BIOL 690</td>
<td>Introduction to Graduate Studies in Biology</td>
<td>1-3</td>
</tr>
<tr>
<td>or BIOS 702</td>
<td>Research Methods</td>
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</tbody>
</table>

Core Biology 13

Select four courses from the following:

- BIOL 568 Advanced Topics in Molecular Genetics
- BIOL 682 Advanced Eukaryotic Cell Biology
- BIOS 743 Genomics, Proteomics, and Bioinformatics
- BIOS 747 Molecular Evolution

Bioinformatics 3

Select one from the following:

- BIOL 580 Computer Applications for the Life Sciences
- BINF 630 Bioinformatics Methods
- BINF 634 Bioinformatics Programming

Molecular Techniques 2-4

Select 2-4 credits from the following:

- BIOL 585 Eukaryotic Cell Biology Laboratory
- BIOL 678 Cell-Based Assays
- BIOS 740 Laboratory Methods in Functional Genomics and Biotechnology

Special topics courses, such as BIOL 575 or BIOL 691, may also be approved for this requirement by the program director, but only in semesters in which they are primarily a laboratory course of at least two credits with substantial content of techniques in molecular biology.

Seminar 2

<table>
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<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>BIOL 695</td>
<td>Seminar in Molecular, Microbial, and Cellular Biology</td>
<td>2</td>
</tr>
</tbody>
</table>

Research 1-6

Select one from the following:

- BIOL 798 Master’s Research Project
- BIOL 799 Thesis (3-6 credits)

Electives 1

Select 0-8 credits from the following:

- BIOL 692 Seminar in Molecular, Microbial, and Cellular Biology
- BIOL 798 Master’s Research Project
- BIOL 799 Thesis (3-6 credits)

1 These courses are provided as suggestions only; this is not intended to be a comprehensive list of elective options. Note that two courses covering substantially similar topics may not both be counted in the student's program of study. Students should consult their faculty research advisor or the graduate program coordinator when preparing a program of study.

MS with Concentration in Microbiology and Infectious Disease (MID)

Research Methodology 1-3

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>BIOL 690</td>
<td>Introduction to Graduate Studies in Biology</td>
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</tr>
<tr>
<td>or BIOS 702</td>
<td>Research Methods</td>
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</table>

Core Biology 12

Select four courses from the following:

- BIOL 553 Advanced Topics in Immunology
- BIOL 563 Virology
- BIOL 669 Pathogenic Microbiology
- BIOL 715 Microbial Physiology
- BIOL 718 Techniques in Microbial Pathogenesis

Seminar 2

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<tbody>
<tr>
<td>BIOL 695</td>
<td>Seminar in Molecular, Microbial, and Cellular Biology</td>
<td>2</td>
</tr>
</tbody>
</table>

Research 1-6

Select one from the following:

- BIOL 798 Master’s Research Project
- BIOL 799 Thesis (3-6 credits)

Electives 1

Select 0-8 credits from the following:

- BIOL 692 Seminar in Molecular, Microbial, and Cellular Biology
- BIOL 798 Master’s Research Project
- BIOL 799 Thesis (3-6 credits)
Select 0-8 credits of electives in BIOL, BIOS, or related areas as approved by the student's advisor and the program director.

- BIOL 553 Advanced Topics in Immunology
- BIOL 568 Advanced Topics in Molecular Genetics
- BIOL 575 Selected Topics in Genetics
- BIOL 579 Molecular Evolution and Conservation Genetics
- BIOL 583 General Biochemistry
- BIOL 585 Eukaryotic Cell Biology Laboratory
- BIOL 682 Advanced Eukaryotic Cell Biology
- BIOL 793 Research in Biology
- BIOS 740 Laboratory Methods in Functional Genomics and Biotechnology
- BIOS 741 Genomics
- BIOS 742 Biotechnology
- BIOS 743 Genomics, Proteomics, and Bioinformatics
- BIOS 744 Molecular Genetics
- BIOS 767 Molecular Evolution

**Total Credits:** 30

1 These courses are provided as suggestions only; this is not intended to be a comprehensive list of elective options. Note that two courses covering substantially similar topics may not both be counted in the student's program of study. Students should consult their faculty research advisor or the graduate program coordinator when preparing a program of study.

### MS with Concentration in Neuroscience (NEUR)

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<tbody>
<tr>
<td>BIOL 690</td>
<td>Introduction to Graduate Studies in Biology</td>
<td>1-3</td>
</tr>
<tr>
<td>or NEUR 702</td>
<td>Research Methods</td>
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</tbody>
</table>

**Research Methodology**

**Core Neuroscience**

Select 12-13 credits from the following:

- NEUR 600 Chemistry and the Brain
- NEUR 601 Developmental Neuroscience
- NEUR 602 Cellular Neuroscience
- NEUR 603 Mammalian Neuroanatomy
- NEUR 604 Ethics in Scientific Research
  or BINF 705 Research Ethics
- NEUR 701 Neuroscience Laboratory

**Seminar**

Select 2 credits from the following:

- BIOL 695 Seminar in Molecular, Microbial, and Cellular Biology
- BIOS 704 Topics in Biosciences
- NEUR 709 Neuroscience Seminars

**Statistics**

Select 3-4 credits from the following:

- ECE 528 Introduction to Random Processes in Electrical and Computer Engineering
- PSYC 611 Advanced Statistics

**Total Credits:** 30

### MS with Concentration in Evolutionary Biology (EB)

<table>
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<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BIOL 690</td>
<td>Introduction to Graduate Studies in Biology</td>
<td>3-4</td>
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</tbody>
</table>

**Seminar**

Select 2 credits from the following:

- BIOL 692 Seminar in Biology
  or BIOL 695 Seminar in Molecular, Microbial, and Cellular Biology
- BIOL 692 Seminar in Biology
  & BIOL 695 Seminar in Molecular, Microbial, and Cellular Biology

**Core Courses**

Select at least two courses from the following:

- BIOL 574 Population Genetics
- BIOL 579 Molecular Evolution and Conservation Genetics
- BIOL 648 Population Ecology

**Organismal Biology**

Select 6-8 credits from the following suggestions in consultation with an advisor and/or committee and the program director:

- BIOL 501 Microbial Diversity: An Organismal Approach
- BIOL 507 Selected Topics in Ecology
- BIOL 508 Selected Topics in Animal Biology
- BIOL 518 Conservation Biology
- BIOL 532 Animal Behavior
- BIOL 533 Selected Topics in Plant Biology
BIOL 537 Ornithology
BIOL 538 Mammalogy
BIOL 539 Herpetology
BIOL 543 Tropical Ecosystems
BIOL 559 Fungi and Ecosystems
BIOL 566 Cancer Genomics
BIOL 572 Human Genetics
BIOL 581 Estuarine and Coastal Ecology
BIOL 582 Estuarine and Coastal Ecology Laboratory
BIOL 643 Microbial Ecology
EVPP 536 The Diversity of Fishes

Molecular Techniques 4-7
EVPP 615 Molecular Environmental Biology II
EVPP 515 Molecular Environmental Biology I

Research 1-6
Select one from the following:
BIOL 798 Master's Research Project
BIOL 799 Thesis (3-6 credits)

Electives 0-10
Select 0-10 credits of suggested courses from the following, but other courses are allowed if approved by an advisor and/or committee and the program director
BIOL 508 Selected Topics in Animal Biology
BIOL 518 Conservation Biology
BIOL 537 Ornithology
BIOL 538 Mammalogy
BIOL 539 Herpetology
BIOL 543 Tropical Ecosystems
BIOL 553 Advanced Topics in Immunology
BIOL 568 Advanced Topics in Molecular Genetics
BIOL 575 Selected Topics in Genetics
BIOL 572 Human Genetics
BIOL 579 Molecular Evolution and Conservation Genetics
BIOL 581 Estuarine and Coastal Ecology & BIOL 582 and Estuarine and Coastal Ecology Laboratory
BIOL 583 General Biochemistry
BIOL 585 Eukaryotic Cell Biology Laboratory
BIOL 666 Human Genetics Concepts for Health Care
BIOL 682 Advanced Eukaryotic Cell Biology
BIOL 793 Research in Biology
BIOS 701 Systems Biology
BIOS 740 Laboratory Methods in Functional Genomics and Biotechnology
BIOS 741 Genomics
BIOS 742 Biotechnology
BIOS 743 Genomics, Proteomics, and Bioinformatics
BIOS 744 Molecular Genetics
BIOS 762 Phylogenetic Analysis
BIOS 765 Molecular Systematics
BIOS 767 Molecular Evolution
EVPP 536 The Diversity of Fishes
EVPP 550 Waterscape Ecology and Management
EVPP 551 Fungi and Ecosystems
EVPP 555 Lab in Waterscape Ecology
EVPP 643 Microbial Ecology
EVPP 651 Multivariate Data Analysis for Ecology and Environmental Science

Total Credits: 30

1 Only required if not previously completed; this course is a prerequisite to EVPP 615.

MS with Concentration in Translational and Clinical Research (TCR)

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<tr>
<th>Code</th>
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<tbody>
<tr>
<td>BIOL 690</td>
<td>Introduction to Graduate Studies in Biology or BIOS 702 Research Methods</td>
<td>1-3</td>
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<tr>
<td>BIOL 695</td>
<td>Seminar in Molecular, Microbial, and Cellular Biology</td>
<td>2</td>
</tr>
<tr>
<td>BINF 704</td>
<td>Colloquium in Bioinformatics</td>
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<tr>
<td>BIOL 508</td>
<td>Selected Topics in Animal Biology (when the topic is research and development related to biotechnology)</td>
<td>3-4</td>
</tr>
<tr>
<td>BIOL 682</td>
<td>Advanced Eukaryotic Cell Biology</td>
<td>3</td>
</tr>
<tr>
<td>BINF 630</td>
<td>Bioinformatics Methods or STAT 535 Analysis of Experimental Data</td>
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<tr>
<td>BIOL 666</td>
<td>Human Genetics Concepts for Health Care</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 572</td>
<td>Human Genetics</td>
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<tr>
<td>BIOS 743</td>
<td>Genomics, Proteomics, and Bioinformatics</td>
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<tr>
<td>BIOS 741</td>
<td>Genomics</td>
<td></td>
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<tr>
<td>BIOS 742</td>
<td>Biotechnology</td>
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<td>BIOS 743</td>
<td>Genomics, Proteomics, and Bioinformatics</td>
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<td>BIOS 744</td>
<td>Molecular Genetics</td>
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<td>BIOS 745</td>
<td>Molecular Systematics</td>
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<tr>
<td>BIOS 765</td>
<td>Advanced Topics in Immunology</td>
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<tbody>
<tr>
<td>BIOL 666</td>
<td>Human Genetics Concepts for Health Care</td>
<td>3</td>
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<tr>
<td>BIOL 572</td>
<td>Human Genetics</td>
<td></td>
</tr>
<tr>
<td>BIOS 743</td>
<td>Genomics, Proteomics, and Bioinformatics</td>
<td></td>
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<tr>
<td>CHEM 563</td>
<td>General Biochemistry I</td>
<td></td>
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<tr>
<td>CHEM 660</td>
<td>Protein Biochemistry</td>
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<tr>
<td>BIOL 798</td>
<td>Master's Research Project</td>
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<tr>
<td>CHEM 798</td>
<td>Research Project</td>
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<tr>
<td>BIOL 799</td>
<td>Thesis (3-6 credits)</td>
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<tr>
<td>CHEM 799</td>
<td>Master's Thesis</td>
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<tr>
<td>BIOS 553</td>
<td>Advanced Topics in Immunology</td>
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</table>

Total Credits: 30
Biology, MS

BIOL 562  Personalized Medicine
BIOL 563  Virology
BIOL 566  Cancer Genomics
BIOL 568  Advanced Topics in Molecular Genetics
BIOL 669  Pathogenic Microbiology
BIOL 715  Microbial Physiology
BIOS 741  Genomics
BIOS 742  Biotechnology
BIOS 743  Genomics, Proteomics, and Bioinformatics
BIOS 744  Molecular Genetics
CHEM 567  The Chemistry of Enzyme-Catalyzed Reactions
CHEM 579  Special Topics
CHEM 624  Principles of Chemical Separation
CHEM 660  Protein Biochemistry
CHEM 661  Antibiotic Chemistry and Resistance
CHEM 662  Modern Methods of Drug Discovery
CHEM 665  Protein-Protein Interactions: Methods and Applications
CHEM 796  Directed Reading and Research

Total Credits: 30

Curriculum Notes

• For students concurrently enrolled in the Advanced Biomedical Sciences Graduate Certificate, contact your advisor for details regarding:
  • BMED course credit that may be counted towards this concentration
  • Meeting requirements for graduate certificates and requirements for master's degrees

Accelerated Master's

Biology, BS/Biology, Accelerated MS

Overview

Qualified undergraduates may be admitted into an accelerated master’s program and obtain both a Biology, BS and a Biology, MS within an accelerated time frame. Students admitted to this program may take graduate courses after completing 90 undergraduate credits, and up to 6 credits of graduate work may be used in partial satisfaction of the requirements for the undergraduate degree. If students earn at least a 3.00 GPA in these classes, they are granted advanced standing in the master’s program and must then complete an additional 24 credits to receive the master’s degree. All other master’s degree requirements must be met, including a minimum of 18 credits taken for the master’s after the bachelor’s degree is complete.

For more detailed information, see AP.6.7 Bachelor’s/Accelerated Master’s Degrees. For policies governing all graduate programs, see AP6 Graduate Policies.

Application Requirements

Applicants to all graduate programs at George Mason University must meet the admission standards and application requirements for graduate study as specified in the Graduate Admission Policies section of this catalog. Application information for this accelerated master’s program can be found on the School of Systems Biology’s website (http://ssb.gmu.edu/admissions).

Successful applicants will have an overall undergraduate GPA of at least 3.20. Additionally, they will have completed the following courses with a GPA of 3.00 or higher:

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<tbody>
<tr>
<td>BIOL 213</td>
<td>Cell Structure and Function (Mason Core)</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 214</td>
<td>Biostatistics for Biology Majors</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 308</td>
<td>Foundations of Ecology and Evolution</td>
<td>5</td>
</tr>
<tr>
<td>BIOL 310</td>
<td>Biodiversity</td>
<td>3</td>
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<td>BIOL 311</td>
<td>General Genetics</td>
<td>4</td>
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<tr>
<td>CHEM 313</td>
<td>Organic Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 315</td>
<td>Organic Chemistry Lab I</td>
<td>2</td>
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Three letters of recommendation, including one from a prospective thesis or project advisor, are required.

Accelerated Option Requirements

At the beginning of the student’s final undergraduate semester, students must submit a bachelor’s/accelerated master’s transition form (available from the Office of the University Registrar (http://registrar.gmu.edu)) to the College of Science’s Office of Academic and Student Affairs (https://cos.gmu.edu/about/contact-us). Students must begin their master’s program in the semester immediately following conferral of the bachelor’s degree.

Students must maintain an overall GPA of 3.00 or higher in graduate coursework and should consult with their faculty advisor to coordinate their academic goals.

After completing 120 credits and all requirements for the bachelor’s degree and filing the Graduation Intent Form, students are awarded a bachelor’s degree. Accelerated master’s students must then submit scores on the GRE to have the provisional qualifier removed. Ordinarily, students should receive a minimum combined score of 303 on the verbal and quantitative portions of the general test.

Reserve Graduate Credit

While still in undergraduate status, a maximum of 6 additional graduate credits may be taken as reserve graduate credit and applied to the master’s program. Reserve graduate credits do not apply to the undergraduate degree.