INTEGRATED AND APPLIED SCIENCES, PH.D.

The Integrated and Applied Sciences (IAS) doctoral program was established to broaden student exposure to all areas of science, encourage collaboration across departments and colleges, and better train graduate students to present their research to a more diverse audience. This interdisciplinary program is large enough to provide students with broad exposure to collaborative scientific projects, yet small enough for students to have one-on-one interaction with their faculty mentor. This personalized approach is necessary for developing the communication skills that will enhance employment opportunities for students and, in keeping with SLU’s Jesuit tradition, endow them with tools to better contribute to society.

Leadership
Vasit Sagan, Ph.D.
Program Director

Curriculum Overview
The Doctor of Philosophy (Ph.D.) program in integrated and applied sciences (IAS) utilizes interdisciplinary approaches and collaboration within the fields to prepare graduates to confidently assume multifaceted roles in the changing scientific community. Students specialize in a concentration depending on their primary mentor’s research area. Concentrations include: Biology, Chemistry, Physics and Environmental Science and GIS

The distribution of courses in the various IAS areas is determined by the student’s dissertation committee with a minimum total of 30 credits between all three areas. A total of 42 credits are required with the remaining 12 credits coming from dissertation credits. An appropriate coursework track is developed by the student and their mentor with subsequent approval by the IAS administrative committee. A typical coursework structure includes:

- Participating departmental core courses (9–12 credits)
- Interdisciplinary credits (18–21 credits)
- Dissertation credits (12 credits)

Biology Concentration
This concentration is geared toward biological research with bioinformatics or integrated geospatial biology. Required core courses may be taken in the Biology Department.

Chemistry Concentration
This concentration is for students interested in chemical research with substantial overlap with other biological or physical science and engineering disciplines.

Environmental Sciences and GIS Concentration
This concentration is for students interested in the application of geographic information systems (GIS) in the field of environmental sciences. Required course are taken in the Earth and Atmospheric Sciences Department as well as the GIS program.

Physics Concentration
This concentration is geared toward students interested in the physics of solid-state and nanomaterials.

Fieldwork and Research Opportunities
This research-intensive doctoral program will train students for careers in pharmaceutical and biochemical industries, as well as in academia. The program’s scientific training takes place in an interdisciplinary environment with biology, biomedical science, chemistry, earth and atmospheric science, engineering, and physics faculty.

Careers
This doctoral program trains scientists for careers in academia as well as chemical, biological, environmental and geospatial science industries and prepares them to collaborate with other professionals. Scientific training takes place in an interdisciplinary environment with faculty from science departments in the College of Arts and Sciences.

Admission Requirements
The integrated and applied sciences administrative committee will ensure that the applicant possesses a minimum of a baccalaureate degree from an accredited, recognized college or university in a discipline relevant to the research of the integrated and applied sciences faculty mentor.

Application Requirements
- Application form and fee
- Transcript(s)
- Three letters of recommendation
- Curriculum vitae
- Professional goals statement

Requirements for International Students
All admission policies and requirements for domestic students apply to international students along with the following:

- Demonstrate English Language Proficiency (http://catalog.slu.edu/academic-policies/office-admission/undergraduate/english-language-proficiency)
- Proof of financial support must include:
  - A letter of financial support from the person(s) or sponsoring agency funding the time at Saint Louis University
  - A letter from the sponsor’s bank verifying that the funds are available and will be so for the duration of study at the University
- Academic records, in English translation, of students who have undertaken postsecondary studies outside the United States must include the courses taken and/or lectures attended, practical laboratory work, the maximum and minimum grades attainable, the grades earned or the results of all end-of-term examinations, and any honors or degrees received. WES and ECE transcripts are accepted.

Review Process
The integrated and applied sciences administrative committee will ensure that the applicant’s previous academic record indicates the ability needed to pursue advanced studies. The committee will then make an admissions recommendation to the graduate admissions department, which is responsible for making the final decision and communicating that decision to both the integrated and applied sciences program director and the applicant.
Scholarships, Assistantships and Financial Aid

For priority consideration for graduate assistantships and tuition scholarships, applicants should complete their applications by the program admission deadlines listed. Fellowships and assistantships provide a stipend and health insurance for the duration of the award.

For more information, visit the student financial services office online at http://www.slu.edu/financial-aid.

Learning Outcomes

1. Graduates will be able to use scientific principles underpinning the primary scientific discipline in which their concentration is based and by applying basic research methodology, demonstrate their application to their particular field of interest (chemistry, biology, physics, environmental science, sustainability science).
2. Graduates will be able to demonstrate advanced creativity in scientific research methodology in their concentration and appropriately use techniques in a laboratory and/or field setting – including experimental, theoretical, and computational methods.
3. Graduates will be able to integrate methods, theories, paradigms, concepts etc. from more than one discipline.
4. Graduates will be able to demonstrate an ability to communicate (oral and written) results and conclusions from their research, describe techniques and methodology used, and apply their experiences in the greater world in which we live.

Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tr>
<td>IAS 6010</td>
<td>Interdisciplinary Seminar (taken over multiple semesters)</td>
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<tr>
<td>IAS 6030</td>
<td>Interdisciplinary Research (taken over multiple semesters)</td>
<td>8</td>
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Concentration Courses
Select one of the following concentrations: † 18
- Biology Concentration (p. 2)
- Chemistry Concentration (p. 2)
- Environmental Sciences and GIS Concentration (p. 3)
- Physics Concentration (p. 3)

Dissertation Research

<table>
<thead>
<tr>
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<th>Title</th>
<th>Credits</th>
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<tr>
<td>HIST 6990</td>
<td>Dissertation Research (taken over multiple semesters)</td>
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Total Credits 42

† Concentration Core Department (9-12 credits), Concentration Interdisciplinary credits (6–9 credits)

Non-Course Requirements

Assuming successful completion of oral and written comprehensive exams, students should complete the Ph.D. program in four to five years. Students entering the program with an appropriate M.S. degree may complete the program in less time, again assuming successful completion of oral and written comprehensive exams.

Continuation Standards

Students must maintain a cumulative grade point average (GPA) of 3.00 in all graduate/professional courses.

Biology Concentration

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<td>BON 5060</td>
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<td>BON 5070</td>
<td>Advanced Biological Chemistry</td>
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<td>BON 5100</td>
<td>Cellular and Molecular Genetic</td>
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<td>BON 5120</td>
<td>Signal Transduction</td>
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<td>BON 5190</td>
<td>Geographic Information Systems in Biology</td>
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</tr>
<tr>
<td>BON 5300</td>
<td>Problems in Vertebrate Physiology</td>
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</tr>
<tr>
<td>BON 5340</td>
<td>Problems in Cell Biology</td>
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<tr>
<td>BON 5350</td>
<td>Current Topics in Cell Biology</td>
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<tr>
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<td>Problems in Genetics</td>
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<tr>
<td>BON 5410</td>
<td>Ecological Genetics</td>
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<td>Problems in Evolutionary Biology</td>
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<td>BON 5450</td>
<td>Biogeography</td>
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<tr>
<td>BON 5460</td>
<td>Exercise Physiology</td>
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<tr>
<td>BON 5480</td>
<td>Conservation Biology</td>
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<tr>
<td>BON 5500</td>
<td>Problems in Ecology</td>
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<tr>
<td>BON 5550</td>
<td>Advanced Ecology</td>
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<tr>
<td>BON 5600</td>
<td>Developmental Genetics</td>
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<tr>
<td>BON 5670</td>
<td>Advanced Population Biology</td>
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<td>BON 5700</td>
<td>Advanced Molecular Biology</td>
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<tr>
<td>BON 5770</td>
<td>Coevolution</td>
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<tr>
<td>BON 5840</td>
<td>Graduate Seminar in Ecology, Evolution and Systematics</td>
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<td>BON 6040</td>
<td>Current Topics in Developmental Biology</td>
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<td>BON 6150</td>
<td>Neural Basis of Behavior</td>
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<td>BON 6510</td>
<td>Plant-Water Relationships</td>
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<td>BON 5820</td>
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Chemistry Concentration

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<td>CHEM 5150</td>
<td>Statistical Methods of Physical Scientists</td>
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<td>CHEM 5160</td>
<td>Advanced Synthetic Chemistry</td>
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<tr>
<td>CHEM 5170</td>
<td>Advances in Analysis and Modeling of Chemical Systems</td>
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<tr>
<td>CHEM 5200</td>
<td>Analytical Chemistry II</td>
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Dissertation Research
Select two to three courses from Earth & Atmospheric Sciences, Engineering, Physics, Mathematics, Chemistry, Biomedical Engineering, or Biomedical Sciences, Center for Sustainability, or GIS courses 6-9

Total Credits 15-21
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<tr>
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<td>CHEM 5205</td>
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<td>CHEM 5250</td>
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<td>CHEM 5260</td>
<td>Analytical Separations</td>
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<td>CHEM 5270</td>
<td>Electroanalytical Chemistry</td>
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<td>Mathematical Techniques in Chemistry</td>
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<td>CHEM 5330</td>
<td>Advanced Physical Chemistry</td>
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<td>CHEM 5340</td>
<td>Advanced Thermodynamics</td>
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<tr>
<td>CHEM 5350</td>
<td>Elements of Surface/Colloid Science</td>
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<td>CHEM 5370</td>
<td>Computational Chemistry</td>
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<td>CHEM 5390</td>
<td>Special Topics: Physical Chemistry</td>
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<td>CHEM 5400</td>
<td>Organic Spectroscopy</td>
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<td>Bioorganic Chemistry</td>
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<tr>
<td>CHEM 5450</td>
<td>Advanced Organic Chemistry</td>
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<td>Synthetic Organic Chemistry</td>
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<tr>
<td>CHEM 5470</td>
<td>Principles of Medicinal Chemistry</td>
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<td>Heterocyclic Chemistry</td>
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<td>CHEM 5500</td>
<td>Inorganic Chemistry</td>
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<td>Organometallic Chemistry</td>
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<td>CHEM 5560</td>
<td>Solid State Chemistry</td>
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<td>CHEM 5570</td>
<td>Group Theory &amp; Spectroscopy</td>
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<td>Special Topics: Inorganic Chemistry</td>
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<td>Environmental Chemistry</td>
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<td>Fundamentals and Design of Nanomaterials</td>
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<td>Polymer Chemistry</td>
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<td>CHEM 5299</td>
<td>Introduction to Analytical Research</td>
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<td>or CHEM 5399</td>
<td>Introduction to Physical Research</td>
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<td>or CHEM 5499</td>
<td>Introduction to Organic Research</td>
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<tr>
<td>or CHEM 5599</td>
<td>Introduction to Inorganic Research</td>
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**Concentration Interdisciplinary Course**

Select two to three of the following: 6-9

- BIOL 4680 Landscape Ecology
- BIOL 5190 Geographic Information Systems in Biology
- BIOL 5480 Conservation Biology
- BIOL 5500 Problems in Ecology
- CHEM 5700 Environmental Chemistry
- SOC 5205 Science, Technology & Policy
- BSDP 5101 Fundamentals of Disaster Planning
- EOH 5970 Research Topics in Environmental and Occupational Health
- EAS 5340 Cloud Physics

**Total Credits** 15-21

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**Environmental Sciences and GIS Concentration**

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<tr>
<td>EAS 4410</td>
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<tr>
<td>EAS 4500</td>
<td>Scientific Communications</td>
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<tr>
<td>EAS 5190</td>
<td>Seminar in Geoscience</td>
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<tr>
<td>EAS 5900</td>
<td>Geoscience Journal Club</td>
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<tr>
<td>EAS 5170</td>
<td>Divergent &amp; Convergent Margins</td>
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<tr>
<td>EAS 5180</td>
<td>Trans Margins &amp; Plate Interior</td>
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<tr>
<td>EAS 5600</td>
<td>Atmospheric Chemistry</td>
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<tr>
<td>GIS 5010</td>
<td>Introduction to Geographic Information Systems</td>
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<tr>
<td>GIS 5020</td>
<td>Intermediate Geographic Information Systems</td>
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<tr>
<td>GIS 5040</td>
<td>Introduction to Remote Sensing</td>
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<tr>
<td>GIS 5060</td>
<td>Geospatial Methods in Environmental Studies</td>
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<tr>
<td>GIS 5070</td>
<td>Research Methods</td>
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</tr>
<tr>
<td>GIS 5080</td>
<td>Digital Cartography and Geovisualization</td>
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<tr>
<td>GIS 5090</td>
<td>Programming for Remote Sensing/Geographic Information Systems</td>
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<td>GIS 5091</td>
<td>Advanced Programming for GIS and Remote Sensing</td>
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<td>GIS 5100</td>
<td>Microwave Remote Sensing: SAR Principles, Data Processing and Applications</td>
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<td>GIS 5110</td>
<td>Interferometric Synthetic Aperture Radar</td>
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<tr>
<td>GIS 5092</td>
<td>Machine Learning for GIS and Remote Sensing</td>
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<td>GIS 5120</td>
<td>Geographic Information Science, Society and Sustainability</td>
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<tr>
<td>GIS 5970</td>
<td>Research Topics</td>
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**Concentration Interdisciplinary Course**

Select two to three of the following: 6-9

- BIOL 4680 Landscape Ecology
- BIOL 5190 Geographic Information Systems in Biology
- BIOL 5480 Conservation Biology
- BIOL 5500 Problems in Ecology
- CHEM 5700 Environmental Chemistry
- SOC 5205 Science, Technology & Policy
- BSDP 5101 Fundamentals of Disaster Planning
- EOH 5970 Research Topics in Environmental and Occupational Health
- EAS 5340 Cloud Physics

**Total Credits** 15-21

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**Physics Concentration**

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<td>PHYS 5010</td>
<td>Nanoscience and Nanofabrication Frontiers</td>
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<tr>
<td>PHYS 5020</td>
<td>Experimental Physics</td>
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<tr>
<td>PHYS 5030</td>
<td>Mathematical Methods in Physics</td>
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**Concentration Core Department**

9

- PHYS 5010 Nanoscience and Nanofabrication Frontiers
- PHYS 5020 Experimental Physics
- PHYS 5030 Mathematical Methods in Physics

**Concentration Interdisciplinary Course**

Select two to three of the following: 6-9

- CHEM 5570 Group Theory & Spectroscopy
- CHEM 5340 Advanced Thermodynamics
- CHEM 5370 Computational Chemistry
- CHEM 5800 Fundamentals and Design of Nanomaterials
- CHEM 5560 Solid State Chemistry
- ECE 5131 Low Noise Electronics Design
- ECE 5132 Analog Integrated Circuit Design
- ECE 5142 Microwave Theory & Techniques
- ECE 5143 Antenna Theory and Design
- ECE 5150 Filter Design

**Total Credits** 15-21
**ECE 5235**  Digital IC Design

**Total Credits**  15-18

### Roadmap

Roadmaps are recommended semester-by-semester plans of study for programs and assume full-time enrollment unless otherwise noted.

Courses and milestones designated as critical (marked with !) must be completed in the semester listed to ensure a timely graduation. Transfer credit may change the roadmap.

This roadmap should not be used in the place of regular academic advising appointments. All students are encouraged to meet with their advisor/mentor each semester. Requirements, course availability and sequencing are subject to change.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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<td><strong>Year One</strong></td>
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<tr>
<td><strong>Fall</strong></td>
<td>Core Course</td>
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<td><strong>Spring</strong></td>
<td>Core Course</td>
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<td>Credits</td>
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<td><strong>Summer</strong></td>
<td>Core or Interdisciplinary Course</td>
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<td>Credits</td>
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<td><strong>Year Two</strong></td>
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<td><strong>Fall</strong></td>
<td>Core or Interdisciplinary Course</td>
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<td></td>
<td>Credits</td>
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<td><strong>Spring</strong></td>
<td>Core or Interdisciplinary Course</td>
<td>3</td>
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<tr>
<td></td>
<td>Credits</td>
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<tr>
<td><strong>Summer</strong></td>
<td>Core or Interdisciplinary Course</td>
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<td>Credits</td>
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<tr>
<td><strong>Year Three</strong></td>
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<td><strong>Summer</strong></td>
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<td><strong>Year Four</strong></td>
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**Program Notes**

- Core Courses are defined as lecture or lab course offered in concentration home department.
- Interdisciplinary Courses are defined as lecture or lab course offered outside of concentration home department.