

# MECHANICAL ENGINEERING

**Home Department:** Mechanical Engineering

**Department Head:**

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## Program Overview

The Bachelor of Science in Mechanical Engineering (ME) prepares students for a broad range of careers associated with the design and implementation of mechanical systems involving the conversion, transmission, and utilization of energy. Mechanical engineering courses that provide breadth in the discipline include design, dynamics, engineering materials, thermodynamics, fluid mechanics, heat transfer, vibrations, systems analysis, and associated laboratories. Large and well-equipped laboratories in experimental mechanics, heat transfer, fluid mechanics, engines, vibrations, hydraulics, instrumentation, and automotive emissions support the mechanical engineering program.

Mechanical Engineering students may elect to customize their degree by taking a set of elective courses in a specific area; either by pursuing a concentration within the Mechanical Engineering program or by pursuing a Minor with non-Mechanical Engineering programs. For more details see Mechanical Engineering Program Concentrations (p. 3) or Minors.

The Mechanical Engineering program is accredited by the Engineering Accreditation Commission (EAC) of ABET.

## Program Educational Objectives

With their Kettering education as a foundation, within a few years of graduation, graduates will attain:

- A reputation for working effectively and ethically in diverse professional environments.
- Leadership in their profession while actively pursuing lifelong learning and contributing to progress within their field.
- The ability to practice responsible decision making and apply best practices to their professional endeavors.

## BS/MASTERS PATHWAY

Undergraduate students also have an opportunity to get their bachelor's and master's degrees in five years with the BS/MASTERS Pathway.

## Program Curriculum Requirements

| Code                                       | Title  | Credit Hours |
|--|--|--------------|
| <b>First Year Experience</b>               |  |              |
| CILE-101                                   | First Year Foundations                           | 1            |
| <b>General Education</b>                   |  |              |
| COMM-101                                   | Rhetoric & Writing                               | 4            |
| ECON-201                                   | Economic Principles                              | 4            |
| LA-201                                     | Sophomore Seminar: Exploring the Human Condition | 4            |
| LA-489                                     | Sr. Seminar: Leadership, Ethics                  | 4            |
| Advanced Humanities Electives <sup>1</sup> |  | 8            |

|  |           |
|--|-----------|
| Advanced Social Science Electives <sup>1</sup> | 8         |
| <b>Total Credit Hours</b>                      | <b>33</b> |

<sup>1</sup> Humanities and Social Science advanced electives must be selected from approved 300 and 400 level courses.

| Code                                 | Title   | Credit Hours |
|--------------------------------------|---|--------------|
| <b>Mathematics and Basic Science</b> |   |              |
| CHEM-135 & CHEM-136                  | Principles of Chemistry and Principles of Chemistry Lab                         | 4            |
| MATH-101 or MATH-101X                | Calculus I  | 4            |
| MATH-102 or MATH-102H or MATH-102X   | Calculus II   | 4            |
| MATH-203 or MATH-203H or MATH-203X   | Multivariate Calculus   | 4            |
| MATH-204 or MATH-204H                | Differential Equations & Laplace Transforms                                     | 4            |
| MATH-258                             | Probability and Statistics  | 4            |
| MATH-305                             | Numerical Methods and Matrices  | 4            |
| PHYS-114 & PHYS-115                  | Newtonian Mechanics and Newtonian Mechanics Laboratory                          | 4            |
| PHYS-224 & PHYS-225                  | Electricity and Magnetism and Electricity and Magnetism Laboratory              | 4            |
| Math/Science Elective <sup>1</sup>   |   | 4            |
| <i>Credit Hours Subtotal:</i>        |   | <b>40</b>    |
| <b>Engineering Topics</b>            |   |              |
| EE-212 & MECH-231L                   | Applied Electrical Circuits and Signals for Mechanical Systems Lab <sup>2</sup> | 4            |
| IME-100                              | Interdisciplinary Design and Manufacturing                                      | 4            |
| MECH-100                             | Engineering Graphical Communication   | 4            |
| MECH-210                             | Statics   | 4            |
| MECH-212                             | Mechanics of Materials  | 4            |
| MECH-300                             | Computer Aided Engineering  | 4            |
| MECH-307                             | Materials Engineering   | 4            |
| MECH-310                             | Dynamics  | 4            |
| MECH-311                             | Introduction to Mechanical System Design  | 4            |
| MECH-312                             | Mechanical Component Design I   | 4            |
| MECH-320                             | Thermodynamics  | 4            |
| MECH-322                             | Fluid Mechanics   | 4            |
| MECH-330 & MECH-331                  | Dynamic Systems with Vibrations and Dynamic Sys w Vibrations Lab                | 4            |
| MECH-420                             | Heat Transfer   | 4            |
| MECH-422                             | Energy Systems Laboratory   | 4            |

|   |   |            |
|---|---|------------|
| MECH-430<br>& MECH-431                            | Dynamic Systems with Controls<br>and Dynamic Systems with Controls<br>Lab | 4          |
| <i>Credit Hours Subtotal:</i>                     |   | 64         |
| <b>Electives</b>                                  |   |            |
| Two Free Electives <sup>3</sup>                   |   | 8          |
| Two Mechanical Engineering Electives <sup>4</sup> |   | 8          |
| Mechanical Engineering Senior Design Project      |   | 4          |
| <i>Credit Hours Subtotal:</i>                     |   | 20         |
| <b>Culminating Undergraduate Experience</b>       |   |            |
| CILE-400  | Culminating Undergraduate Experience:<br>Thesis <sup>5</sup>              | 4          |
| <b>Total Credit Hours</b>                         |   | <b>128</b> |

**(Minimum) Total Credits Required for the Program: 161**

<sup>1</sup> Math/Science elective is described as: Any level BIOL, CHEM, MATH or PHYS that is not used to complete core degree requirements.

<sup>2</sup> Students pursuing an Electrical Engineering minor take EE-210/EE-211 in lieu of MECH-231L/EE-212.

<sup>3</sup> Free electives are described as: Any Kettering University course except any course that consists of an elementary nature when advanced topics have been mastered, and any course that consists of topics, which are very similar to topics which have been mastered.

<sup>4</sup> ME electives are described as: Any 300-599 level BIOL, CE, CHEM, CHME, CS, ECE, EE, EP, IME, ISYS, MATH (except pre-calc and college math), MECH, or PHYS that is not used to complete core degree requirements. In addition, BUSN-303, BUSN-304 and MGMT-419 also qualify as M.E. Electives.

<sup>5</sup> Students are automatically registered for CILE-400 in a co-op term when they reach Junior II status.

## Mechanical Engineering Concentrations

Students majoring in Mechanical Engineering may select a concentration consisting of 20 credit hours of courses focused in a particular area. Concentrations may include both required and elective courses. The first six terms are common to all Mechanical Engineering students. Senior I through Senior III representative programs are given for each concentration.

A Mechanical Engineering concentration provides students a depth of study in preparation for a career within an industrial sector and/or as a foundation for graduate study. However, the student's degree is Mechanical Engineering and the selected concentration does not prevent students from working within any industry. The primary advantage is to provide a "jump start" over mechanical engineering graduates from other schools with traditional degree programs. Courses are subject to cancellation due to low enrollment.

### Alternative Energy Concentration

| Code     | Title                             | Credit Hours |
|----------|-----------------------------------|--------------|
| MECH-495 | Senior Design Project             | 4            |
| MECH-426 | Fuel Cell Science and Engineering | 4            |
| MECH-427 | Energy and the Environment        | 4            |
| MECH-428 | Bio and Renewable Energy          | 4            |

|                               |                                    |    |
|-------------------------------|------------------------------------|----|
| MECH-445                      | Hybrid Electric Vehicle Propulsion | 4  |
| <i>Credit Hours Subtotal:</i> |                                    | 20 |

### Automotive Engineering Design Concentration

| Code  | Title  | Credit Hours |
|---|--|--------------|
| MECH-448  | Vehicle Design Project   | 4            |
| Select four of the following:                             |  | 16           |
| MECH-416  | Introduction to Finite Element Analysis with Structural Applications |              |
| MECH-426  | Fuel Cell Science and Engineering                                    |              |
| MECH-440  | Introduction to Internal Combustion Engines                          |              |
| MECH-441  | Advanced Automotive Power Systems                                    |              |
| MECH-442  | Chassis Systems  |              |
| MECH-444  | Introduction to Automotive Powertrains                               |              |
| MECH-445  | Hybrid Electric Vehicle Propulsion                                   |              |
| MECH-446  | Vehicle Systems Dynamics   |              |
| MECH-450  | Automotive Bioengineering: Occupant Protection and Safety            |              |
| MECH-451  | Vehicular Crash Dynamics and Accident Reconstruction                 |              |
| <i>Credit Hours Subtotal:</i>                             |  | 20           |
| Other courses with the approval of the automotive faculty |  |              |

### Bioengineering Applications Concentration

| Code                           | Title   | Credit Hours |
|--------------------------------|---|--------------|
| <b>Required Courses</b>        |   |              |
| MECH-350                       | Introduction to Bioengineering Applications               | 4            |
| MECH-495                       | Senior Design Project                                     | 4            |
| <b>Electives</b>               |   |              |
| Select three of the following: |   | 12           |
| BIOL-141<br>& BIOL-142         | General Biology and General Biology Lab                   |              |
| BIOL-241<br>& BIOL-242         | Human Biology and Human Biology Lab                       |              |
| BIOL-341                       | Anatomy and Physiology                                    |              |
| MECH-450                       | Automotive Bioengineering: Occupant Protection and Safety |              |
| MECH-451                       | Vehicular Crash Dynamics and Accident Reconstruction      |              |
| PHYS-354                       | Medical Physics Principles                                |              |
| <i>Credit Hours Subtotal:</i>  |   | 20           |

### Machine Design & Advanced Materials Concentration

| Code     | Title   | Credit Hours |
|----------|---|--------------|
| MECH-416 | Introduction to Finite Element Analysis with Structural Applications    | 4            |
| MECH-482 | Mechanics and Design Simulation of Fiber-Reinforced Composite Materials | 4            |

|  |                       |   |
|--|-----------------------|---|
| MECH-495                                 | Senior Design Project | 4 |
| Two MDAM Concentration Related Electives |                       | 8 |

| Course | Title | Credit Hours |
|--------|-------|--------------|
|--------|-------|--------------|

**Freshman I**

|          |  |   |
|----------|--|---|
| CILE-101 | First Year Foundations                           | 1 |
| CHEM-135 | Principles of Chemistry                          | 3 |
| CHEM-136 | Principles of Chemistry Lab                      | 1 |
| COMM-101 | Rhetoric & Writing                               | 4 |
| MATH-101 | Calculus I                                       | 4 |
| MECH-100 | Engineering Graphical Communication <sup>1</sup> | 4 |

|                     |           |
|---------------------|-----------|
| <b>Credit Hours</b> | <b>17</b> |
|---------------------|-----------|

**Freshman II**

|          |   |   |
|----------|---|---|
| IME-100  | Interdisciplinary Design and Manufacturing <sup>1</sup> | 4 |
| LS-201   | Sophomore Seminar: Exploring the Human Condition        | 4 |
| MATH-102 | Calculus II   | 4 |
| PHYS-114 | Newtonian Mechanics                                     | 3 |
| PHYS-115 | Newtonian Mechanics Laboratory                          | 1 |

|                     |           |
|---------------------|-----------|
| <b>Credit Hours</b> | <b>16</b> |
|---------------------|-----------|

**Sophomore I**

|          |                                      |   |
|----------|--------------------------------------|---|
| ECON-201 | Economic Principles                  | 4 |
| MATH-203 | Multivariate Calculus                | 4 |
| MECH-210 | Statics                              | 4 |
| PHYS-224 | Electricity and Magnetism            | 3 |
| PHYS-225 | Electricity and Magnetism Laboratory | 1 |

|                     |           |
|---------------------|-----------|
| <b>Credit Hours</b> | <b>16</b> |
|---------------------|-----------|

**Sophomore II**

|                                    |   |   |
|------------------------------------|---|---|
| EE-212                             | Applied Electrical Circuits                 | 3 |
| MECH-231L                          | Signals for Mechanical Systems Lab          | 1 |
| MATH-204                           | Differential Equations & Laplace Transforms | 4 |
| MECH-212                           | Mechanics of Materials                      | 4 |
| Math/Science Elective <sup>3</sup> |   | 4 |

|                     |           |
|---------------------|-----------|
| <b>Credit Hours</b> | <b>16</b> |
|---------------------|-----------|

**Junior I**

|  |  |   |
|--|--|---|
| MATH-305                                       | Numerical Methods and Matrices           | 4 |
| MECH-307                                       | Materials Engineering                    | 4 |
| MECH-311                                       | Introduction to Mechanical System Design | 4 |
| MECH-312                                       | Mechanical Component Design I            | 4 |
| Advanced Humanities or Social Science Elective |  | 4 |

|                     |           |
|---------------------|-----------|
| <b>Credit Hours</b> | <b>20</b> |
|---------------------|-----------|

**Junior II**

|  |   |   |
|--|---|---|
| MATH-258                                       | Probability and Statistics              | 4 |
| MECH-300                                       | Computer Aided Engineering <sup>2</sup> | 4 |
| MECH-310                                       | Dynamics                                | 4 |
| MECH-320                                       | Thermodynamics                          | 4 |
| Advanced Humanities or Social Science Elective |   | 4 |

|                     |           |
|---------------------|-----------|
| <b>Credit Hours</b> | <b>20</b> |
|---------------------|-----------|

**Senior I**

|  |  |   |
|--|--|---|
| MECH-322                                       | Fluid Mechanics  | 4 |
| MECH-330 & MECH-331                            | Dynamic Systems with Vibrations and Dynamic Sys w Vibrations Lab | 4 |
| Advanced Humanities or Social Science Elective |  | 4 |
| Free Elective                                  |  | 4 |
| ME Elective <sup>3</sup>                       |  | 4 |

|                     |           |
|---------------------|-----------|
| <b>Credit Hours</b> | <b>20</b> |
|---------------------|-----------|

**Senior II**

|                     |   |   |
|---------------------|---|---|
| LS-489              | Senior Seminar: Leadership, Ethics, and Contemporary Issues         | 4 |
| MECH-420            | Heat Transfer   | 4 |
| MECH-430 & MECH-431 | Dynamic Systems with Controls and Dynamic Systems with Controls Lab | 4 |

|                          |  |   |
|--------------------------|--|---|
| ME Elective <sup>3</sup> |  | 4 |
|--------------------------|--|---|

|                     |           |
|---------------------|-----------|
| <b>Credit Hours</b> | <b>16</b> |
|---------------------|-----------|

**Senior III**

|  |                           |   |
|--|---------------------------|---|
| MECH-422                                       | Energy Systems Laboratory | 4 |
| Advanced Humanities or Social Science Elective |                           | 4 |
| Free Elective                                  |                           | 4 |
| ME Senior Design Project <sup>4</sup>          |                           | 4 |

|                     |           |
|---------------------|-----------|
| <b>Credit Hours</b> | <b>16</b> |
|---------------------|-----------|

**Any Term**

|          |   |   |
|----------|---|---|
| CILE-400 | Culminating Undergraduate Experience: Thesis <sup>5</sup> | 4 |
|----------|---|---|

|                     |          |
|---------------------|----------|
| <b>Credit Hours</b> | <b>4</b> |
|---------------------|----------|

|                           |            |
|---------------------------|------------|
| <b>Total Credit Hours</b> | <b>161</b> |
|---------------------------|------------|

<sup>1</sup> Approximately one-half of the students take MECH-100 Freshman I and IME-100 Freshman II, the other one-half take IME-100 Freshman I and MECH-100 Freshman II.

<sup>2</sup> Approximately one-half of students take MECH-300 Junior II and MECH-311 Junior I, the other one-half take MECH-311 Junior II and MECH-300 Senior I.

<sup>3</sup> Elective courses may vary in lecture and/or laboratory credits and terms from those shown. Math/Science electives are any level MATH, BIOL, CHEM, or PHYS course that is not used to complete core degree requirements.

<sup>4</sup> ME Senior Design Projects may vary in lecture and/or laboratory credits and terms from those shown.

<sup>5</sup> Students are automatically registered for CILE-400 in a co-op term when they reach Junior II status.

## Bachelor of Science in Mechanical Engineering Curriculum by Concentration Alternative Energy Concentration

Freshman I through Junior II Representative Program Credit Total: 105

| Course | Title | Credit Hours |
|--------|-------|--------------|
|--------|-------|--------------|

**Senior I**

|                     |  |   |
|---------------------|--|---|
| MECH-322            | Fluid Mechanics  | 4 |
| MECH-330 & MECH-331 | Dynamic Systems with Vibrations and Dynamic Sys w Vibrations Lab | 4 |

|  |   |           |
|--|---|-----------|
| MECH-427                                       | Energy and the Environment  | 4         |
| Advanced Humanities or Social Science Elective |   | 4         |
| <b>Credit Hours</b>                            |   | <b>16</b> |
| <b>Senior II</b>                               |   |           |
| LS-489   | Senior Seminar: Leadership, Ethics, and Contemporary Issues         | 4         |
| MECH-420                                       | Heat Transfer   | 4         |
| MECH-430 & MECH-431                            | Dynamic Systems with Controls and Dynamic Systems with Controls Lab | 4         |
| MECH-428                                       | Bio and Renewable Energy  | 4         |
| MECH-445                                       | Hybrid Electric Vehicle Propulsion                                  | 4         |
| <b>Credit Hours</b>                            |   | <b>20</b> |
| <b>Senior III</b>                              |   |           |
| MECH-422                                       | Energy Systems Laboratory   | 4         |
| MECH-426                                       | Fuel Cell Science and Engineering                                   | 4         |
| MECH-495                                       | Senior Design Project   | 4         |
| Advanced Humanities or Social Science Elective |   | 4         |
| <b>Credit Hours</b>                            |   | <b>16</b> |
| <b>Any Term</b>                                |   |           |
| CILE-400                                       | Culminating Undergraduate Experience: Thesis <sup>1</sup>           | 4         |
| <b>Credit Hours</b>                            |   | <b>4</b>  |
| <b>Total Credit Hours</b>                      |   | <b>56</b> |

**(Minimum) Total Credits Required for Program: 161**

<sup>1</sup> Students are automatically registered for CILE-400 in a co-op term when they reach Junior II status.

### Automotive Engineering Design Concentration

Freshman I through Junior II Rep. Program Credit Total: 105

| Course  | Title   | Credit Hours |
|---|---|--------------|
| <b>Senior I</b>                                   |   |              |
| MECH-322  | Fluid Mechanics   | 4            |
| MECH-330 & MECH-331                               | Dynamic Systems with Vibrations and Dynamic Sys w Vibrations Lab    | 4            |
| Advanced Humanities or Social Science Elective    |   | 4            |
| Automotive Concentration Electives <sup>1,2</sup> |   | 8            |
| <b>Credit Hours</b>                               |   | <b>20</b>    |
| <b>Senior II</b>                                  |   |              |
| LS-489  | Senior Seminar: Leadership, Ethics, and Contemporary Issues         | 4            |
| MECH-420  | Heat Transfer   | 4            |
| MECH-430 & MECH-431                               | Dynamic Systems with Controls and Dynamic Systems with Controls Lab | 4            |
| Automotive Concentration Elective                 |   | 4            |
| <b>Credit Hours</b>                               |   | <b>16</b>    |
| <b>Senior III</b>                                 |   |              |
| MECH-422  | Energy Systems Laboratory   | 4            |
| MECH-448  | Vehicle Design Project  | 4            |

|  |   |           |
|--|---|-----------|
| Advanced Humanities or Social Science Elective |   | 4         |
| Automotive Concentration Elective              |   | 4         |
| <b>Credit Hours</b>                            |   | <b>16</b> |
| <b>Any Term</b>                                |   |           |
| CILE-400                                       | Culminating Undergraduate Experience: Thesis <sup>3</sup> | 4         |
| <b>Credit Hours</b>                            |   | <b>4</b>  |
| <b>Total Credit Hours</b>                      |   | <b>56</b> |

**(Minimum) Total Credits Required for Program: 161**

- <sup>1</sup> Elective courses may vary in lecture and/or laboratory credits and terms from those shown.  
<sup>2</sup> Students select a Concentration related elective or Concentration related ME elective with approval of their ME Concentration Advisor.  
<sup>3</sup> Students are automatically registered for CILE-400 in a co-op term when they reach Junior II status.

### Bioengineering Applications Concentration

Freshman I through Junior I Representative Program Credit Total: 85

| Course   | Title   | Credit Hours |
|--|---|--------------|
| <b>Junior II</b>   |   |              |
| MECH-300   | Computer Aided Engineering  | 4            |
| MECH-310   | Dynamics  | 4            |
| MECH-320   | Thermodynamics  | 4            |
| MECH-350   | Introduction to Bioengineering Applications                         | 4            |
| Advanced Humanities or Social Science Elective               |   | 4            |
| <b>Credit Hours</b>  |   | <b>20</b>    |
| <b>Senior I</b>  |   |              |
| MATH-258   | Probability and Statistics  | 4            |
| MECH-322   | Fluid Mechanics   | 4            |
| MECH-330 & MECH-331  | Dynamic Systems with Vibrations and Dynamic Sys w Vibrations Lab    | 4            |
| Advanced Humanities or Social Science Elective               |   | 4            |
| Bioengineering Concentration Related Elective <sup>1,2</sup> |   | 4            |
| <b>Credit Hours</b>  |   | <b>20</b>    |
| <b>Senior II</b>   |   |              |
| LS-489   | Senior Seminar: Leadership, Ethics, and Contemporary Issues         | 4            |
| MECH-420   | Heat Transfer   | 4            |
| MECH-430 & MECH-431  | Dynamic Systems with Controls and Dynamic Systems with Controls Lab | 4            |
| Bioengineering Concentration Related Elective <sup>1,2</sup> |   | 4            |
| <b>Credit Hours</b>  |   | <b>16</b>    |
| <b>Senior III</b>  |   |              |
| MECH-422   | Energy Systems Laboratory   | 4            |
| MECH-495   | Senior Design Project   | 4            |
| Advanced Humanities or Social Science Elective               |   | 4            |
| Bioengineering Concentration Related Elective <sup>1,2</sup> |   | 4            |
| <b>Credit Hours</b>  |   | <b>16</b>    |

**Any Term**

|                           |  |           |
|---------------------------|--|-----------|
| CILE-400                  | Culminating Undergraduate Experience:<br>Thesis <sup>3</sup> | 4         |
| <b>Credit Hours</b>       |  | <b>4</b>  |
| <b>Total Credit Hours</b> |  | <b>76</b> |

- <sup>2</sup> Students select a Concentration related elective or Concentration related ME elective with approval of their ME Concentration Advisor.
- <sup>3</sup> Students are automatically registered for CILE-400 in a co-op term when they reach Junior II status.

**(Minimum) Total Credits Required for Program: 161**

- <sup>1</sup> Elective courses may vary in lecture and/or laboratory credits and terms from those shown.
- <sup>2</sup> Students select a Concentration related elective or Concentration related ME elective with approval of their ME Concentration Advisor.
- <sup>3</sup> Students are automatically registered for CILE-400 in a co-op term when they reach Junior II status.

**Machine Design & Advanced Materials Concentration**

Freshman I through Junior II Representative Program Credit Total: 105

| Course   | Title   | Credit Hours |
|--|---|--------------|
| <b>Senior I</b>                                      |   |              |
| MECH-322   | Fluid Mechanics   | 4            |
| MECH-330 & MECH-331                                  | Dynamic Systems with Vibrations and Dynamic Sys w Vibrations Lab        | 4            |
| MECH-416   | Introduction to Finite Element Analysis with Structural Applications    | 4            |
| MECH-482   | Mechanics and Design Simulation of Fiber-Reinforced Composite Materials | 4            |
| Advanced Humanities or Social Science Elective       |   | 4            |
| <b>Credit Hours</b>                                  |   | <b>20</b>    |
| <b>Senior II</b>                                     |   |              |
| LS-489   | Senior Seminar: Leadership, Ethics, and Contemporary Issues             | 4            |
| MECH-420   | Heat Transfer   | 4            |
| MECH-430 & MECH-431                                  | Dynamic Systems with Controls and Dynamic Systems with Controls Lab     | 4            |
| Machine Design Concentration Elective <sup>1,2</sup> |   | 4            |
| <b>Credit Hours</b>                                  |   | <b>16</b>    |
| <b>Senior III</b>                                    |   |              |
| MECH-422   | Energy Systems Laboratory   | 4            |
| MECH-495   | Senior Design Project   | 4            |
| Advanced Humanities or Social Science Elective       |   | 4            |
| Machine Design Concentration Elective <sup>1,2</sup> |   | 4            |
| <b>Credit Hours</b>                                  |   | <b>16</b>    |
| <b>Any Term</b>                                      |   |              |
| CILE-400   | Culminating Undergraduate Experience:<br>Thesis <sup>3</sup>            | 4            |
| <b>Credit Hours</b>                                  |   | <b>4</b>     |
| <b>Total Credit Hours</b>                            |   | <b>56</b>    |

**(Minimum) Total Credits Required for Program: 161**

- <sup>1</sup> Elective courses may vary in lecture and/or laboratory credits and terms from those shown.