<table>
<thead>
<tr>
<th>Program learning outcomes</th>
<th>Courses/Requirements related to these learning outcomes</th>
<th>Assessment method</th>
<th>Measures/Criteria, Rubric</th>
<th>Data collection</th>
<th>Assessment cycle</th>
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<tbody>
<tr>
<td>PhD Chemistry</td>
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<td>Demonstrate advanced level knowledge in both (i) synthesis and materials chemistry and (ii) analytical and physical chemistry methods, with a higher level of knowledge expected in the student’s area of research.</td>
<td>a) Courses: Synthesis and Materials Courses: CHEM 5160 - Advanced Synthetic Chemistry CHEM 5440 - Bioorganic Chemistry CHEM 5450 - Organic Chemistry CHEM 5460 - Synthetic Organic Chemistry CHEM 5470 - Medicinal Chemistry CHEM 5550 - Organometallic Chemistry CHEM 5560 - Solid State Chemistry Analytical and Physical Methods Courses: CHEM 5230 - Mass Spectrometry CHEM 5250 - Bioanalytical Methods CHEM 5260 - Analytical Separations CHEM 5270 - Electroanalytical Chemistry CHEM 5330 - Advanced Physical Chemistry CHEM 5340 - Advanced Thermodynamics CHEM 5620 - Biophysical Chemistry CHEM 5630 - Chemical Biology and Biotechnology</td>
<td>a) For all, final score in class. b) For all, final score in class.</td>
<td>a) &gt;90% Exceeds expectations b) 70 - 89% Meets expectations c) 65 - 69% Approaching expectations d) &lt;65% Not meeting expectations</td>
<td>1 course from each area will be assessed in Year 1 of a 3 year cycle</td>
<td>Every offering</td>
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<td>Use standard search tools and retrieval methods to obtain information about a topic, substance, technique, or an issue relating to chemistry and assess relevant studies from the chemical literature.</td>
<td>a) Courses: CHEM 5470 CHEM 5200 CHEM 5270 CHEM 5630 b) Research proposal</td>
<td>a) CHEM 5470 - Rubric is being developed b) CHEM 5200 - Rubric c) CHEM 5270 - Scoring system d) CHEM 5630 - Scoring system</td>
<td>a, b, c, d) Scores on rubric</td>
<td>Every offering</td>
<td>b) Year 2</td>
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<td>Communicate scientific findings from literature and original findings from the student’s own independent research in written publications and oral presentations.</td>
<td>a) Courses: CHEM 5620 CHEM 5470 CHEM 5270 CHEM 5630 b) 2nd year research update c) Research proposal and defense d) 4th year seminar e) Dissertation and Final defense</td>
<td>a) CHEM 5620 - Rubric b) CHEM 5470 - Rubric is being developed c) CHEM 5270 - Rubric to be developed d) CHEM 5630 - Scoring system</td>
<td>a, b, c, d, e) Scores on rubric</td>
<td>Every offering</td>
<td>c) Year 3</td>
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Acquire the basic tools, including chemical practices and theories, needed to conduct advanced chemical research. Students will become proficient in their specialized area of chemistry and complete an advanced, independent research project resulting in peer-reviewed publications.

### Courses

**Synthesis and Materials Courses:**
- CHEM 5160 - Advanced Synthetic Chemistry
- CHEM 5440 - Bioorganic Chemistry
- CHEM 5450 - Advanced Organic Chemistry
- CHEM 5460 - Synthetic Organic Chemistry
- CHEM 5470 - Medicinal Chemistry
- CHEM 5550 - Organometallic Chemistry
- CHEM 5560 - Solid State Chemistry

**Analytical and Physical Methods Courses:**
- CHEM 5230 - Mass Spectrometry
- CHEM 5250 - Bioanalytical Methods
- CHEM 5260 - Analytical Separations
- CHEM 5270 - Electroanalytical Chemistry
- CHEM 5330 - Advanced Physical Chemistry
- CHEM 5340 - Advanced Thermodynamics
- CHEM 5620 - Biophysical Chemistry
- CHEM 5630 - Chemical Biology and Biotechnology

### Research proposal

- a) Courses
- b) Research proposal
- c) Dissertation

### Adhere to accepted ethical and professional standards in chemistry.

- a) CHEM 5000
- b) Research proposal

### Assessment

<table>
<thead>
<tr>
<th>Course</th>
<th>Assessment</th>
<th>Grading Scale</th>
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</table>
| For all courses | Final score in class | a) >90% Exceeds expectations  
70 - 89% Meets expectations  
65 - 69% Approaching expectations  
<65% Not meeting expectations |
| Research proposal | Proposal will require section devoted to ethics that will be evaluated with a rubric | a) Must score >80% to meet expectations  
b) Rubric |
| Adherence to ethical standards | Score on online quiz | a) 1 course from each area will be assessed in Year 1 of a 3 year cycle  
b) Assessed in Year 2  
c) Assessed in Year 3 |