Expected Outcome 1: Electricity and Magnetism

Students will demonstrate an understanding of Electricity and Magnetism at the intermediate level and advanced level. Representative topics include: electrostatics, the Laplace and Poisson equations and their solutions, magnetostatics, dipoles and multipole moment expansion, Faraday’s Law, scalar and vector potentials, gauge conditions, Maxwell equation, Poynting’s Theorem and electromagnetic waves and their interaction with matter.

Assessment Method: Graduate Doctoral Exam

The Physics Department holds a written Graduate Doctoral Examination (GDE) in the beginning of every Fall semester, with a second retake session in the beginning of each spring semester. The GDE consists of three four-hour examinations. Each examination consists of six problems, with only five of the six problems graded. (Each student chooses the five problems they wish to submit.) Physics Department faculty write the examination problems. The problems are at the intermediate to advanced level. Each problem is graded by two faculty (generally the author of the problem and another faculty member) on a 20 point scale. One of the four-hour examinations covers Electricity and Magnetism at the intermediate to advanced level.

Findings:

Five Ph.D. students graduated in 2013-14. Their scores on their respective Electricity and Magnetism subsections of the GDE are tabulated below. The qualitative categories are based on examination results over many years, and the collective opinions of the faculty

<table>
<thead>
<tr>
<th></th>
<th>GDE Electricity and Magnetism</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Excellent</td>
</tr>
<tr>
<td>Raw Score</td>
<td>76-99</td>
</tr>
<tr>
<td>Fraction of 2013-14 Ph.D. Recipients</td>
<td>20%</td>
</tr>
<tr>
<td>Number of 2013-14 Ph.D. Recipients</td>
<td>1</td>
</tr>
</tbody>
</table>

Use of Findings for Improvement

The substantial fraction of Ph.D. student whose Electricity and Magnetism scores were only Fair is cause for concern. If this pattern persists for several years, the Graduate Faculty of the department will take action.

Expected Outcome 2: Quantum Mechanics

Students will demonstrate an understanding of Quantum Mechanics at the intermediate level and advanced level. Representative topics include: matrix mechanics, Schroedinger equation and its solutions in one to three dimensions,
interpretation and mathematical properties of wave functions, operator methods, creation and annihilation operators, perturbative solutions, angular momentum, spin, parity, the Pauli exclusion principle and its consequences for solid state physics, atomic spectra, blackbody radiation, energy and angular momentum quantization, atomic structure, second quantization.

Assessment Method: Graduate Doctoral Exam

The Physics Department holds a written Graduate Doctoral Examination (GDE) in the beginning of every Fall semester, with a second retake session in the beginning of each Spring semester. The GDE consists of three four-hour examinations. Each examination consists of six problems, with only five of the six problems graded. (Each student chooses the five problems they wish to submit.) Physics Department faculty write the examination problems. The problems are at the intermediate to advanced level. Each problem is graded by two faculty (generally the author of the problem and another faculty member) on a 20 point scale. One of the four-hour examinations covers Quantum Mechanics at the intermediate to advanced level.

Findings

Five Ph.D. students graduated in 2013-14. Their scores on their respective Quantum Mechanics subsection of the GDE are tabulated below. The qualitative categories are based on examination results over many years, and the collective opinions of the faculty

<table>
<thead>
<tr>
<th>GDE Quantum Mechanics</th>
<th>Excellent</th>
<th>Very Good</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Score</td>
<td>76-99</td>
<td>60-75</td>
<td>50-59</td>
<td>36-49</td>
<td>10-25</td>
</tr>
<tr>
<td>Fraction of 2013-14 Ph.D. Recipients</td>
<td>40%</td>
<td>20%</td>
<td>40%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Number of 2013-14 Ph.D. Recipients</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Use of Findings for Improvement

This distribution of scores on the GDE examination is typical. No special action is needed to address this Expected Outcome at this time.

Expected Outcome 3: Research Results

Students will demonstrate an ability to perform original research

Assessment Method 1: Dissertation Defense

Candidates for the Ph.D. degree write a dissertation on their original research. They present the results of their dissertation research in an oral thesis defense administered by members of the student’s dissertation committee and an outside representative of the Graduate School. If a student fails the examination,
Assessment Report 2013-14
Physics Department – Ph.D.

a re-examination may be given on the recommendation of the student’s committee

Findings
All five of the Ph.D. students who received their degrees in Academic Year 2013-14 passed their Dissertation Defense on the first attempt.

Use of Findings for Improvement
No improvement is possible on this Assessment Method.

Assessment Method 2: Publication of Research Results in Refereed Journals
Authorship or co-authorship by a Ph.D. recipient on articles in refereed journals is assumed to be a good indication of the ability of the student to perform original research.

Findings
All five of the Ph.D. students who received their degrees in Academic Year 2013-14 have been authors or co-authors on articles published in refereed journals. The average number of articles published per student is 4.4. Two of the five Ph.D. students each had eight publications. It is important to note that publication in journals is a long process, and that there may be more articles that will be published based on these students’ dissertation research.

Use of Findings for Improvement
These are extremely positive results. However, there is the possibility that the large number of publications indicates that some Ph.D. students could have completed their degree program earlier than they actually did. The Department Chair and Graduate Program Officer will take steps to ensure that Ph.D. students are encouraged to complete their degrees in a timely and expeditious manner.