

## 1. INTRODUCTION

In response to the last external review in 2011, the Physics Department has taken many steps to improve and expand its programs. Most recommendations pertaining to the curriculum, the program structure, and faculty scholarship have been implemented. There have also been some positive developments with respect to university support for the department, such as additional office/research space and a suitable start up package for the newest engineering hire, but on some other fronts institutional support is lagging behind the needs of the department. In this five-year cycle we will build on our recent accomplishments and continue to collaborate with university administration to address the outstanding needs of the department.

Below we highlight more specific outcomes tied to external review recommendations.

### *Curriculum:*

- The department piloted two upper level courses, Biophysics and Bioinstrumentation, to introduce students to some advanced special topics beyond the standard sequence of physics courses.
- Students learn to use research databases and to gather and to evaluate electronic research literature in the junior level Research Methods course.

### *Program:*

- The department continues to actively pursue science and technology outreach/communication, and this remains one of the themes that brings together most members of the department.
- The department is more deliberative on how it supports women and other underrepresented groups. Compared to the 15.9% non-white minority students university wide, 24% the department majors were minority students in Fall 2015. Over the past four years, the fraction of female to male students increased from 26% to 32%.
- The department updated its mission statement, as well as the mission statement for the Engineering Program
- The department has made some use of current majors in admission events, such as student led tours during the Fellows Weekend. The number of majors in the department remained stable, fluctuating between 56 – 64 over the past four years.
- Additional space from the move of the Physical Therapy Education (PTE) department out of McMichael Science Center was used to set up a student engagement space for the engineering program and added four faculty offices. A further more distinctive use of space must to wait until the expansion of science facilities planned by the university.
- The department started publishing a newsletter to reach alumni and friend of the physics and engineering programs and it holds annual events with invitations sent to alumni.

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### *Scholarship:*

- Most faculty in the department maintain active inter-institutional collaborations
- The department continues to involve itself with the local universities, and through the engineering program it has reached out to local industries
- Although most faculty in the department are pursuing science public outreach or science communication, work is still ongoing to define a common strategy for how to bring these interests together.
- With the hire of one astrophysicist and two engineers the visibility and impact of research in the department has increased. We plan to continue to support and strengthen the scholarship bona fides of Elon physics and engineering.
- Physics research is poised to benefit from the hire of a materials engineer and a biomedical engineer, and our new engineering colleagues benefit from interactions with current physics faculty
- Several members of the department are establishing substantive physics or interdisciplinary research credentials, and others are on track to do the same. We aim to support all members of the department as they gain recognition for their scholarship.
- As the department acquired space, and reorganized how introductory physics laboratories are taught, four new faculty/student research spaces have become available.

### *Facilities and Support:*

- The addition of space due to the move of the PTE department out of McMichael was a very welcome development, addressing critical office, student engagement, and research space needs.
- The Introductory Physics Lab, McMichael 207, was updated with new furniture and more useful electric outlets. Screens and projectors were installed in Advanced Physics Lab, McMichael 206, and in the Engineering Workshop.
- The department has made effort to feature science on a larger scale at the university, such as through programs tied to science speakers and a science colloquium series in the McMichael Science Center, still the external reviewer's critique that the campus does not feature science continues to be valid.
- The department annual budget continues to be low for the number of students and courses the department serves. The university has not allocated sufficient operating funds for consumables as well as teaching equipment updates and maintenance.
- Some equipment/materials for instructional labs and advanced courses has been procured with the department gift funds and special requests from the provost's office.
- Faculty needing significant computing resources have been successful at obtaining grants for supercomputer use time. Still, there is a need for a more extensive university server space, for the use of faculty and students in research projects.

Going forward, the department is in synch with the mission of the Elon Commitment Strategic Plan: we are an academic community committed to student transformation; we value freedom of thought and liberty of conscience; we are at core a science department

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fully supportive of the applied engineering program; we believe in active student engagement; we are dedicated both to teaching and scholarship; and we believe in the preparation of global citizens, in civic engagement, and in preparing our students for meaningful lives of work and service.

We strongly identify with a focus on increasing the level of academic challenge at the university, and support a dynamic cadre of physics and engineering majors. We agree with the emphasis on liberal arts and sciences as the foundation of an Elon education. We value and nurture Elon's strong sense of community and conscientiously maintain exemplary collegiality in the department. We seek effective interdepartmental collaborations within and beyond the College of Arts and Sciences.

In the next five years we plan to continue to grow as an excellent department. We will support the engineering program as it transitions to its own department with cross listing courses, through ongoing research collaborations, and by sharing administrative duties. We plan to distinguish ourselves with a department wide focus on outreach, service, and communication. We will also keenly collaborate with the university administration to address the need to increase the annual operations budget, to maintain and update instructional equipment, and to provide additional space and facilities for instruction, student and alumni engagement, special projects, and research.

## **2. MISSION STATEMENTS**

### **A. Physics Department Mission Statement:**

The Department of Physics at Elon University strives to educate its students in a breadth of mind predicated on the ability to thoughtfully pursue solutions to a wide range of problems. Our majors are provided the opportunity and guidance to develop an essential background in physics, laboratory research experiences, and problem-solving skills that can be applied beyond the confines of any particular discipline. All of our students develop a knowledge base that extends their horizons and makes them better citizens of an increasingly technological and scientifically oriented world. Our program fosters innovation and critical thinking through active engagement in research and participation in the professional community, while maintaining a supportive and inclusive environment founded on respect of all learners. We offer students a chance to become powerful thinkers with wide-ranging intellectual curiosity and the capacity to engage in problem solving at all levels. Our faculty is fundamentally committed to both disciplinary and interdisciplinary scholarship and strives to serve as a model of broad intellectual engagement. Our students and faculty are leaders in the intellectual life of the University and actively reach out to and communicate with communities beyond. Our graduates have the capacity to excel in a variety of professions by dint of their refined problem solving skills and capacity for intellectual engagement.

### **B. Engineering Program Mission Statement:**

The Engineering Program at Elon University prepares students to enter the engineering profession as well-rounded, technically proficient engineers and world citizens. The unique nature of the program stems from its interdisciplinary emphasis and commitment to service. We value a variety of active-learning approaches in the classroom, a supportive, inclusive, and collaborative environment among students and faculty, and mentoring that promotes the development of substantively contributive citizens and ethical engineers. The intent of this program is to provide a stronger and broader foundation than is available in a traditional engineering curriculum, not only in the natural sciences and mathematics, but also in the liberal arts, with multiple learning opportunities to pursue engineering projects and scientific research. Our graduates are team-oriented, proficient analytical and creative problem solvers, and exhibit broad intellectual ability that complements their lifelong passion for learning and societal welfare.

### 3. DEPARTMENT GOALS.

#### A. Curriculum

*1. Establish a five-year review cycle for courses in the department.*

Persistent light and vibration issues with the astronomy observation platform require a proposal to go along with the planning for science facilities expansion, therefore Introduction to Astronomy (PHY 102) is first on the list of courses to review. With recent curricular changes in General and University Physics, the review of these courses is set for three years from now by which time a more extensive assessment data set will become available. Our upper level majors' courses are consistently highly evaluated by students, so the review of these courses is pushed to the last two years of the cycle. The course review will be part of the department's annual report.

2016-17	100 level, non-science majors' courses with a separate lab or without a lab (9-12 sections per year) <ul style="list-style-type: none"> <li>• Introduction to Astronomy (PHY 102 and PHYL 102)</li> <li>• Introduction to Oceanography (PHY 104)</li> </ul>
2017-18	100 level, non-science majors' courses with an integrated lab (9-12 sections per year) <ul style="list-style-type: none"> <li>• Conceptual Physics (PHY 101)</li> <li>• Introduction to Geology (PHY 103)</li> <li>• Physics of Sound (PHY 105)</li> <li>• Energy and the Environment (PHY 110)</li> </ul>
2018-19	200 level introductory courses for science majors (9-12 sections per year) <ul style="list-style-type: none"> <li>• General Physics (PHY 201/202 and PHYL 201/202)</li> <li>• University Physics (PHY 221/222 and PHYL 221/222)</li> </ul>
2019-20	Upper level physics majors' courses <ul style="list-style-type: none"> <li>• Modern Physics (PHY 313)</li> <li>• Modern Astrophysics (PHY 314)</li> <li>• Circuit Analysis (PHY 321 and PHY 322)</li> <li>• Bioinstrumentation (PHY 3xx)</li> <li>• Computational Methods for Scientists and Engineers (PHY 3xx)</li> <li>• Electrodynamics I and II (PHY 403 and 404)</li> <li>• Physics Research (PHY 499)</li> </ul>
2020-21	Upper level physics majors' courses <ul style="list-style-type: none"> <li>• Biophysics (PHY 3xx)</li> <li>• Research Methods I and II (PHY 397 and 398)</li> <li>• Classical Mechanics (PHY 401)</li> <li>• Quantum Mechanics (PHY 411)</li> <li>• Physics Internship (PHY 481)</li> </ul>

*2. Implement the Writing Excellence initiative*

The physics program is entering the third year of the Writing Excellence quality enhancement initiative. We have evaluated the current practice of writing in the physics BS and BA majors and identified PHY 221/222, PHY 313, and Physics Senior Seminar as places in the curriculum where specific writing instruction will take place. We have also become more strategic in how we incorporate writing across all courses offered in the department. As part of the course review cycle (A.1) we will continue to evaluate writing instruction and assessment. Over the next couple of years we hope to implement specific interventions to help students master writing and communication in the discipline.

2016-17	<ul style="list-style-type: none"> <li>• Pilot writing and communication interventions in PHY 221/222 and in PHY 313</li> <li>• Collect assessment data for the pilot interventions</li> <li>• Submit Physics Senior Seminar for curricular review, and revise the physics BS and BA to include this capstone experience</li> </ul>
2017-18	<ul style="list-style-type: none"> <li>• Pilot writing and communication interventions in Physics Senior Seminar</li> <li>• Develop an improved strategy for reaching writing and communication outcomes in PHY 221/222 and PHY 313</li> <li>• Collect assessment data for the Writing Initiative interventions</li> </ul>
2018-19	<ul style="list-style-type: none"> <li>• Develop an improved strategy for reaching writing and communication outcomes in Physics Senior Seminar</li> <li>• Collect assessment data for the Writing Initiative interventions</li> </ul>
2019-20	<ul style="list-style-type: none"> <li>• Collect assessment data for the Writing Initiative interventions</li> <li>• Amend the Writing Initiative interventions as needed</li> </ul>
2020-21	<ul style="list-style-type: none"> <li>• Collect assessment data for the Writing Initiative interventions</li> <li>• Amend the Writing Initiative interventions as needed</li> </ul>

*3. Strengthen the existing majors*

Over the past several of years we have continually innovated class pedagogy in core courses in the department. General Physics (PHY201/202 and PHYL 201/202) now makes use of the Physics for Life Sciences approach, piloted at the University of Maryland. University Physics I (PHY 221 and PHYL221) has a fully integrated lab component, so that most class meetings are anchored by hands-on inquiry similar to the Workshop Physics approach. In Modern Physics (PHY 313) students demonstrate mastery of content through self-paced, low stakes, challenge problems, which for each course topic are organized by A-B-C grade level. In upper level courses, Classical and Quantum Mechanics (PHY 401 and PHY 411) as well as in Electrodynamics I and II (PHY 403 and 404) instructors make use of small group tutorial structure to deepen students' engagement with course topics. As we move forward we envision strengthening the physics BS and BA majors to support both the Writing Excellence initiative and students' disciplinary competence.

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2016-17	<ul style="list-style-type: none"> <li>• Introduce a Physics Senior Seminar requirement for Physics BS and BA degrees</li> <li>• Introduce an additional upper level course requirement for Physics BS and BA degrees</li> <li>• Submit upper level courses for curricular review: Biophysics, Bioinstrumentation, and possibly also Computational Methods for Scientists and Engineers.</li> <li>• Offer Biophysics BS and Astronomy BA as independent majors</li> <li>• Evaluate the program based on the <i>Preparing Physics Students for 21st-Century Careers</i> report from the American Physical Society</li> </ul>
2017-18	<ul style="list-style-type: none"> <li>• Update the curriculum plan based on the external review in 2016-17.</li> <li>• Pilot Computational Methods for Scientists and Engineers.</li> <li>• Offer Biophysics BS and Astronomy BA as independent majors</li> </ul>
2018-19	<ul style="list-style-type: none"> <li>• Pilot an upper level Astrophysics course</li> <li>• Offer Biophysics BS and Astronomy BA as independent majors</li> </ul>
2019-20	<ul style="list-style-type: none"> <li>• Submit Biophysics BS to curricular review</li> <li>• Offer Biophysics BS and Astronomy BA as independent majors</li> </ul>
2020-21	<ul style="list-style-type: none"> <li>• Submit Astronomy BA to curricular review</li> </ul>

4. Establish an ABET accredited (general) engineering major

Please refer to the Engineering Program Five Year Plan for more details on the proposed new major. Below we highlight some main steps to be taken.

2016-17	<ul style="list-style-type: none"> <li>• Submit the engineering major proposal, based on the work of the Engineering Bridge Committee, to curricular review</li> </ul>
2017-18	<ul style="list-style-type: none"> <li>• Start offering the major to the class of 2021</li> <li>• Invite engineering students already at Elon University to become part of the first class in the program</li> <li>• Hire a consultant to carry out an external review and to advise on the accreditation process</li> </ul>
2018-19	<ul style="list-style-type: none"> <li>• Pilot new 2<sup>nd</sup> year courses in the major</li> <li>• Complete a self-study needed for the readiness report to be submitted to ABET</li> </ul>
2019-20	<ul style="list-style-type: none"> <li>• Pilot new junior/senior courses in the major</li> <li>• Complete the readiness report required for initiating ABET accreditation</li> </ul>
2020-21	<ul style="list-style-type: none"> <li>• Pilot new junior/senior courses in the major</li> <li>• Complete a self-study needed for ABET accreditation visit in the 2021-2022 academic year</li> </ul>



**B. Program**

*1. Expand opportunities for global engagement for physics and engineering faculty and students*

Several professors in the department have taught in the study abroad context as well as maintain active national and international collaborations. Over the next five years we plan to leverage this experience to expand the emphasis in the department on global citizenship.

2016-17	<ul style="list-style-type: none"> <li>• Develop plans for the Engineering World Health preparatory course to expand student pipeline in this international internship program</li> <li>• Together with the Global Education Center identify and communicate pathways for students in the department to study abroad for a semester.</li> <li>• Feature faculty international collaborations and ties to global programs on the department website and in promotional materials</li> </ul>
2017-18	<ul style="list-style-type: none"> <li>• Pilot the Engineering World Health preparatory course</li> <li>• Develop additional science/engineering based international internships and/or service learning opportunities</li> </ul>
2018-19	<ul style="list-style-type: none"> <li>• Pilot science/engineering based international internships and/or service learning opportunities</li> </ul>
2019-20	<ul style="list-style-type: none"> <li>• Recruit additional instructors for science/engineering based international internships and/or service learning opportunities to ensure these remain available to students in the future.</li> </ul>
2020-21	<ul style="list-style-type: none"> <li>• Carry out a review of the global engagement in the department in preparation for the subsequent five-year cycle</li> </ul>

*2. Expand opportunities for local community engagement for physics and engineering faculty and students*

Several professors in the department have taught service-learning courses and maintain active local and regional community collaborations. Over the next five years we plan to leverage this experience to expand the emphasis in the department on citizenship closer to home.

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2016-17	<ul style="list-style-type: none"> <li>• Develop a proposal to establish the Center for Science in Society, in collaboration with STEM departments and others at the university, whose mission, in part, is to promote the engagement of Elon STEM with the community</li> <li>• Together with the Kernodle Center identify and communicate opportunities for students in the department to serve locally in a science-related context.</li> <li>• Run programs in support of STEM education in Alamance county</li> <li>• Apply for Funds for Excellence to support a “Science in Society” symposium focused on university STEM outreach with K-12 students</li> <li>• Seek external support for STEM outreach with K-12 students and teachers</li> </ul>
2017-18	<ul style="list-style-type: none"> <li>• Begin the operation of the Center for Science in Society</li> <li>• Run programs in support of STEM education in Alamance county</li> <li>• Develop a plan to involve students in community outreach on a more regular basis</li> <li>• Hold the “Science in Society” symposium</li> <li>• Seek external support to house the Center in the new Physics and Engineering Building</li> </ul>
2018-19	<ul style="list-style-type: none"> <li>• Run programs in support of STEM education in Alamance county</li> <li>• Seek external support for STEM communication programs</li> <li>• Apply for Funds for Excellence to support a “Science in Society” symposium focused on STEM communication with the public</li> </ul>
2019-20	<ul style="list-style-type: none"> <li>• Run programs in support of STEM education in Alamance county</li> <li>• Hold the “Science in Society” symposium</li> </ul>
2020-21	<ul style="list-style-type: none"> <li>• Move the Center into its home in the new Physics and Engineering Building</li> <li>• Run programs in support of STEM education in Alamance county</li> <li>• Review the first three years of the Center’s operations and update its mission and scope of activities accordingly</li> </ul>

*3. Promote diversity in the student body and faculty*

2016-17	<ul style="list-style-type: none"> <li>• Draft and approve a diversity statement for the department</li> <li>• Work with Student-Athlete Support Services to develop a plan for student athletes to complete degree requirements in all majors in the department</li> </ul>
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2017-18	<ul style="list-style-type: none"> <li>• Develop and implement strategies for supporting all learners in the department, including students from groups underrepresented in physics and engineering</li> <li>• Seek to expand diversity in the department through a new physics hire.</li> <li>• Work with Student-Athlete Support Services to promote physics/engineering with athletes enrolling at the university</li> <li>• Seek to expand diversity in the department through a new physics hire</li> </ul>
2018-19	<ul style="list-style-type: none"> <li>• Seek to expand diversity in the department through a new engineering hire</li> </ul>
2019-20	<ul style="list-style-type: none"> <li>• Review and improve strategies for supporting all learners in the department, including students from groups underrepresented in physics and engineering</li> </ul>
2020-21	<ul style="list-style-type: none"> <li>• Seek to expand diversity in the department through a new engineering hire</li> </ul>

*4. Alumni programming*

We plan to maintain traditions of the annual newsletter sent out to alumni and friends of the department, as well as encouraging alumni participation in department events. Below we outline additional programming involving former students and friends of the department.

2016-17	<ul style="list-style-type: none"> <li>• Establish a physics advisory board for the department, primarily made up of alumni, and seek the board's input as part of the external review process.</li> </ul>
2017-18	<ul style="list-style-type: none"> <li>• Establish an engineering advisory board for the department, primarily made up of alumni, and seek the board's input as part of the external review process.</li> <li>• Develop the proposal for an Elon Innovations Labs (C.2) postgraduate fellowship to support alumni transitions to mature innovators and entrepreneurs, as well as to support the department in making the engineering workshop available to students under the fellow's supervision.</li> </ul>
2018-19	<ul style="list-style-type: none"> <li>• Seek alumni to take part in the Elon Innovations Labs (C.2) inaugural year, and offer postgraduate fellowships to the best candidates</li> <li>• Reach out to alumni to advise on the plans for the new Physics and Engineering building</li> </ul>
2019-20	<ul style="list-style-type: none"> <li>• Seek alumni to take part in the Elon Innovations Labs (C.2), and offer postgraduate fellowships to the best candidates</li> </ul>
2020-21	<ul style="list-style-type: none"> <li>• Review the postgraduate fellowship program</li> <li>• Seek alumni to take part in the Elon Innovations Labs (C.2), and offer postgraduate fellowships to the best candidates</li> </ul>

### C. Scholarship

*1. Develop pathways to support ongoing research and student projects*

2016-17	<ul style="list-style-type: none"> <li>• Encourage all department faculty to apply for FR&amp;D and external funding or to participate in grant writing workshops</li> <li>• Work with sponsored programs and the dean to explore the possibility to use a fraction of indirect cost from grants in the department to support student and faculty projects</li> </ul>
2017-18	<ul style="list-style-type: none"> <li>• Map out future space and equipment needs pertaining to research and development taking place in the department, to inform the design of the new Physics and Engineering building</li> </ul>
2018-19	<ul style="list-style-type: none"> <li>• Seek external funding tying Elon Innovation Labs to faculty and student research</li> </ul>
2019-20	<ul style="list-style-type: none"> <li>• Seek external funding to outfit the new Physics and Engineering building with sufficiently advanced research equipment</li> </ul>
2020-21	<ul style="list-style-type: none"> <li>• Hold the NC Section Meeting of the American Association of Physics Teachers</li> </ul>

*2. Establish “Elon Innovation Labs”, an innovation incubator for recent graduates, faculty, and current students.*

2016-17	<ul style="list-style-type: none"> <li>• In conjunction with other interested departments develop a proposal for STEM based technology incubator</li> </ul>
2017-18	<ul style="list-style-type: none"> <li>• Seek community partnerships and external funding to support Elon Innovation Labs</li> </ul>
2018-19	<ul style="list-style-type: none"> <li>• Seek external funding to support the Elon Innovation Labs postgraduate fellowship</li> <li>• Open Elon Innovation Labs and welcome its first resident projects</li> </ul>
2019-20	<ul style="list-style-type: none"> <li>• Establish an advisory board for the Elon Innovation Labs</li> </ul>
2020-21	<ul style="list-style-type: none"> <li>• Move Elon Innovation Labs to the new facility in the Physics and Engineering building</li> </ul>

## D. Facilities and Support

### 1. Physical plant and equipment

2016-17	<ul style="list-style-type: none"> <li>• Identify space and equipment required to support further growth in the physics major</li> <li>• Identify space and equipment required to establish an ABET accredited engineering major</li> <li>• Identify space and equipment required to support future faculty scholarship and student projects</li> <li>• Identify engagement space needs to maintain exemplary levels of student mentoring</li> <li>• Collaborate with University Advancement to develop a clearly representative narrative for the fundraising drive, for the Physics and Engineering building</li> <li>• Develop plans to move the astronomy observation platform to a location with less light pollution and fewer vibration issues</li> </ul>
2017-18	<ul style="list-style-type: none"> <li>• Develop short and long term plans for a physical presence for the Center for Science in Society, which includes outreach space for visiting K-12 students and teachers, tied to existing space and the Physics and Engineering building</li> <li>• Develop short and long term plans for a physical presence of Elon Innovation Labs incubator, tied to existing space and the Physics and Engineering building</li> </ul>
2018-19	<ul style="list-style-type: none"> <li>• Move the astronomy observation lab to a location with less light pollution, better vibrational stability, and improved accessibility</li> <li>• Work with the Physics and Engineering building architects to ensure optimal design of the new space</li> <li>• Seek funding for a Science Playground to be part of the Center for Science in Society, in the proximity to the Physics and Engineering building</li> </ul>
2019-20	<ul style="list-style-type: none"> <li>• Construct the Science Playground and the Physics and Engineering building</li> </ul>
2020-21	<ul style="list-style-type: none"> <li>• Move into the new building</li> </ul>

### 2. University Support

2016-17	<ul style="list-style-type: none"> <li>• Identify administrative support needed to complete the accreditation process</li> <li>• Encourage all department faculty to apply for external funding or to participate in grant writing workshops</li> <li>• Develop proposal with science departments and the dean for addressing the need for lab consumables and instructional equipment maintenance and replacement</li> </ul>
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2017-18	<ul style="list-style-type: none"> <li>• Establish the equipment replacement cycle for astronomy</li> <li>• Hire a physicist in part to oversee General Physics, making sure a sufficient start-up package is offered</li> </ul>
2018-19	<ul style="list-style-type: none"> <li>• Hire an engineer to support the growing major making sure a sufficient start-up package is offered</li> <li>• Draft a plan for university investment in research and project equipment to go into the new Physics and Engineering building</li> </ul>
2019-20	<ul style="list-style-type: none"> <li>• Finalize the plan for university investment in research and project equipment to go into the new Physics and Engineering building</li> </ul>
2020-21	<ul style="list-style-type: none"> <li>• Hire an engineer to support the growing major making sure a sufficient start-up package is offered</li> </ul>

**E. Mapping Department and Elon Strategic Plan Goals**

<b>Elon Commitment Strategic Plan Themes</b>	<b>5-year Plan Goals</b>
<i>I. An unprecedented university commitment to diversity and global engagement</i>	B.1, B.2, B.3, D.1, D.2
<i>II. Supporting a world-class faculty and staff</i>	C.1, C.2, D.1
<i>III. Attaining the highest levels of achievement across our academic program</i>	A.1, A.2, A.3, D.1
<i>IV. Launching strategic and innovative pathways in undergraduate and graduate education</i>	A.4, C.2, D.1, D.2
<i>V. Stewarding Elon's commitment to remain a best-value university</i>	D.2
<i>VI. Developing innovative alumni programs to advance and support the Elon graduate</i>	B.4, C.2, D.2
<i>VII. Establishing a national tournament tradition of athletics success along with the highest academic standards for Phoenix athletics</i>	B.3
<i>VIII. Significantly enhancing Elon's campus with premier new academic and residential facilities and a commitment to protecting our environment</i>	D.1, D.2

#### 4. PLAN FOR STUDENT LEARNING ASSESSMENT

We plan to continue the assessment structure proposed in the 2011-15 five-year plan, reproduced below. In addition, we will institute learning assessment based on i) the Writing Excellence Initiative plan of action, which will be part of the ARAP report, and ii) the proposed five-year review cycle of courses offered in the department, which will be included in the annual department report.

##### A. Student Learning Goals

1. Students will have conceptual understanding of mechanics, electrodynamics, and modern physics.
2. Students will be able to design, conduct, and present research with the assistance of a faculty member.
3. Students will be equipped with the mathematical and computational tools, as well as the content knowledge, necessary for post-graduate physics research. (B.S. recipients only)
4. Students will reflect on their learning to reassess their beliefs and attitudes relating to the physics enterprise.

##### B. Student Learning Outcomes

1. Students will interpret physics demonstrations using the framework of Newton's Laws of Motion.
2. Students will solve problems that involve gravitational and electromagnetic forces.
3. Students will present science research with at least one poster and one slideshow.
4. Students will include error analysis and hypothesis testing in research results.
5. Students will read physics research articles and design experiments to confirm or expand the findings.
6. Students will write computer simulations of experiments conducted in the lab.
7. Students will begin to fulfill the role and carry out the duties of scientists in society.
8. Students will understand the history and significance of science as perceived by experts.

##### C. Course Map (Course map identifies degree to which course emphasizes outcomes)

	Goal 1 Conceptual Understanding	Goal 2 Research	Goal 3 Tools and Content	Goal 4 Beliefs and Attitudes	Goal 5 Writing Excellence
PHY 221, 222	Primary		Secondary		Secondary
PHY 314	Primary	Secondary			Secondary
PHY 397,		Primary		Secondary	

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PHY 401		Secondary	Primary		
PHY 403, 404	Secondary		Primary		
PHY 410	Secondary		Primary		
PHY 499		Primary		Secondary	
PHY Senior Seminar		Primary			Secondary

**D. Assessment Plan**

1. We assess students' conceptual understanding of mechanics and electrodynamics during their first year using two instruments: the Force Concept Inventory (FCI) and the Conceptual Survey of Electricity and Magnetism (CSEM). These are administered at the beginning and end of each semester. Elon student gain scores  $\langle g \rangle$  are compared to the national averages for both traditional and interactive pedagogies.

2. We assess student research during public presentations. Students present their research from PHY 397/398 or 499 as part of the Spring Undergraduate Research Forum and at Society of Physics zone meetings. Members of the physics faculty review these talks afterward to evaluate the students' grasp of research and to determine which students would merit receipt of our Physics Research Award.

3. We assess content knowledge during the junior year using old versions of the Graduate Record Examination Physics Subject test.

4. We assess student attitudes on the relationship of their physics knowledge to real-world phenomena and how one makes sense of the natural world using the Colorado Learning Assessment of Science Survey for Physics (CLASS-Phys). These are administered at the beginning and end of the introductory mechanics course as well as the end of the introductory electricity and magnetism course. Additionally, we will administer this survey as part of the junior and senior assessments.

## **5. STATEMENT OF RELATIONSHIP BETWEEN PHYSICS AND ENGINEERING**

### **A. Background and Rationale**

As the four-year, ABET accredited, engineering major is being implemented over the next five-year cycle, it is important to ensure high visibility for the major to attract students and potential donors to the program. Web presence, in particular, should communicate the stability and expansion mode of engineering at Elon University. To address this need, in part, it will be advantageous for Engineering to appear as a separate department, rather than the current structure of a program housed in the Physics Department.

As Physics and Engineering become separate departments, we need to ensure there is sufficient administrative and budgetary support in the transition process, as well as a continued strong web presence for Physics even as we elevate Engineering to its own department. To this end we recommend that the two departments share administrative resources and faculty, and that gradually over the next five-year cycle their administrative structures are disentangled.

### **B. Affiliate-Appointments of Faculty**

Several EGR courses are already cross-listed with physics, and one experimental EGR course is currently cross-listed with CSC. Faculty in Physics and Computer Science who have the required competency may teach these courses, as needed. In addition, colleagues from other departments (Physical Therapy Education, Exercise Science, Business, etc) have engineering background and could potentially serve as EGR499 research mentors. Therefore we propose the following structure for faculty cross-appointments and these colleagues will complement the expertise of core engineering faculty:

- Individual faculty are invited by the Engineering Department to consider a cross-appointment for a five year period
- Interested faculty then petition their chair and dean to approve the cross-appointment
- If a cross-appointed faculty wishes to teach an EGR course (which is not cross-listed with their home department), they will seek approval of both department chairs
- For EGR499, the Engineering chair needs to sign off on the project
- There is no additional remuneration for the cross- appointment with Engineering
- Cross- appointed faculty are asked to attend one Engineering department meeting per year, and advise the Engineering chair on relevant matters
- Evaluations of cross-appointed faculty for the purpose of P&T is through their home departments
- The title of the cross-appointment will be consistent with ABET accreditation requirements

We propose a similar affiliate-appointment structure in the Physics Department, with SACS accreditation requirements replacing those of ABET.

### **C. Department Structure**

We propose to form the Engineering Department in 2017. In the five-year planning cycle starting in 2016 a detailed plan will be developed for an amicable eventual split of all department functions between physics and engineering. The plan may be amended to a different time frame for this process. The plan will be presented to the dean for advice and approval. The initial proposal is outlined below.

- We envision that over the next five-year cycle chair duties for both departments will initially fall on the physics chair, so that the engineering program director can focus on curriculum development and accreditation.
- The position of engineering program director will be retitled to associate chair of engineering, and the two-course reassigned time will be kept with this new position.
- An external consultant should be hired to help with the ABET process over the next five years. Alternately, if the necessary expertise is available in the department, sufficient reassigned time is provided from the dean to support accreditation work.
- At the end of the transition period a new position of engineering department chair – separate from physics – will be formed, with two-course reassigned time per year.
- Since preparing for ABET accreditation and maintaining the 3-2 transfer agreements will be ongoing and time-intensive tasks for the foreseeable future, we recommend that the associate chair role, together with its two-course reassigned time, remain in place even as the new engineering chair role, with its two-course reassigned time, is taken up by a core member of the engineering department.
- Engineering faculty who plan to undergo P&T review in the transition period will continue to be evaluated according the existing physics department scholarship document.