Engineering Physics Program Review Summary

The Department of Physics and Astronomy offers Bachelor of Arts degrees in Astronomy and Physics, Bachelor of Science degrees in Astronomy, Physics and Engineering Physics and, beginning with the 2010 academic year, a minor in Astrobiology. Graduate degrees are offered in Physics and Astronomy. The Engineering Physics is an undergraduate program only. Degrees in Astronomy and Physics are granted through the College of Liberal Arts and Sciences (CLAS). Engineering Physics degrees are granted through the School of Engineering. The Director of the Engineering Physics program is a faculty member in Physics and Astronomy, so the Department and the School of Engineering share the administration of this program. Students are encouraged to identify with their degree program (physics, astronomy, or engineering physics) as well as with the Department as a whole. Approximately one-third of the Department’s undergraduates are Engineering Physics majors. Most (81%) students graduate in five years of study or less. The average time to complete an Engineering Physics degree is ~ 4.5 years.

The Department has 23 full-time faculty members. The graduate program trains about 35 Ph.D.-bound students per year. Three members of the current faculty are Assistant Professors and six are in Associate Professor positions. Women make up ~ 13% of the full-time faculty. All faculty are qualified and eligible to teach courses that are cross-listed as EPHX.

The Department’s faculty members publish regularly in many high-quality, peer-reviewed journals. Currently, the departmental research programs bring in external funding at a level of $3.7 M/year (>160K/FTE). Research funding is drawn mainly from Federal sources including NSF, NASA, DOD, and DOE. Members of the faculty have diverse research interests, but will identify with one of three umbrella areas -- applied physics (condensed matter and biophysics), foundational physics (high energy and nuclear) and astronomy and astrophysics (astronomy, astrobiology, cosmology, and space science). Three members of the faculty are Fellows of the American Physical Society, one is a Fellow of the American Association for the Advancement of Science, and one is a Fellow of the American Geophysical Union. One professor has won the Higuchi Research Achievement Award that recognizes contributions to research programs at all Kansas Board of Regents institutions. The Department has one University Distinguished Professor. Within the past five years, three Assistant Professors have been NSF CAREER award winners.

The Engineering Physics program, which is inherently multidisciplinary, has the objective to produce graduates who have sufficient education in physics and engineering to enter positions in research and development either before or after subsequent graduate study. The graduates should have the analytical, problem solving and communication skills needed to succeed in their chosen career. They should have sufficient background knowledge to understand and make use of developments in basic science and technology throughout their professional lives.
A priority for faculty is to maximize opportunities for students by promoting their visibility within the research community. All students are required to do some undergraduate research, but many will take full advantage of the research opportunities offered by the faculty. It is common for undergraduates to become co-authors of research papers and to give research talks at professional meetings. Undergraduate researchers have been authors on papers published in leading journals; e.g., *Astronomical Journal, Astrophysical Journal, Geophysical Research Letters, Physical Review Letters, Applied Physics Letters, Nano Letter*, for work based on research supervised by Department faculty.

The quality of students in the Department remains unequivocally outstanding. Physics, Astronomy, and Engineering Physics students collectively form a group that tends to have the highest mean ACT score of any program at the University. Forty three KU students have won Goldwater Scholarships since 1989 and more than one third have been majors in physics, astronomy or engineering physics. With 18 Goldwater Scholars in recent years, KU ranks at the top of the Big 12. Of those 18, 10 have been majors from Physics and Astronomy, making our department the top-ranked at the University of Kansas in this impressive statistic.

Over the last three years the number of graduates in each degree program has been 2 for the Astronomy B.A., 12 for the Physics B.A., 13 for the Astronomy B.S., 33 for the Physics B.S. and 22 for the Engineering Physics B.S. Included in these numbers are 5 graduates who achieved double majors in Physics, Astronomy or Engineering Physics. Several of our students have obtained NSF Fellowships after graduation and one of our students was awarded an APS Minority Fellowship. That student just started graduate school at Yale and was recently awarded an NSF Fellowship. The Department graduated 5 students with Engineering Physics degrees in May 2010. Four of the 5 found jobs in industry and 1 was admitted to graduate school. Of the 5 Engineering Physics graduates in 2009, 3 went on to engineering graduate school and the other 2 obtained positions in industry. Four of 5 Engineering Physics graduates in 2008 went to graduate or professional schools.

The Engineering Physics program has an outcomes assessment process that includes collecting data using assessment tools, analysis of the data, and a feedback loop to implement suggestions arising from the analysis. There are two main outcomes assessment tools: faculty course surveys and senior exit interviews. Instructors are to assess the achievement of the students on each outcome that is addressed by the course and to submit examples of student work that support their conclusions. The EPHX committee works with the instructors to develop an appropriate metric for each outcome and analyzes the course survey and interview comments. This process has resulted in improvements to various aspects of the program. Additionally, periodic external assessments are important to maintaining program quality. The Department underwent an independent external program review in 2008. One of the findings of that review was: “The undergraduate program is strong with excellent students who go on to fine graduate programs and elsewhere”.
Department of Physics and Astronomy
Engineering Physics

Accomplishments

The Engineering Physics program within the Department of Physics and Astronomy is one of a small number of ABET-accredited EPHX programs in the country and the only one in Kansas. Engineering Physics is consistently able to attract outstanding incoming students based on ACT scores, which are often higher on average than those of incoming students in other Engineering disciplines. Once they become part of the program, students continue to excel and many choose to double major in physics, astronomy or engineering. EPHX graduates in 2009 had the highest average GPA among all graduates from the School of Engineering. Undergraduate research is a requirement for Engineering Physics students and it is a priority for Department faculty to encourage students to become engaged in research in a significant way. Consequently, many undergraduates are co-authors on papers published in respected peer-reviewed journals and many make presentations at technical conferences and symposia. Department students have done very well in the competition for the Goldwater Scholarship, representing a large fraction of all Goldwater Scholars at KU. Graduates of the Engineering Physics program are highly successful at finding positions in graduate school or industry. The last three graduating classes included 15 Engineering Physics majors. Of the 14 who shared information with the Department, 8 went to graduate or professional school and 6 took positions in industry or the military. Engineering Physics alumni include retired Rear Admiral Gene Kendall, who was awarded the School of Engineering Distinguished Engineering Service Award in 2007, and Mr. William Anderson, formerly a vice president with Lockheed-Martin and currently chair of the Department’s Alumni Advisory Board.
1. What do we do and why do we do it?

Physics and astronomy are the oldest of the natural sciences and physics provides the foundation for all other science and engineering fields. Consequently, the Department has an important role in educating students from many different disciplines. The faculty is deeply committed to both teaching and research. We believe the success of our educational mission at both the undergraduate and graduate level depends on the strong faculty research effort. Our strong points are faculty research, preparing our undergraduate and graduate students for the profession, broadly based service to the profession as well as the University and the State of Kansas, and strategic planning for the Department.

The Department offers Bachelor of Arts degrees in Astronomy and Physics and Bachelor of Science degrees in Astronomy, Physics and Engineering Physics. We encourage students to identify with their degree program (physics, astronomy, or engineering physics) as well as with the Department as a whole. We also recently obtained approval to offer a minor in astrobiology and the first astrobiology minors will graduate in May 2010. The degree requirements for Engineering Physics are presented in Appendix A. Degrees in Astronomy and Physics are granted through the College of Liberal Arts and Sciences (CLAS). Engineering Physics degrees are granted through the School of Engineering. The Director of the Engineering Physics program is a faculty member in Physics and Astronomy, so the Department and the School of Engineering share the administration of this program.

Engineering Physics is the specific focus of this review; however, the goals, strategies, implementations, issues, concerns, and accomplishments of Engineering Physics cannot easily be segregated from those of physics and astronomy. Accordingly, this report will necessarily include relevant information about both Engineering Physics and the Department as a whole.

The Department’s research can be roughly divided into three broad categories, applied physics; nuclear and particle physics; and astronomy, cosmology, and space physics. We have been guided in our hiring decisions for many years by the goal of maintaining strength in each of these three umbrella areas. These umbrella areas are subdivided into more than a dozen specialized areas where individual faculty members are active. For a relatively small to moderate size department, we offer an exceptionally wide variety of research opportunities.
The Department has long promoted research that is interdisciplinary or multidisciplinary in nature. Examples include our programs in biophysics, astrobiology (a collaboration with geology, ecology and evolutionary biology, and the KU Natural History Museum), the collaboration between our faculty and the School of Engineering, our science education programs involving KU’s Natural History Museum and the Department of Design, and our nanotechnology program.

Our Engineering Physics program, which is inherently multidisciplinary, has the objective to produce graduates who have sufficient education in physics and engineering to enter positions in research and development either before or after subsequent graduate study. The graduates should have the analytical, problem solving and communication skills needed to succeed in their chosen career. They should have sufficient background knowledge to understand and make use of developments in basic science and technology throughout their professional lives.

Diversity is important to the Department in both our students and our faculty. However, as with other physics and astronomy departments, this has been a challenge. The percentage of minority undergraduates has recently fluctuated around 5%. Women make up ~ 13% of the full-time faculty. The gender balance in the undergraduate programs varies from just under 10% female in the physics majors, 24% in the engineering physics major, to nearly 45% in the astronomy major. Approximately one-third of our undergraduates are Engineering Physics majors.

2. Who does it?

The Department will have 24 full-time faculty members with the addition of a new assistant professor who will start in August 2010. Three members of the current faculty hold Assistant Professor positions, and six are in Associate Professor positions. Appendix B provides specific demographic information relevant to the Department faculty. All faculty are qualified and eligible to teach courses that are cross-listed as EPHX. Department policy is that faculty with full time appointments normally divide their time 40% to teaching, 40% to research, and 20% to service. The normal teaching load for research active faculty is one course each semester in addition to advising one or more graduate students.

The Department’s faculty members publish regularly in many high-quality, peer-reviewed journals. Currently, our departmental research programs bring in external funding at a level of $3.7 M/year (>160K/FTE). Research funding is drawn mainly from Federal sources including NSF, NASA, DOD, and DOE. Members of the faculty have diverse research interests but will identify with one of our umbrella areas of applied physics (condensed matter and biophysics), foundational physics (high energy and nuclear) and astronomy and astrophysics (astronomy, astrobiology, cosmology, and space science). Three members of our faculty are Fellows of the American Physical Society. One member is a Fellow of the American Association for the Advancement of Science, and one member is a Fellow of the American Geophysical Union. One professor has won the Higuchi Research Achievement Award that recognizes contributions to research programs at all Kansas Board of Regents institutions. One member is a University
Distinguished Professor. Within the past five years, three of our Assistant Professors have been NSF CAREER award winners. The graduate program trains about 35 Ph.D.-bound students per year.

Approximately every five to seven years, the Department undertakes a planning process for the purposes of establishing hiring and other priorities. A committee is convened which examines the health of the Department and makes recommendations on all aspects of the program. These recommendations are then discussed and approved by the Departmental Assembly. This process has recently resulted in a faculty hire in the area of experimental biophysics, and also a hire to fill an experimental condensed matter position that had been vacated. Additionally, succession planning identified the need for an extragalactic observational astronomer as well as a physicist whose primary training is in field theory. The astronomer position was filled two years ago and the high energy theory position was filled in the last few months. A new planning process has just been initiated and we will continue to assess the strengths and weaknesses of the umbrella areas. It is considered important that there should be a balance in the three broad research areas to keep a diverse mix of research fields. The median age of the faculty suggests that for the next five years attrition will likely not be a significant issue. However, it will be a major concern as we look ahead 10 years.

The standing committees established by the Department are the Undergraduate, the Graduate, and the Engineering Physics Committees. These committees work together and through the Department Assembly to address a variety of issues dealing with degree requirements, course offerings, student concerns, etc. The Director of the Engineering Physics program chairs the Engineering Physics Committee and is a member of the Undergraduate Committee.

3. How well do we do it, and who thinks so?

Our student successes are a point of pride for the Department, and we strive to maximize opportunities for our students by promoting their visibility within the research community. All of our students are required to do some undergraduate research, but many will take full advantage of the research opportunities offered by the faculty. It is common for our undergraduates to become co-authors of research papers and to give research talks at professional meetings. It certainly helps that the quality of our students remains unequivocally outstanding. Our students collectively form a group that tends to have the highest mean ACT score of any program at the University.

Forty three KU students have won Goldwater Scholarships since 1989 and more than one third have been majors in physics, astronomy or engineering physics. With 18 Goldwater Scholars in recent years, KU ranks at the top of the Big 12. Of those 18, ten have been majors from Physics and Astronomy, making our department the top-ranked at the University of Kansas in this impressive statistic. Undergraduate researchers have been authors on papers published in leading journals; e.g., *Astronomical Journal, Astrophysical Journal, Geophysical Research Letters, Physical Review Letters, Applied*
Physics Letters, Nano Letter, for work based on research supervised by department faculty.

Over the last three years the number of graduates in each degree program has been 2 for the Astronomy B.A., 12 for the Physics B.A., 13 for the Astronomy B.S., 33 for the Physics B.S. and 22 for the Engineering Physics B.S. Included in these numbers are 5 graduates who achieved double majors in Physics, Astronomy or Engineering Physics. We expect 5 Engineering Physics graduates in May 2010. Several of our students have obtained NSF Fellowships after graduation and one of our students was awarded an APS Minority Fellowship. That student just started graduate school at Yale and was recently awarded an NSF Fellowship. Of the 5 Engineering Physics graduates in 2009, 3 went on to engineering graduate school and the other 2 obtained positions in industry. Most (81%) of our students graduate in five years of study or less.

The Department has a strong commitment to service and public outreach. Several members of the faculty have been nationally recognized for their work with the Kansas Citizens for Science. Efforts to improve K-12 teacher preparation in science have been started in the Department. The astronomers host public viewing sessions with the KU-based telescopes and the particle physicists have started a multimedia program to excite elementary aged children in science. Three faculty members have won the Steeple's Service to Kansans Award, which recognizes faculty at the University who provide significant service to the people of Kansas.

Assessment will be discussed in more detail in Section 4; however, there are two main assessment tools that evaluate outcomes for current students in Engineering Physics: faculty course surveys and senior exit interviews. Appendix C lists the educational objectives and goals identified by the Engineering Physics program. Senior exit surveys are administered to students who are about to complete their studies, typically on “Stop Day”. For Engineering Physics students, there is a written survey followed by an exit interview conducted by a panel of Engineering Physics alumni. The alumni are asked to assess the achievements of the students on each our educational outcomes on a scale of 1 through 5. We also try at that time to capture some permanent address and email address information as well as immediate plans for school or employment. Instructional quality is assessed in at least one standard manner, by way of the University-sponsored survey on Curriculum & Instruction. These student surveys are administered in the final weeks of the semester for each class above an enrollment of six for all teaching faculty. Faculty receives scores and comments after grades are submitted. Department mean scores for questions addressing course design and instructor effectiveness are generally 4.0 on a scale of 1 (strongly negative) to 5 (strongly positive.)

4. Overall Quality

There are many outstanding, internationally recognized researchers in our Department representing a wide variety of research fields. The faculty believes that having exposure to a wide set of disciplines creates a unique vitality in the Department, benefiting both faculty and students. We also recognize, however, that a critical mass is necessary for
any given research program, and that having people working in isolation from local colleagues is likely to be detrimental to our long-term reputation. We have worked to address this problem by having many of our recent hiring requests (as described in Section 2) focused on building bridges between programs for easier collaboration. Faculty hires in the area of astroparticle physics and space physics, leadership on the Radio Ice Cerenkov Experiment, a new Astrobiology program, and a long-standing reputation in cosmology have provided the nucleus for a national caliber astrophysics program. The interests of the high-energy physics and nuclear physics programs have been growing closer, with both groups planning programs that make use of the CMS detector at the CERN Large Hadron Collider. Also, there are numerous projects of joint interest to the condensed matter physicists and the biophysicists, many of these dealing with the characterization of structures at the nanometer scale.

Some of the accomplishments of our faculty in research and scholarship have been summarized in Section 2. In terms of teaching, the graduate program trains about 35 Ph.D.-bound students per year in addition to about 10 students per year in our M.S. programs. Almost all graduate students receive some form of financial support as research assistants, teaching assistants or through fellowships. Almost all Ph.D. graduates have job offers upon finishing, with about half going on to postdoctoral appointments. Our undergraduate programs have about 63 declared physics and astronomy majors and 15 declared engineering physics at the Jr/Sr level. Many of the graduates from our undergraduate program continue their studies at the country’s premiere graduate programs in physics and astronomy or engineering. Our success in placing our students can be largely attributed to the Department’s commitment to undergraduate research.

In addition to the education of our majors and graduate students, each semester approximately 1000 other students learn about physics and astronomy through our broad overview courses. Five of our faculty members have received Kemper Awards from the University for outstanding undergraduate teaching. The Department also has a strong commitment to service and public outreach. Several members of the faculty have been nationally recognized for their work with the Kansas Citizens for Science. The Department has initiated efforts to improve K-12 teacher preparation in science (see Section 5). The astronomers host public viewing sessions with the KU-based telescopes and the particle physicists have started a multimedia program to excite elementary aged children in science. Three faculty members have won the Steeples Service to Kansans Award, which recognizes faculty at the University who provide significant service to the people of Kansas.

Periodic external assessments are important to maintaining program quality. The Department underwent an independent external program review in 2008. Those results are available separately as needed. Additionally, the Engineering Physics program is ABET accredited and so is formally reviewed as a separate activity by an external agency every six years. Much of our program assessment strategy has developed from the Engineering Physics accreditation requirements. Our most recent ABET review was in Fall 2006. Our Engineering Physics assessment procedures were revised as a result of
that review. The revisions were considered in terms of the needs of the astronomy and physics programs and we now believe we have a system in place that will provide us with the tools we need for continuous evaluation and improvement of all of our programs.

Assessment is an important activity in order to understand opportunities for improvements in the quality of our programs. The assessment tools we use can be grouped into two categories -- one for graduates and one for current students. The main sources of information relevant to whether our graduates are meeting our longer-term objectives are alumni surveys, employer surveys, and placement data. The alumni survey is sent out every year during the summer to former students who graduated one, six and ten years earlier. For this survey, we typically have about a 30% return rate. The Department has analyzed comments from these and initiated curricular changes as a result. An important example is a major overhaul of the junior/senior labs that was done a few years ago. Additionally, we have now begun to include an employer survey with the alumni survey. The alumnus is asked to pass along this survey to his/her employer. Unfortunately, the return rate on the employer survey has so far been very low.

Placement data on jobs and graduate schools are gathered at the senior exit interviews and in the surveys. Student internships, undergraduate research experiences, scholarships and fellowships also provide information on likely career and graduate school success. Informal input is also sought by the faculty – including conversations with recruiters, career services personnel, alumni and faculty. A folder on such data is kept through the six-year ABET cycle.

The Engineering Physics is most relevant to the current review and it is an undergraduate program only. One of the findings of the 2008 independent external review was: “The undergraduate program is strong with excellent students who go on to fine graduate programs and elsewhere”. Based on the definitions supplied in the Self Study Question document, this would correspond to a rating of very good to excellent.

5. **Given your present assessment of program quality, what are your plans to advance the program?**

Our vision for the future of the Department and our programs is guided by our internal planning process along with the external reviews and the assessment data that we receive from our students, our alumni, and our external evaluators. Regarding our undergraduate program, it is our hope that the recent revisions to the B.S. degrees will allow us to increase the number and diversity of our majors. If we can dramatically improve the retention of freshmen who express an interest in one of our majors, we could, in principle, double the number of graduates. To help in this regard, we have recently implemented a new freshman seminar, PHSX 150, that is designed to help retention in all three B.S. programs, including Engineering Physics. The seminar introduces students to the workings of the Department, introduces students to the Department’s research programs, encourages students to become involved with undergraduate research, and gives students a sense of key questions facing the discipline today.
Any significant increase in our number of majors will require that we increase the frequency of several of our upper level course offerings. For each of the past two years we have had an oversubscription for our advanced laboratory classes, and have had uncomfortably large enrollments in our junior-level mechanics and electrodynamics courses. Offering these courses once each term, rather than once a year, would result in reasonably-sized classes and also make it much less likely that students would find themselves out of sync with the recommended undergraduate curriculum and therefore be unable to complete their course requirements in four years. However, the only way to increase the frequency of specific course offerings without compromising other aspects of the program is to increase the number of faculty.

Additional instructors could also allow a greater range of offerings for non-science majors. Presently, the only science literacy courses we regularly offer are ASTR 191 and PHSX 111. Starting in the spring of 2009 we began to offer ASTR 394, a course titled “The Quest for Extraterrestrial Life”. Our hope is to be able to offer it every spring. If we can enhance this menu further, we might better contribute to the general science education of students. It is especially crucial that we find a way to increase students’ understanding of the process of science in these courses for non-majors.

The Department is also involved with the University’s UKanTeach program, which has a goal of increasing the number of secondary science and math teachers. We have outlined a course sequence whereby a student can obtain a teaching credential while earning a B.S. in Physics. The UKanTeach staff is aggressively recruiting students to the program by offering a free one-credit hour course that introduces them to secondary science teaching. The University currently graduates only one or two students per year trained as secondary physics teachers in a program with significantly less physics content than the UKanTeach model. We are hoping to assist in enhancing both the numbers and preparation of future teachers.

We envision the future Physics and Astronomy Department will maintain its current strengths. We are very good at one-on-one mentoring of students by a collegial faculty working across a diverse range of research areas. We offer relevant courses for the range of topics being explored in the Department and we work to integrate new students into research programs. Ideally, the future program will have more and deeper financial resources allowing students to get started faster on research and to complete their degrees more quickly.

At present, planning for faculty hires assumes the rather pessimistic assessment that the Department will maintain its current size. As emphasized previously it is important that there be a balance in the three broad research areas to keep a diverse mix of research fields. The Department sees a strong window of opportunity to help the University enhance its stature by adding more faculty members. In comparisons with our peers, we have found that programs that are ranked higher than ours have more faculty members. We believe that increasing the number of faculty in the Department is a critical step if we are to become more competitive. Despite large increases in research activity and external funding, the number of faculty members in the Department has approximately remained
constant over the past 20 years. For instance, in 1980, there were 24 full-time faculty members in the Department. Today there are 23. Under the University’s tuition enhancement plan we anticipated there being funding for new faculty positions within certain well-defined areas, such as the biological sciences. The Department proposed a new research area in biophysics as a response to this initiative and we have been successful in recruiting two faculty members in this area. Unfortunately, the tuition-enhancement positions have not resulted in an overall increase in the size of the Department. Our initiatives to expand into new areas have tended to be at the expense of existing programs.

It will be difficult, if not impossible, for the Department to significantly enhance its current national standing without increasing the number of faculty to a competitive number. The last NRC rankings were highly correlated with department size. We envision a faculty of 28 to 29 members to achieve parity with our peers.

Perhaps the most compelling reason for increasing the faculty, however, is that it will allow us to increase the national and international prominence of one or more of our research programs. All of our programs are small compared to comparable programs elsewhere. At the moment we see the greatest potential for growth that is likely to lead to significantly increased funding in the condensed matter area. However, there is a very strong sentiment among the faculty that the Department must maintain its diversity as it grows. This longstanding principle has worked well for our students and for us.

6. How will you evaluate future progress and successes?

The Engineering Physics program has an outcomes assessment process that includes collecting data using assessment tools, analysis of the data, and a feedback loop to implement suggestions arising from the analysis. There are two main outcomes assessment tools: faculty course surveys and senior exit interviews. Instructors teaching all 500- and 600- level courses are asked to fill out a survey at the end of each term. Instructors are to assess the achievement of the students on each outcome that is addressed by the course and to submit examples of student work that support their conclusions. The EPHX committee works with the instructors to develop an appropriate metric for each outcome.

As described above, senior exit interviews are conducted each May by a panel of alumni. The alumni are asked to assess the achievements of the students on each of the a) thru k) outcomes (refer to Appendix C) on a scale of 1 thru 5 (5 being high achievement, 1 being low). Scores of 3 or higher on this metric are considered satisfactory.

Since courses offered by the School of Engineering are used heavily in the curriculum, data from those courses are important to the outcomes assessment. For each design option, a representative faculty member from another program in the School of Engineering is appointed to the Engineering Physics liaison committee. (For example a faculty member from the Aerospace Engineering Department is appointed to represent the aerospace design option in EPHX.) The liaison committee members report on
outcomes assessment data from their program when the liaison committee meets each spring. The liaison committee is chaired by the Director of Engineering Physics.

Between the senior exit interviews in May and the start of the next academic year in August, the EPHX committee studies its assessment data from the previous academic year and prepares a written report assessing each of the a) thru k) outcomes. This report is first circulated to the liaison committee members for comment and possible revision. Then the report goes to the Undergraduate Committee which, in turn, reports on the assessment of all Department undergraduate programs to the Departmental Assembly in the fall.

While assessment data are gathered on all outcomes in the exit interviews and on all relevant outcomes in each faculty course survey, the EPHX committee primarily bases its annual assessment reviews on particular data items identified for each outcome. The additional assessment information will be examined for consistency with the main metrics. Certain core courses are identified as key to meeting one or more of the objectives as well as specific portions of the exit interviews.

The EPHX committee also reviews the results of the alumni surveys and employer surveys (see Section 4). Informal input is also sought by the EPHX committee, such as conversations with recruiters, career services personnel, alumni and faculty.

Every three years the EPHX committee formally reviews the data on our objectives and writes an assessment report. This report is presented to the Undergraduate Committee, which in turn presents it to the Department Assembly. Changes in advising, career counseling and/or curriculum may be suggested by the assessment. Assessments may also reflect on the appropriateness of the objectives themselves. The most recent report was done in Fall 2009.

The Department is quite responsive to comments generated through exit and alumni surveys. Our freshman seminar course was motivated in part by these responses. Based on alumni comments, we have completely revamped our advanced laboratory curriculum and have recently increased the amount of quantum mechanics taught in our physics B.S. degree track to address feedback that additional training in this area would be useful for students going on for advanced training.
Appendix A

Requirements for the Bachelor of Science Degree in Engineering Physics
A total of 127-128 hours is required for the degree. Each student takes a common core of
courses and selects one of four
design concentrations.
Common Core (70.5 credit hours)
Physics (26.5 hours)
PHSX 150 Seminar in Engineering Physics 0.5
PHSX 211 (or PHSX 213), PHSX 212 (or PHSX 214), PHSX 313 and PHSX 316
General Physics I, II, and III
EPHX 516 Physical Measurements 4
EPHX 521 Mechanics I 3
EPHX 531 Electricity and Magnetism 3
EPHX 601 Design of Physical and Electronic Systems 4
Chemistry (5 hours)
CHEM 184 Foundations of Chemistry I 5
Mathematics (18 hours)
MATH 121 and MATH 122 Calculus I and II 10
MATH 223 Vector Calculus 3
MATH 290 Elementary Linear Algebra 2
MATH 220 Applied Differential Equations (3) or
MATH 320 Elementary Differential Equations (3) 3
English (6 hours)
ENGL 101 Composition 3
ENGL 102 Critical Reading and Writing 3
General Education Component (15 hours)
Economics elective 3
Ethics elective 3
Communication elective 3
Environmental concern elective 3
Contemporary issues elective 3
Design Concentrations (57-58 hours)

Aerospace Systems
AE 245 Introduction to Aerospace Engineering 3
AE 345 Fluid Mechanics 3
AE 421 Aerospace Computer Graphics 4
AE 445 Aircraft Aerodynamics and Performance 3
AE 507 Aerospace Structures I 3
AE 521 Aerospace Systems Design I 4
AE 522 Aerospace Systems Design II (or AE 523 or AE 524) 4
AE 545 Fundamentals of Aerodynamics 5
AE 550 Dynamics of Flight I 3
AE 551 Dynamics of Flight II 4
AE 572 Fundamentals of Jet Propulsion 3
C&PE 121 Introduction to Computers in Engineering 3
C&PE 221 Basic Engineering Thermodynamics 3
CE 301 Statics and Dynamics 5
CE 310 Strength of Materials 4
EPHX 536 Electronic Circuit Measurement and Design 4

**Chemical Systems**
C&PE 121 Introduction to Computers in Engineering 3
C&PE 211 Material and Energy Balances 3
C&PE 221 Basic Engineering Thermodynamics 3
C&PE 511 Momentum Transfer 3
C&PE 512 Process Engineering Thermodynamics 3
C&PE 521 Heat Transfer 3
C&PE 522 Economic Appraisal of Chemical and Petroleum Projects 2
C&PE 523 Mass Transfer 4
C&PE 524 Chemical Engineering Kinetics and Reactor Design 3
C&PE 613 Chemical Engineering Design I 4
C&PE 615 Introduction to Process Dynamics and Control 3
C&PE 616 Chemical Engineering Laboratory I 3
C&PE 623 Chemical Engineering Design II 2
CHEM 188 Foundations of Chemistry II 5
CHEM 624 Organic Chemistry I 3
CHEM 646 Introduction to Physical Chemistry 3
EPHX 536 Electronic Circuit Measurement and Design 4
EPHX 611 Introductory Quantum Mechanics 3

**Digital Electronic Systems**
EECS 140 Introduction to Digital Logic Design 4
EECS 168 and EECS 268 Programming I and II 8
EECS 211 and EECS 212 Circuits I and II 7
EECS 312 Electronic Circuits I 3
EECS 360 Signal and System Analysis 4
EECS 388 Computer Systems and Assembly Language 4
EECS 443 Digital Systems Design 4
EECS 448 Software Engineering I 3
EECS 461 Probability and Statistics 3
EECS 470 Electronic Devices and Properties of Materials 3
EECS 541 Computer Systems Design Laboratory I 3
EECS 542 Computer Systems Design Laboratory II 3
EECS 645 Computer Architecture 3
EECS Elective (EECS 546, EECS 644, EECS 670, EECS 690 or EECS 713) 3
EPHX 611 Introductory Quantum Mechanics 3

**Electromechanical Control Systems**
EECS 140 Introduction to Digital Logic Design 4
EECS 168 and EECS 268 Programming I and II 8
EECS 211 and EECS 212 Circuits I and II 7
EECS 312 Electronic Circuits I 3
EECS 360 Signal and System Analysis 4
EECS 444 Control Systems (3) or AE 750 Applied Optimal Control (3) or AE 753 Digital Flight Controls (3) 3
EPHX 611 Introductory Quantum Mechanics 3
ME 228 Computer Graphics 3
ME 311 Mechanics of Materials 4
ME 312 Basic Engineering Thermodynamics 3
ME 501 Mechanical Engineering Design Process 3
ME 528 Mechanical Design I 3
ME 641, ME 642 or ME 643 Design Project Option A, B or C 3
ME 708 Microcomputer Applications in Mechanical Engineering 3
Additional engineering elective 3
Credit for ROTC Courses. Students can petition for ROTC credit to replace a communication elective.
Credit for Foreign Language. Foreign language courses are not applicable to this degree program.
Appendix B
Faculty Demographics

Tenured Faculty: 20
Tenure Track Faculty: 3
Lecturers: 3
% Faculty that are Women: 13%
% Faculty that are Minority: 0%
% Faculty that are International: 35%
% Faculty with Terminal Degrees: 100%
Mean Age of Faculty: 50.2

Instructional FTE (Faculty): 23.0
Instructional FTE (GTA): 9.5

Instructional SCH (Faculty, Fall 2009): 4,760
Appendix C

Engineering Physics Program’s Objectives and Outcomes

Program Objectives and Outcomes
In ABET jargon “objectives” are “broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.” The assessment of objectives should focus on alumni who are several years from graduation. “Outcomes” are “statements that describe what students are expected to know and be able to do by the time of graduation.” The assessment of outcomes should be based on current students, especially seniors about the graduate.

Program Objectives
The objective of the Engineering Physics program is to produce graduates who have sufficient education in physics and engineering to enter graduate study in either field or to enter positions in research and development. The graduates should have the analytical, problem solving and communication skills needed to succeed in their chosen career. They should have sufficient background knowledge to understand and make use of developments in basic science and technology throughout their professional lives.

Program Outcomes
(a) An ability to apply knowledge of mathematics, science, and engineering
(b) An ability to design and conduct experiments, as well as to analyze and interpret data
(c) An ability to design a system, component, or process to meet desired needs within realistic constraints
(d) An ability to operate on multi-disciplinary teams
(e) An ability to identify, formulate, and solve engineering problems
(f) An understanding of professional and ethical responsibility
(g) An ability to communicate effectively
(h) The broad education necessary to understand the impact of engineering solutions in a global and societal context
(i) A recognition of the need for, and an ability to engage in life-long learning
(j) A knowledge of contemporary issues
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.