New Mexico State University
Engineering Physics External Advisory Board
2016 Report

Engineering Physics External Advisory Board 2016 Membership

Dr. Steven Castillo, Sandia National Laboratories; Albuquerque, New Mexico
Ms. Laura Dominik, Honeywell, Inc.; Minneapolis, Minnesota
Mr. Jon Haas (Chair), NASA Langley Research Center
Dr. Alan Lovell, Air Force Research Laboratory; Albuquerque, New Mexico
Mr. T. Nathaniel Nunley, EP Alumnus
Prof. David. Probst, Southeast Missouri State University; Cape Girardeau, Missouri
Dr. Kurt Schoenberg, Partner, Applied Science Enterprises consulting, &
User Facility Director (Emeritus), Los Alamos Neutron Science Center
Mr. Ronald Tafoya, Intel Corporation; Albuquerque, New Mexico

Executive Summary

2016 EP External Advisory Board Meeting, Charter, and Membership

The Engineering Physics External Advisory Board (EPEAB) convened for its ninth meeting on Friday and Saturday, May 6th and 7th, 2016. The meeting was hosted by the Physics Department, and held in Gardiner Hall on the main campus of New Mexico State University (NMSU) in Las Cruces, New Mexico. Additionally, the EPEAB reviewed the EP Program Committee's responses to the 2014 recommendations.

The standing charter of the EPEAB is to:

1. Review the current policies and procedures within the program and within the university administration in order to identify strengths and weaknesses.
2. Identify issues within the program, the department and the university that directly affect the EP program and make recommendations for improvement.
3. Identify potential opportunities and threats to future of the EP program.
4. Evaluate whether the EP Program achieves its stated Program Educational Objectives.
5. Prepare a report to be presented to the Engineering Physics Program Committee and for distribution to the deans, and Provost.

The 2016 EPEAB is additionally charged with two particular tasks:

6. Review or suggest avenues to accommodate upcoming changes in the requirements for minimum credits (going from 128 to 120).
7. Formulate expectations for the state-wide General Education, as well as the university-specific 'Viewing the Wider World' (VWW) requirements.

The EPEAB represents the various constituencies served by the Engineering Physics (EP) Program, with representatives from academia, federal science laboratories, industry, and program alumni. Additionally, the EPEAB has both in-state, and out-of-state representation, with both continuous long-term and new membership.

The NMSU Engineering Physics Program was inaugurated in 2001, produced its first graduate in 2004, and gained ABET[1] accreditation in 2007. To date, the program has produced 39 graduates, and continues to attract new students with an approximately 10% annual growth rate.

[1] Accreditation Board for Engineering and Technology, Inc.

Program Strengths

Achieving Program Educational Objectives

The variety of data and metrics reviewed all point to a very successful EP program. The Committee was presented with many good examples of student academic successes and student's abilities to find employment in scientific or technical organizations. In addition, several recent graduates are moving forward with plans for an advanced degree at very respectable scientific or engineering schools. General performance data based on standardized testing shows a skewed distribution where roughly the top 10 percent rank nationally in physics comprehension.

In addition to the program specific educational objectives discussed below, The EP Program contributes towards the broader objectives of NMSU.

***EP Objective 1*: Competitiveness.** *Graduates are competitive in internationally recognized academic, government, and industrial environments*

The EP Program continues to attract top students into its challenging curriculum, with graduates of the program proving competitive in graduate-level academic, government, and industrial environments. EP Program graduation rates are increasing, with career choices for graduating EP students more diverse than physics department graduates[2].

***EP Objective 2*: Adaptability.** *Graduates exhibit success in solving complex technical problems in a broad range of disciplines subject to quality engineering processes.*

EP Program graduates are entering advanced courses of study, and being hired into a diverse selection of high-tech jobs in industry and government laboratories, with some engaged in entrepreneurship. These not only meet the goals of the program, but of the broader university, and with greater economic impact.

***EP Objective 3*: Teamwork and Leadership.** *Graduates have a proven ability to function as part of and/or lead interdisciplinary teams.*

Preparation for leadership of interdisciplinary teams is a commonly neglected element of focused engineering and science programs, but simultaneously among the most needed skills leading to the success of large engineering and science projects. EP Program graduates are well-prepared to bridge this project integration gap. During the previous review, it was noted that 23% of program graduates list supervisory duties and 92% report working in team environments.

[2] Program reported graduation and post-graduate employment statistics

Continued faculty and College commitment to EP Program

EP is a small program compared with major initiatives in the College of Engineering or even in College of Arts and Sciences. During discussions with University Management (Deans from both the Engineering College and College of Arts and Sciences), and faculty in the Physics Department and various Engineering Departments, it is clear that that the value of EP to the University is recognized.

Student Satisfaction

The EP Program has better than average retention rates: close to 50% of incoming freshmen in EP remain and graduate in the program, outperforming other departments at NMSU. Typically, program graduates move on to advanced study in either physics or engineering graduate programs, or to careers in industry. Job placement and graduate school admission rates among EP graduates are above 90%. Both committee interviews and senior exit interviews indicate student satisfaction with the program supported by the following statistics: 70% of graduates are employed immediately upon graduation (80% within 3 months, and 100% within 6 months), with $70k average salary, and 90% currently employed in a science or engineering field.

Threats and Recommendations for Improvement

While the EP Program demonstrates the characteristics of a strong functional program, the EPEAB highlights several threats to continued success, and offers its recommendations for improvement.

University-wide budget cuts represent a significant threat

Issue: The EP program, like the Physics Department and other Departments in general, will be impacted by the budget cut at NMSU. The Department of Physics operates on a very lean overhead. As such, budget cuts will directly translate to Department or Program impacts. Past budget cuts have impacted both Teaching Assistant and Research Assistant hires – that then ultimately caps the number of students in Department programs. However, from 2005 to 2015, undergraduate student enrollment—both within the EP program and Physics Department wide—increased by between 300 and 400 percent. However, future undergraduate enrollment will likely be capped due to budget cuts or reductions.

Recommendations: While it is hoped that the administration will recognize the out-sized value of the EP Program in terms of its ultimate impact on economic activity in New Mexico, and limit this reduction, there are avenues available to increase research revenues in support of faculty and students through two principal paths:

1) Increase success at competing for government research grants.
2) Form strategic partnerships with New Mexico government and industrial research institutions.

With respect to funding, it is the sense of the Committee that professors in Physics, as in other Engineering Departments are putting significant effort into grant writing with demonstrated successes. How the "success rate" of grant proposals could be increased should be a strategic discussion among the Department Faculty. On partnerships within the government sector, the two largest National Laboratories in the US are in New Mexico. While there presently exists valuable collaboration between Los Alamos and Sandia National Laboratories (SNL) research staff and NMSU faculty, for example, between the SNL Center for Integrated Nanotechnologies and the Chemical and Materials Engineering Department, the Committee recommends continued development of additional strategic alliances. Both Los Alamos and Sandia face staff demographics where approximately 25% of the work force will have to be replaced over the next 5 years (e.g. 2000 employees at Los Alamos). Hiring across all Laboratory functionalities (technical staff, support staff, etc.) will require significant recruiting. NMSU should position itself as an important skilled labor source for this purpose. Here, the Committee believes that the skills afforded EP graduates will be of high value to fill National Laboratory positions.

Another avenue for an NMSU Strategic Alliance with Los Alamos is through the contract re-competition process slated to begin in 2017. Here, negotiating with the National Nuclear Security Administration (NNSA) by way of the New Mexico Congressional Delegation could ensure that the new contract values Laboratory support of New Mexico Institutions of Higher Education through research and teaching partnerships.

Increasing burden of program coordination

Issue: Past EPEAB Committee reports have highlighted the increasing need for funding administrative support to the growing EP Program. EP is a complex program. While this comes with high overhead demands, as previously demonstrated, it also produces greater positive impacts, both economically and technologically. EP is integrated across two colleges and multiple disciplines, and is accredited. Maintaining accreditation (which is highly recommended) represents an additional burden which is currently borne by faculty. Additional Program-related activities include recruiting, advising, curriculum development and coordination, academic program review, orientation of students, participation in meetings and events in the College of Engineering, and extracurricular activities. The EP Program has had no separate funding for program coordination since 2010; additionally, there is no faculty release time budgeted for EP Program work.

Recommendation: The EPEAB again recommends that the University administration recognize the return on investment and find additional resources to restore EP Program coordination funding.

Possible mandated reduction in credit hours for degree completion

Issue: A proposal is under consideration that would mandate a reduction in the minimum number of credit hours required for graduation for all programs at NMSU (and other NM Universities). The current EP requirement is 128 credits, which is proposed to be reduced to 120. This one-size-fits-all proposition is purportedly directed toward making any degree achievable in four years.

Engineering Physics is among the most challenging disciplines in which to achieve a degree, and attracts the brightest and most self-motivated students. The success of program graduates and their contributions to constituencies is evidenced by the breadth of high-tech positions held by graduates, as well as the high salaries commanded by graduates.

NMSU's requirement of 128 credits for award of an EP degree is already below the median of peer institutions offering the BSEP degree. Additionally, the unusually heavy Core Curriculum (CC) and Viewing the Wider World (VWW) requirements at NMSU (43 credits) are higher than at peer institutions (30-37 credits). This further dilutes the number of critical Engineering and Science credits needed for success.

Statistics maintained by the program show that the average number of credits earned by a BSEP graduate is 168, with only one student graduating with fewer than 130. While a portion of the additional work is generally attributable to rectifying insufficient math preparation, several other reasons should not be overlooked: Because of the rigor of the EP program, students often elect to acquire additional minors, particularly in math, which only requires two additional courses. Other students opt for double majors. While the statistics explain in what courses additional credits were earned, the EPEAB spoke directly with 21 current and former EP students for their perspective on 'why'. The answer given to the board was uniform and strong: These students either felt their performance in upcoming classes would benefit with the additional coursework, or more often, that they had special technical interests for which they wanted additional knowledge to prepare themselves for career choices. The baseline program was seen as too sparse to support their personal goals. No student interviewed expressed that reducing the number of required credits would benefit them, or result in them graduating sooner. Therefore, any university-wide reduction in required credits is unlikely to have a substantive effect on the EP Program's four-year graduation rate.

Recommendation: The EPEAB strongly recommends against deleting any core engineering or science requirements from the curricula for the degrees in Engineering Physics. However, because of the ever-changing content of courses in both colleges, due diligence should be given to the few opportunities where some course content may overlap. While the EPEAB did not have the necessary insight for a full review of every course, a few areas to look are offered: There may be some potential overlap in Math 392 and Phys 395 which might be combined, and depending on the prerequisite needs of AE 424, some content of AE 362 might be reduced or eliminated. If a reduction in CC or VWW requirements is realized, this may provide a means to alleviate some pressure on the curriculum, and provide students with an opportunity to pursue internships during their course of study.

The EPEAB concurs with the EP Committee's 2014 response: "…that while the reduction of the total number of credits for the Engineering Physics Program is desirable, this reduction should not come at the expense of core engineering, physics, and math courses. The best solution would be to reduce the number of General Education and Viewing the Wider World (VWW) credits required for all majors."

Internships and the effect on timely graduation

Issue: Despite the outsized impact of the EP Program, small programs can be affected by small operational issues. Here, in talking principally with students, class availability and phasing are issues that should be on the radar of the administration. Specifically, the availability of core courses and associated pre-requisites directly affects the time required to complete the EP degree. In several EP focus areas, there is virtually no way to accommodate a semester slip of a "critical path course", without delaying the degree by one year. For example, the ability of students to perform "field internships" was deemed by the committee of high-value to EP student education. We understand the constraints in faculty availability for teaching core courses. Nevertheless, perhaps a more proactive alternatives process, where students could petition for using other available courses of suitable subject matter to fulfill core course requirements could help with this issue. Here is an example where the reduction in program coordination between departments during curriculum change negotiations creates difficulty.

Recommendation: The physics department is working hard to help students navigate the required EP course schedules, but a more systemic and collaborative solution involving the College of Engineering Faculty is recommended. Improved coordination during curriculum changes is a key element of this.

Improving opportunities for undergraduate research:

Issue: Successful undergraduate research experience is strongly correlated with professional performance. Past EPEAB reports have highlighted a need to provide on-campus undergraduate research opportunities for EP students. Support for undergraduate opportunities in the Physics Department has varied with the funding environment and faculty tenure. Currently, opportunities for on-campus physics research are at low ebb. While this is not likely a permanent condition, this situation highlights the need and recommendation to continuously pursue external opportunities for students as an option.