

# **New Mexico State University Engineering Physics Advisory Board 2011-12 Report**

## **The 2011-12 Engineering Physics Advisory Board**

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## **Executive Summary**

The 2011-12 academic year marks the 11th year of the Engineering Physics (EP) Program at New Mexico State University (NMSU), the only EP Program in New Mexico. Many challenges facing this and similar programs throughout the nation are discussed in previous reports and will not be readdressed here. Despite these challenges, the NMSU EP Program has continued to attract the best and brightest students from New Mexico including some from other states and countries. The faculty attending to the program have achieved significant success in educating and graduating successful and productive students. A review of graduates since the program's inception demonstrates this success through the quality of employment, and notably the breadth of employment. This is a strong program and congratulations are deserved on a successful close to the first decade.

This, like other programs that seek to educate the brightest students and prepare them for careers in the nation's most productive jobs, struggles with attracting resources. By their nature, such programs are small in headcount but large in impact. Formula funding models don't work well in determining resource needs for such small programs. Therefore the success of small, high-impact programs, especially during their initiation and growth phases requires advocacy and dedication. The dedication of the faculty is manifest in the program's success. This advisory board continues to advocate strongly for the program as representatives of prospective employers in desperate need of employees possessing these specialized skills.

Part of this board's advocacy role is to highlight its benefits to College administration in hopes of extending that advocacy to the University executive administration. In this respect, the board noted significant and encouraging improvement in the Colleges' recognition of the engineering physics program. Both the Dean of the College of Arts and Sciences and the Associate Dean of Engineering, were well versed with the successes, benefits, and needs of the program.

The report offers several observations and recommendations to continue the success of the program and to assure its continued accreditation through the Accreditation Board for Engineering and Technology (ABET), which is subject to renewal this year.

## **2011-12 Advisory Board Meeting, Charter, and Membership**

The Engineering Physics Advisory Board (EPAB) convened for its seventh meeting on Monday and Tuesday, January 23rd and 24th, 2012. 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. The primary charter of the EPAB is to represent the various constituencies served by the Engineering Physics (EP) Program; to provide feedback to the Physics Department, the associated engineering departments, and the University regarding program objectives, strengths and weaknesses; and to advocate

for a successful program in the interests of the faculty, students, and the constituents we represent. In this respect, the EPAB is satisfied with current board membership, which has representation from academia, federal science laboratories, industry, and program alumni. Additionally, the board has both in-state and out-of-state representation, with both continuous long-term and new membership.

### **Program Strengths**

According to its mission statement, NMSU is a land-grant institution dedicated to serving the educational needs of New Mexico's diverse population through comprehensive programs of education, research, extension education, and public service. The Engineering Physics program is well aligned with this mission. The EP program provides high-quality interdisciplinary technical education that bridges the basic and applied physical sciences with engineering practice. Program graduates are highly valued by technological industries, government and industrial research laboratories, and advanced technical graduate programs that bring billions of dollars to New Mexico's economy.

The Physics Department faculty members are a major strength of the program, devoting significant time and resources to the success of the program. Faculty members in the NMSU Physics Department together with their colleagues in the Engineering College are skilled and dedicated educators engaged in diverse activities including basic, theoretical, and experimental research and technology development. This diversity of research and development activities offers students a broad spectrum of opportunities at the undergraduate and graduate levels, a richer educational experience, as well as healthy employment opportunities upon completion of their degree requirements.

The Engineering Physics degree program, which was first proposed in 2001, is now a successful, accredited, and growing component of the physics and engineering departments at NMSU. ABET accreditation was awarded in 2009 and made retroactive to 2005. The program saw its first graduate in 2004 and has seen 17 graduates to date, with five more expected this academic year. Program Graduates are nearly equally represented in business, industrial or government research, academics and graduate studies. Enrollment continues to increase, with 24 new students entering since 2010 (17 of which are still active in the program).

The students are exceptionally motivated, engaged and pleased with the challenges and level of instruction they are receiving. They remain excited about their post-graduate prospects for employment, career impact and earning potential.

## **Observations and Recommendations**

During its visit with faculty, staff, students and deans, the EPAB collected observations on items affecting program performance to share with the program and administration, and where appropriate, make recommendations to improve outcomes. While some concerns are under the control of the program alone, others may require broader efforts to address adequately.

### **University, College, and Department-Level Issues**

#### *Administration Changes*

**Observation:** Previously the Board noted that the significant turnover in the NMSU administration (President, Provost, some Vice Presidents, the Dean of the College of Arts and Sciences, and the Dean of the College of Engineering) was impacting the development of a vision addressing the growth of the Engineering Physics Program. The past two years have seen new administrative stability which has had a positive impact on the program evidenced by the new deans' engagement with EP Program concerns. The Physics Department head, Prof. Stefan Zollner, has been leading the department for three years and is a strong program advocate.

#### *Partnering College and Department Support*

**Observation:** There is a growing need to strategically plan for the growth and continued success of the EP Program. While not a critical need during the first ten years, the continued success and specifically the growth of the EP Program has the potential to create its own negative impact as resources become spread more thinly across a growing number of students and focus areas (Mechanical, Electrical, Chemical, and Aerospace). Inasmuch that the Physics faculty are a major strength of the EP Program, it is equally clear that these faculty are devoting a great deal of time and effort into the success of this program, while balancing as well as possible their other duties.

**Recommendation:** We recommend that the EP Program begin to identify and track specific issues that might negatively impact program outcomes. Examples elements to consider are: numbers of students vs. available resources, imbalances in the focus areas, strengths or technical focus areas the program will develop over the next five years, the effect of limited staff resources on a growing program, growth targets and how to meet them, and other growth related topics.

We reiterate our recommendation that the College of Engineering provide partial support for an administrative assistant to help manage the EP Program. The EPAB also reiterates the need for stronger involvement by engineering faculty in the EP Program. Involvement appears to have grown since last year, a very good sign. Continued growth

in this involvement is encouraged for sharing the administrative and advisement roles, as well as involvement of faculty who are seasoned at ABET accreditation reviews.

### Mission Alignment and the Value of Research

**Observation:** The EPAB discussed the University's (12-16-2011 draft) *Building the Vision* Academic Strategic Plan with a particular emphasis on identifying areas of alignment with the Engineering Physics Program. The EP program is well aligned with the strategic success goals of **Economic Engine** (evidenced by the high return on investment offered to employers of EP graduates), **Effectiveness and Efficiency** (evidenced by the service of EP graduates to their New Mexico constituencies), and **International Reach** (evidenced by the program focus on producing globally-productive technology developers). Furthermore, even for students who do not complete the EP Program, most continue onto graduation in some field at NMSU, supporting **Graduation Goal #1**.

#### **Recommendation:**

The EP faculty in physics and engineering should continue to increase the involvement of EP students in research. The department is already doing an excellent job of this. Growing this effort has synergy with the need to increase research overall.

### Admissions

**Observation:** There appear to be few, if any, admission standards for accepting new students into study programs at NMSU. While the EP Program has tended to be somewhat self-limiting by virtue of its published and demanding curriculum, faculty suggest (and the EPAB agrees) that the lack of admission standards is potentially harmful to the process of educating and graduating highly skilled students. Given the land-grant status of NMSU, this situation must be addressed with sensitivity.

**Recommendation:** While University or College-level standards may not be appropriate, we recommend that a study of the minimum level of preparedness for entrance into the EP Program be conducted to determine potential negative and positive impacts. Students not meeting the minimum standards may be offered alternatives to prepare them adequately so that students entering the program have improved graduation rates from the EP Program. This would improve both the metrics of success as well as the efficient application of scarce resources. This should be a part of an EP Program strategic vision for growth.

## **Program-Level Issues**

### *Accreditation – Realignment of Program Educational Objectives*

**Observation:** The EP Program is subject to reaccreditation this year. The program needs to restate its Educational Objectives to reflect revised and clarified accreditation standards. The program outcomes should better demonstrate what attributes graduates should be expected to obtain and demonstrate as working professionals (or continuing students) in their fields.

**Recommendation:** The EPAB discussed several good points of departure for realigning and restating these objectives. Work should continue on these definitions openly, across the two Colleges and with student and faculty inputs. The Objectives should enhance the specific strengths of the program elements and align with the university mission, all while satisfying the ABET definition. Objectives should be few and generally stated.

### *Selling the Program- Recruitment*

**Observation:** While the EP Program is mentioned in a brochure highlighting study options at NMSU, the EP Program could be more effective attracting high-potential students who are not already considering an in-state education. It has been stated that 60% of New Mexico high school graduates with ACT scores above 25 leave New Mexico for university studies. Note also that slightly more than 50% of the incoming EP students are first-time college-enrolled high school graduates.

The EPAB notes the positive potential impact of the recent Educational Partnership Agreement between NMSU and the Air Force Research Laboratories.

**Recommendation 1:** Attracting high-potential in-state students strengthens the program, directly aligns with NMSU's land-grant mission, and improves the chances of retaining highly educated technical professionals for employment in New Mexico's technology sectors. Reaching these students cannot be achieved by cold marketing activities. Ambassadors (e.g. faculty, staff, recruiters, advocates, current students, board members) must seek out and directly influence students' decisions about what to study, why, and where. There are a number of high-school internship programs at laboratories, industries, including high-school clubs which offer pools of pre-selected high-potential students to approach. The EPAB recommends that the EP Program establish a formal plan with objectives and metrics for recruiting, and incorporate that plan into a vision for growth.

**Recommendation 2:** The EPAB recommends that a standard set of recruiting tools for the EP Program be established, to accompany the existing brochure. This would include a boilerplate recruiting slide brief available to any/all Ambassadors, building a list of recruiting contacts (e.g. schools, labs), and any other items considered necessary for an effective recruiting campaign.

**Recommendation 3:** The Engineering College has offered resources to help market the EP Program. The EPAB recommends that the EP Program work with the College of Engineering to create a marketable program identity.

### Student Activities

**Observation:** A great improvement has been the reactivation of the Society of Physics Students (SPS) and the creation of the Society of Engineering Physics (SEPh).

**Recommendation:** Both groups are small and share some resources, but interact less than may be beneficial. The separation may be by choice, but if not, these two small organizations may be more productive and helpful to one another given some opportunities for crossover, such as co-sponsored activities.

### Computational Physics

**Observation:** The EPAB acknowledges that incorporation of a formal computational physics requirement into the program would be burdensome. However, we also note the continued growth of computational methods in all engineering disciplines and especially in technology R&D.

**Recommendation:** The EPAB recommends that the EP degree program continue to look for ways to introduce students to the necessity of computational physics. Capstone projects may be an opportunity for students to gain modest exposure to the techniques of computational methods.

### Interaction with Surrounding Industry/Labs

**Observation:** There is a wide array of Science and Technology industry, National Laboratories, and Observatories throughout New Mexico, Arizona, and Texas within several hours' drive of the NMSU campus. This provides opportunity for both student field trips to these labs and invited speakers to visit the campus.

**Recommendation:** The EPAB recommends that EP faculty, with the aid of the SPS and SEPh Societies, initiate a pipeline of invited speakers from the surrounding area to speak during society meetings, departmental seminars, or EP classes. The contact list would be similar to that for recruiting, with faculty drawing largely on their colleagues. These same contacts could also be used to coordinate site visits for EP classes or SPS/SEPh student groups.

### Capstone Projects

**Observation:** The National Laboratories are an excellent resource to align with the capstone projects, both for high-level sponsorship and technical mentorship. Projects formulated in this fashion mutually benefit both sides: the Lab expands its R&D portfolio and the EP Program increases its visibility and attractiveness.

**Recommendation:** The EPAB recommends partnering with constituents to identify, mentor, and sponsor capstone projects. Faculty should proactively advertise the capstone project concept to colleagues at National Labs, soliciting project ideas that align with both EP and Lab interests. Encourage the Labs to host the students to showcase their work.

**Observation:** The students' research and design activities (including both the capstone projects and undergraduate research) can be leveraged for conference presentations, journal publication, and design competitions. Teaching students the process and benefits of documenting their intellectual property will serve them well after graduation and further attract future employers. Many professional engineering societies (e.g., AIAA, ASME, IEEE) sponsor one or more annual student conferences and individual or group design competitions.

**Recommendation:** Faculty should help increase the demonstration of students' creative endeavors by directing them to various outlets for publication, conference presentation and/or participation, poster sessions, design competitions, and by documentation of intellectual property. This is a key area where faculty in the Engineering Departments can and should contribute.