

## **Responses to 2014 EPEAB recommendations**

### ***General***

*Need for computational methods: ... We do note a perceived need for adding more computational methods instruction within the program as presented. However, we also note that a plan for just such additions to the curriculum also was presented during the review meeting, and we point readers to the section below on that implementation plan.*

### ***Implementing Computational Methods into the EP Curriculum***

*EP students currently take various computational courses in their engineering departments. These courses are primarily MatLab based. ... The EP Program is investigating the potential benefits of using MatLab throughout the EP curricula. Both Colleges of Arts and Sciences and Engineering have MatLab licenses. ... All departments with an Engineering degree, including the EP Program, are asked to teach one section of ENGR 100. The content of this course is a subject of much discussion, with topics including: ... the use of computation to optimize parameters of a mathematical model.*

### **Response:**

Following the recommendations of the 2014 Board, the Department of Physics has purchased its own Matlab license for use throughout its Physics and EP curricula. The license includes the Curve Fitting, Instrument Control, Statistics, and Symbolic Math toolboxes. Nowadays, students use Matlab in the PHYS 315L "Experimental Modern Physics" course for data analysis -- this course is required of all EP majors. We have also recently started to use Matlab in the PHYS 150 "Elementary Computational Physics" course -- this is not required of EP majors but serves as a model for how the Physics department might teach a section of ENGR 100. Furthermore, students will find the Matlab tool kit particularly useful in our PHYS 476 "Computational Physics" course, and we are also encouraging use of computational methods throughout our upper-division physics offerings.

### ***Partnering College and Department Support***

*Recommendation: Communication of this report to appropriate University administrators, deans, and department heads is highly recommended and should serve as a starting point for better coordination of the EP Program between the associated colleges and departments. ... The EPEAB further recommends considering the establishment of an oversight committee, with joint participation from the Physics Department and the partnering engineering departments, and regularly scheduled review meetings to bridge the college and departmental gaps in program support and participation. ... should go hand-in-hand with substantial College of Engineering participation in the next EPEAB meeting.*

### **Response:**

As recommended, the EPEAB report was distributed to the Deans and Associate Deans in both colleges and also to the Department Heads in the associated engineering departments: Chemical & Materials Engineering, Electrical & Computer Engineering and Mechanical & Aerospace Engineering. It should be noted that the Engineering Physics Program Committee serves as the

oversight committee to the EP program. It consists of physics faculty and staff members, the physics department head, a representative from each of the associated engineering departments, and (*ex officio*) a representative from the College of Engineering. Interim Engineering Dean Stochaj has attended several EP committee meetings. The full oversight committee meets about once a month. Participation of the engineering members in this committee is expected in some, but not all, of the committee meetings, depending on the agenda. In general, our engineering colleagues attend when their input is needed.

### ***Resources to Manage Program***

*Recommendation: From a financial perspective, the lack of support at the college level is believed to be due, in part, to the University lacking a strategic plan for sustainable growth of its technical programs. As NMSU adopts a strategy for education, the EPEAB recommends seeking input from external constituents. We further recommend that the University push budget, staffing, and teaching load authority to the lowest practical level consistent with budgetary constraints. However, the board recognizes that many support staff needs of the EP Program could benefit through shared resources with the partnering engineering departments.*

*One obvious example where shared resources would benefit the EP Program is the Capstone projects. ... The EPEAB recommends that EP Program students pursue their Capstone projects within their Engineering concentrations, thus alleviating one of the current burdens on the Physics Department faculty.*

### **Response:**

The EP Program was started more than ten years ago in a partnership between the College of Engineering (CoE) and the College of Arts & Sciences (CoA&S) without an agreement on how to allocate resources. At that time, the assumption was that the CoE would manage the program academically (including hosting the headcount and awarding degrees) while the CoA&S would provide most resources for management and extracurricular activities. However, over the last ten years, NMSU has seen significant budget cuts, which are expected to become worse in the near future. Budget cuts are usually implemented top down (mostly across the board), with somewhat larger than average cuts affecting the CoA&S (and, by association, the Department of Physics). The NMSU budget process does not allocate resources based on figures of merit (headcount, degrees, and student credit hours) or strategic priorities. There is no cost-sharing with departments or programs that see significant increases in headcount, degrees, retention, or student credit hours. Despite its enrollment growth in Physics and Engineering Physics, the Department of Physics has suffered significant losses in faculty lines, operational funds, space, and three staff positions (administrative assistant, machinist, glass blower). Although both colleges seem very supportive of the EP Program, they are suffering from own budget cuts and have very limited resources for future strategic planning. The CoE has attempted to offset some of the problems due to the reduction in resources together with the growth in enrollments by introducing an engineering student fee. An appropriate share of this fee is passed down to the Department of Physics, which has been used to upgrade computers and instructional lab equipment. It could also support capstone projects. Many college-wide resources in both colleges (machine shop, computer labs, etc.) are shared with EP students. EP students are considered for college-wide scholarships and awards in engineering. In addition, the CoA&S just established a scholarship fund for EP students, clearly showing across-college collaboration. Historically, the

Department of Physics has always requested resources (such as faculty lines and start-up, teaching assistantships, equipment or building improvement funds) through the CoA&S, but even this model is under discussion and might change. Some resources for tutoring and supplemental instruction are also provided directly from the Provost's Office.

The CoE provides all resources related to EP students enrolled in engineering courses and also hosts most EP students in their capstone courses. Since a capstone project typically has four students in one group, sheer statistics makes it difficult for the physics department to host even one capstone group with four EP students. Therefore, most EP students complete their capstone projects in the associated engineering departments, following their rules and procedures. On the other hand, the physics department has faculty and resources available to guide capstone projects. In the fall of 2015, a request for EP capstone courses with a physics prefix was submitted and is currently pending approval from the CoA&S. The Engineering Physics Program Committee will continue to discuss how to best implement capstone courses for EP students. Project coordination is a challenge, because each associated department has different sets of capstone rules and guidelines.

### ***Program Coordinator***

*Recommendation: The EPEAB recommends discussion beginning at the Dean level on the possibilities of the College of Engineering supporting a program coordinator for a program that delivers high caliber students to, and graduates of, their departments.*

### **Response:**

Lower enrollments, reduced funding from the State of New Mexico and less overhead production from grants and contracts have led to much tighter budgets for the University in recent years. The university administration uses various approaches to deal with the budget impasse. Among others, administrative staff positions are now evaluated with increased scrutiny and permissions for 'new' positions, such as program administrators, are currently denied by our administration. It should be noted that the program coordinator position for CoE's Aerospace Engineering program was eliminated and the tasks associated with that previous position are covered by the Department Head (Ian Leslie) and the Associate Department Head (Gabe Garcia). As for Physics, the Department Head is a 12-month position with a one-course release. No similar benefits are provided to the Associate Department Head, except for a small supplemental pay of \$2000 per year. Given current budgets, it seems therefore unrealistic to further pursue hiring of a separate Program Coordinator. However, some of a Program Coordinator's tasks may be taken on by an appointed member of the EP Program Committee, as indicated in our response to 'Program Recognition and Employment Opportunities' below.

Unfortunately, the situation at the Department of Physics has gotten much worse, because the budget for replacing our administrative assistant was eliminated, pending a review of the need for a second administrative position within the department, besides our budget administrative assistant, Rosa Christensen. This has led to the situation that even the most basic day-to-day administrative tasks are only barely covered, using overtime and part-time temporary support from current and/or former students. We do not expect that the Department of Physics will be given permission by the CoA&S to re-hire a second administrator in the near future, a situation that seems unbearable given the complexities of the EP Program. The EP Program Committee

would greatly appreciate input from the External Advisory Board on how to best approach the administration in justifying a second admin. For example, should we try to pursue a second administrative assistant to be fully supported through CoE, given that EP has now similar enrollment compared to our physics program? It is not clear whether such an approach might create unnecessary tensions with our home college of A&S.

***Graduation rates/curriculum conflicts.***

*Recommendation: It appears that experience has allowed EP Program faculty to streamline the curriculum, but stresses remain to update courses, design and include new courses, include new course content, etc. ... Where appropriate, opportunities for advanced coursework should be considered within the context of four-plus-one Master's Degree programs to alleviate the issue.*

*Furthermore, the EPAB recommends that the Physics Department work with the partnering engineering departments to identify disciplines, for which a Bachelors degree in Engineering Physics could be combined with a Masters degree in Engineering.*

**Response:**

The curriculum committees of the Physics and Engineering departments have been continuously working on improving and streamlining the curriculum of the Engineering Physics Program. A major part of this work has been focused on reducing the average time to graduate and giving the students a realistic chance to graduate in 4 to 5 years. To accomplish this objective, several changes have been made in the Engineering Physics curriculum over the last year:

- 1) The curricula of the Aerospace, Chemical, and Mechanical Engineering Physics Concentrations have been substantially redesigned. The purpose of the redesign was to modernize the engineering part of the curriculum, streamline the curriculum, and eliminate duplication of the material presented in the engineering and physics courses. The updated curriculum of the Chemical Concentration has placed a larger emphasis on modern areas of physics and chemical engineering, such as materials design and nanotechnology. The recently implemented changes in the engineering curriculum are expected to help Engineering Physics students to be better prepared for the high-tech job market.
- 2) Several new physics courses have been introduced. These courses included Physics 420 "Capstone Project I", Physics 421 "Capstone Project II", and Physics 468 "Intermediate X-ray Diffraction". The physics capstone courses I and II were introduced as alternatives to engineering capstone design courses for Engineering Physics students. The X-ray diffraction course was introduced as a new technical elective course for Engineering Physics students. This course has been cross-listed with CHME 488 offered by the Chemical and Materials Engineering department. The new courses should make the Engineering Physics program more flexible by expanding the number of options available for students. Another advantage of PHYS pre-fix capstones is that they would allow accommodating EP students from different concentrations into one single capstone without worrying about different pre-requisite requirements within the different concentrations. In other words, EP students with different concentrations can work on the same capstone project, making it thus more interdisciplinary. .
- 3) The Physics and Engineering departments have begun a discussion about a possible reduction of the total number of credit hours required by the Engineering Physics Program. The Board of Regents of New Mexico State University has recently approved changing the minimum number

of credits required for a bachelor's degree from 128 to 120. This change is expected to improve the graduation rates and increase the percentage of students graduating from New Mexico State University in 4 to 5 years. It should be emphasized 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. The Board of Regents and the University Administration are discussing the possibility of reducing the number of General Education and VWW credits, or even eliminating the VWW program. Because the General Education program requirements are mandated by the State of New Mexico, changes in this program must be approved by the State of New Mexico Executive Branch. The outcome of this discussion is not clear yet. As they are, ABET already imposes very stringent program accreditation requirements, which often cannot be fit into the current 128 minimum credits. For example, in the last accreditation cycle, we had almost lost accreditation for EP-ChME because of arguments about whether our program offered enough engineering credit hours (48). We will not be able to accommodate any further reduction of major-specific course work, i.e. a reduction to 120 credits without affecting accreditation and program rigor is only possible if GenEd or VWW requirements are reduced.

The Engineering Physics Program offers a straightforward path to both Physics and Engineering graduate degrees. A bachelor's degree in Engineering Physics could be easily combined with master's degrees in Aerospace, Chemical, Electrical, and Mechanical Engineering. Engineering Physics students wishing to pursue a master's degree in Physics at New Mexico State University can apply up to 9 upper-level undergraduate credits toward their graduate degree. This provides students with an opportunity to complete the requirements for a master's degree in Physics in one year. Similarly, the CoE departments confirmed that EP students can enter a 4+1 program with a BS in EP and a MS in the respective engineering program.

### ***Internship Opportunities***

*Recommendation: While the EP Program appears to enjoy healthy connections to academia and industry, as demonstrated by the documented success of students moving on to graduate programs and careers in high-tech manufacturing and industrial R&D, the program's connections to federal science labs and industry within New Mexico could be strengthened significantly. Student employment opportunities abound at Los Alamos National Laboratory, Sandia National Laboratories, and Intel Corporation, and the faculty may even benefit through the connections their students make. Recent improvements in connections to the Department of Defense, NASA, and a broader spectrum of industry should continue to improve prospects. These contacts should not be left solely to the departments and programs, but should become part of NMSU's administrative strategy.*

### **Response:**

The Department of Physics receives information about internship opportunities from industry, national laboratories and academia-based materials research centers. Those opportunities are advertised to the EP student body, a folder of internship advertisements is kept in the departmental office and the Society of Engineering Physics (SEPh) students is provided with frequent updates of such opportunities.

In addition, the department strives to prepare students to more successfully compete for such internships. For example, Stefan Zollner (Department Head of Physics) offered a one-credit seminar for juniors and seniors during the fall 2015 semester to inform students about procedures for applying to graduate schools, internships, and permanent employment, based on the SPS Physics Careers Toolkit. We took field trips to UNM, Sandia, and Arizona State University, attended the Four Corners Section Meeting of the APS, and met with colloquium speakers employed in various sectors. This course needs to be advertised better and its content requires some fine-tuning for future offerings.

### ***Program Recognition and Employment Opportunities***

*Recommendation: The EPEAB recommends development of a placement program and closer partnership with the career development center on designing resumes specific to the EP degree. If possible, a Program Coordinator could work with career advisors to reach out to potential employers to educate them on the EP degree and its unique advantages, as well as to obtain their feedback on their employment needs.*

*There may be a need to determine the types of disciplines and industries that are and should be, targeted for the EP degree. With this information, a network of employers could be developed for the graduating EP students.*

*There may be a window of opportunity for marketing the EP Program to potential employers. Estimates are that only 20% of universities offer this degree. Promoting the program now could put the University in a leadership role for this expertise.*

### **Response:**

Mike DeAntonio has volunteered to serve as a *de facto* (unpaid) Program Constituency Liaison to work with the CoE, Career Placement, members of the External Advisory Board, peer Engineering Physics programs and other constituencies to develop a placement program for students graduating in Engineering Physics. He intends to work with and report to the committee and other Physics and Engineering faculty members on this development and will present a plan at the Engineering Advisory Board meeting in 2017.

Tentatively, his tasks in that position will be

- 1) To determine the types of disciplines and industries to be targeted for the Engineering Physics degree and find representatives in each of these areas.
- 2) To set up communication channels between the various constituencies and the representatives.
- 3) To work with Physics Faculty, the CoE, Career Placement, members of the external advisory board, peer Engineering Physics programs and other constituencies to develop a plan of action for post-graduation recruitment.
- 4) To create an outreach program to Graduate Programs and Industries explaining the benefits of the Engineering Physics degree.

Feedback from the External Advisory Board about such plans will be appreciated.

## ***Opportunities and Threats***

### ***Opportunities***

*As mentioned above, the EP Program's connections to federal science labs and industry within New Mexico could be strengthened significantly. Student employment opportunities abound at Los Alamos National Laboratory, Sandia National Laboratories, and Intel Corporation, and the faculty may even benefit through the connections their students make. The pursuit of opportunities for students may very well lead to long-term relationships for faculty members, with potential partnering on research proposals and activities. These contacts should not be left solely to the departments and programs, but should become part of NMSU's administrative strategy.*

### **Response:**

The Department of Physics has strong connections with federal laboratories and companies in New Mexico, especially Los Alamos, Sandia, AFRL and its contractors, Intel, etc. To strengthen NMSU involvement with LANL, Dr. Zollner was appointed by the Board of Regents to serve as Secretary on the New Mexico Consortium Board of Directors (NMC, a non-profit founded by the three NM research universities to enhance collaboration with LANL). Two recent EP graduates accepted positions with Intel and ATA Aerospace (AFRL contractor) in ABQ. Four faculty members (Fohlung, Cooper, Nakotte, Wang) spend a significant portion of their time collaborating with LANL scientists. Zollner has a current user proposal at CINT/Sandia. Two faculty members are seeking connections with Sandia and AFRL for sabbaticals and have applied for funding. While internship and employment opportunities abound for a small number of our best EP students (with a GPA above 3.5 and good experimental training), those students in our program with average GPAs (between 2.5 and 3.5) are struggling to find such opportunities. All EP majors have access to information about summer internships through the physics department and NMSU Career Services. The NMSU Administration pursues lab and industry contacts within NM through the Vice President for Research (who nominated Zollner for the NMC Board) and with joint faculty hires between LANL and NMSU (Cooper, Fohlung, Wang). Efforts for joint hires with AFRL (space physics, nuclear monitoring) and Sandia (spectroscopy, characterization) have thus far been unsuccessful.

To strengthen ties between the EP Program and regional industry and national labs, potential partners must recognize that our best students often pursue out-of-state opportunities and should perhaps consider also younger students or those with lower GPAs in our EP program. They might also provide sabbatical funding for our faculty members, since this will influence the reach to our EP students. Also, CINT might include an educational and diversity component in their mission. (George Maracas-DOE was not sympathetic.) Zollner has been struggling to maintain CINT user access for EP majors in his research group, since their modest abilities cannot support the CINT core research programs. While AFRL has an established summer internship program, many internships at Sandia are intended for UNM students (since most Sandia interns work year-round). Finding summer internships at Sandia and LANL are hard to find for our EP majors, because no central registry seems to exist. Therefore, making the match requires personal contacts between the EP student and mentors at NMSU and Sandia/LANL. The NMC has been discussing a summer internship program at LANL for undergraduate and graduate students. If this is implemented starting with the summer of 2017 and suitably advertised, then this might allow more NMSU EP majors to make the connection with LANL internships.

Finally, it is worthwhile to mention that a representative of our EP Program Committee (Steve Pate) serves on the CoE Dean Search Committee.

### ***Threats***

*The EP Program is quite small relative to their engineering department colleagues. Many of the resource issues that have arisen in this program are overshadowed by the very real problems faced by the much bigger engineering departments. But the fact remains that the engineering departments benefit by the existence of this very successful program, and modest assistance could bring about even higher levels of success.*

*Despite being a small program, the EP Program has grown considerably over the years, and likely will continue to do so. However, existing limited resources could turn continued growth into a serious threat as there exist serious resource needs at the current program size for dedicated staff mentors, program coordination with the engineering college, and related pressures.*

### **Response:**

Overall NMSU experiences decreasing enrollments, and the EP Program is one of few programs at NMSU with stable enrollment increases. The current Interim Dean for the CoE, Steve Stochaj, has commended the program for the continued success, and it was noted across the college. It's fair to state that our EP Program and our students is now widely recognized among the departments in the CoE, more so than in our own CoA&S. On the other hand, it still happens that EP may be sometimes 'forgotten' when it comes to CoE activities and/or recruitment materials.

The CoE has begun to charge lab fees from engineering students taking any of the required experimental labs, including the introductory physics laboratories. The Department of Physics receives a fair share of these fees, which are used to support instructional equipment and software licenses needed for our undergraduate programs. For example, the fees were used to pay for the MatLab license, which are now used in PHYS150 and PHYS315L.

Finally, it should be noted that ties with the engineering departments continues to grow, partly because of joint research or educational activities, as well as shared laboratory space during the renovation phase of Jett Hall, which houses the Departments of Chemical & Materials Engineering and Mechanical & Aerospace Engineering.