

## **Criterion B.4 Professional Component**

The College of Engineering has offered the degree of Bachelor of Science in Engineering Physics (BSEP) since Fall of 2002. The BSEP degree program is administered by the Department of Physics and affiliated with two engineering departments, Electrical Engineering (EE) and Mechanical Engineering (ME). Students may choose a program of study from the Electrical Option or the Mechanical Option. Course requirements for the two options are shown in Table I-1 in the Appendix.

Engineering Physics students in both options (Electrical and Mechanical) receive strong in-depth training in Physics, Mathematics, natural science, and in their respective engineering options. In addition, EP students take a sequence of General Education courses mandated by NMSU, designed to broaden their knowledge and understanding in the arts and humanities, and foster life-long learning. The course of study culminates in a capstone design project, which emphasizes teamwork, design skills, working within technical and budgetary constraints, coordination of multiple disciplines, and communication skills. The design experience also forces the students to consider the social impact and ethical considerations of engineering solutions. EP students participate in a design project within their engineering option area.

### **B.4.1 Mathematics and Basic Sciences**

Math preparation begins with 12-15 credits of calculus courses culminating in vector analysis and ordinary differential equations. Students in the Mechanical Option take four semesters of calculus and differential equations, Math 191, 192, 291, and 392. Students in the Electrical Option take these courses, plus an additional semester of Vector Analysis (EE 301). For both options, this is followed by a 3-credit course in Mathematical Methods in Physics (Phys 495) that trains EP students in selected mathematical methods applied to science and engineering problems.

Physics instruction begins with 12 credits of an introductory sequence of calculus-based courses in basic physics subjects: mechanics, electricity and magnetism, heat and thermodynamics, optics and acoustics, and modern physics (Phys 213, 214, 217, 315). The introductory course sequence is designed to provide the basis for succeeding science and engineering courses. Six credits of companion laboratory courses, taken simultaneously with the above courses (Phys 213L, 214L, 217L, 315L), provide the initial link to experimental science and engineering, including experimental design, execution, and analysis. In these laboratories, apart from experimental training, the EP students are also introduced to team working, oral presentation, and ethical responsibilities. A 4-credit course in General Chemistry (Chem. 111) rounds out their initial scientific education.

### **B.4.2 Engineering and Physics Topics, and Design**

Engineering practice is taught through specific courses in the engineering option taken either in the EE or the ME department as well as 400-level physics courses. The physics components are designed to complement the engineering components. Depending on their engineering option, EP students take approximately 40 credits (approximately three semesters) of courses from either the Electrical Engineering (EE) or the Mechanical Engineering (ME) Department.

EP students with the Electrical Option take core EE courses that cover computer programming, electromagnetism, analog and digital circuits, and signals and systems. Physics complements this coursework by covering advanced mechanics, thermodynamics, and modern physics.

EP students taking the Mechanical Option take core ME courses that cover computer programming and mechanical design, material properties, statics and dynamics, fluid mechanics, thermodynamics, and heat conduction. Here, physics complement to this coursework by adding topics in electromagnetism and modern physics.

All engineering physics students take 6 credits of Modern Physics (Physics 454, 455), which introduces topics in quantum physics of importance to many areas of science, engineering, and technology. Conventional programs in EE or ME do not cover modern physics topics, and this component makes the NMSU BSEP degree unique.

Following the introductory laboratory courses, both the Electrical and Mechanical Options provide a choice between two advanced undergraduate laboratories, Advanced Experimental Modern Physics (Phys 475) and Modern Experimental Optics (Phys 471). These courses span much of the experimental basis for modern experimental science and engineering. The Electrical Option, in particular, also provides for extensive experimental training.

A culminating challenge in the EP Program is the Capstone Design (EE 498, 499) or Design Project (ME 426, 427), a two-semester sequence of engineering courses taken in the final year. EP students may satisfy the Capstone Design requirement by completing 6 course credits within one of these sequences. The Capstone Design course provides students with the opportunity to ‘bring together’ their complementary training in mathematics, science, and engineering in an intensive engineering design experience with ‘real-world’ constraints. It provides experience at team projects in an engineering environment.

The Physics, Mathematics, and Chemistry courses described above provide EP students with complementary expertise that may be applied to engineering principles and technical skills. In collaboration with the EE and ME departments, the BSEP degree meets or exceeds the required course load of study in college-level mathematics and basic sciences, engineering sciences, and general education. Both options offer the opportunity, through 9 or more credits of physics and engineering electives, to broaden, complete, or enhance their knowledge of physics and engineering in areas of their own choosing.

Finally, it is important to note that the program described by the above course requirements emphasizes the ABET Program Outcomes *(a)-(k)*. Most courses often contribute to several of the outcomes, even though we typically measure only one (or few) outcomes in each course.

### **B.4.3 General Education Component**

All EP students must satisfy the General Education requirement of the College of Engineering consisting of 28 credits of coursework in arts and humanities. This includes English, such as Engl.

111G *Rhetoric and Composition*, and Engl 218G *Technical and Scientific Communication*, several 3-credit electives in *Critical Thinking and Analysis*, *Historical Perspectives*, *Human Thought and Behavior*, *Social Analysis*, *Literature and Fine Arts*, and 6 credits of Viewing a Wider World (VWW) courses. VWW courses are taken from a list of 300-400 level courses outside the College of Engineering. All General Education courses are selected from a list approved by the NMSU General Education Committee.