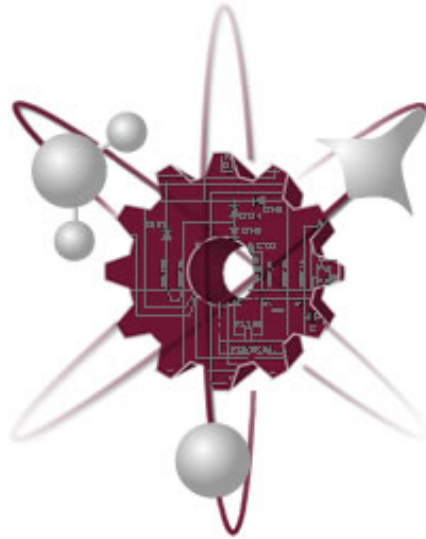


Criterion 5: Curriculum

Engineering Physics

Bachelor of Science in Engineering Physics



Self-Study Report

New Mexico State University



June 2012

CRITERION 5. CURRICULUM

A. Program Curriculum

Complete Table 5-1 that describes the plan of study for students in this program including information on course offerings in the form of a recommended schedule by year and term along with average section enrollments for all courses in the program over the two years immediately preceding the visit. State whether you are on quarters or semesters and complete a separate table for each option in the program.

Compared to the 2006 Self-Study Report of NMSU's Engineering Physics program, the curriculum has considerably evolved. Since then, the Engineering Physics Program Committee added two additional concentrations, *Aerospace* and *Chemical*, in addition to the original ones, *Electrical* and *Mechanical*. Subsequently, the curricula for the *Aerospace* and the *Chemical concentrations* are presented here for the first time in an official ABET Self-Study Report. However, even for the *Electrical* and *Mechanical concentrations*, there have been some significant changes compared to the previous 2006 Self-Study Report. Some significant changes are summarized next:

As result of outcomes assessment , the Department of Physics realized that many of the students do not have solid enough upper-level Math skills when they the 400+ level physics courses. Therefore, we introduced a new course *PHYS 395 – Intermediate Mathematical Methods in Physics*, which is to be taken as a pre-requisite or co-requisite of course such as *PHYS 451, 454* or *462*. This course is now required for each of the Engineering Physics concentrations. The previously required *PHYS 495 – Mathematical Methods in Physics* is now offered as a possible elective.

The curriculum for Electrical Engineering majors underwent a major overhaul in recent years. Some courses were eliminated, others combined and new ones introduced. The changes did affect the curriculum for Engineering Physics major with the *Electrical concentration* as well.

While not as substantial as in the case of Electrical Engineering, the Mechanical & Aerospace Engineering Department also revised some portions of the curricula for their majors, particularly in the pre- and co-requisite requirements. This had some effect on Engineering Physics majors with *Aerospace* or *Mechanical concentrations*.

In order to allow for more scheduling flexibility, the participating departments agreed allowing alternate course in the other department to satisfy a particular requirement (i.e. *ME 333* or *PHYS 451*).

Discontinuation of the 9-credit rule to substitute for a *Viewing-the-Wider-World (VWW)* would have increased the number of total credit hours by another 3 credits (on top of an already high-credit degree). The Engineering Physic Program Committee therefore decided to reduce the number of technical credits required (mostly electives).

Tables 5.1.a-d provide the plan of study for each of the four Engineering Physics concentrations (in alphabetical order), namely *Aerospace*, *Chemical*, *Electrical* and *Mechanical*. NMSU operates on a semester system with spring and fall semesters of ~14 weeks of instruction each. For some of the lower-level courses students have the opportunity to make up classes during summer.

Table 5.1.a. Curriculum for Bachelor of Science in Engineering Physics – Aerospace Concentration

Course (Department, Number, Title) List all courses in the program by term starting with first term of first year and ending with the last term of the final year.	Indicate Whether Course is Required, Elective, or a Selective Elective by an R, an E or an SE ²	Curricular Area (Credit Hours)				Last Two Terms the Course was Offered: Year and, Semester, or Quarter	Average Section Enrollment for the Last Two Terms the Course was Offered ¹
		Math & Basic Sciences	Discipline Specific Topics	General Education	Other		
Year 1, Semester 1 (15 credits)							
MATH 191G, Calculus and Analytic Geometry I	R	4				F 2011 S 2012	40 40
PHYS 213 (or 215), Mechanics	R		3			F 2010 F 2011	28 28
PHYS 213L (or 215L), Experimental Mechanics	R		1			F 2010 F 2011	22 24
M E 102 (or AE102), Mechanical Engineering Orientation	R		1			F 2011 S 2012	53 32
M E 159, Graphical Communication and Design	R		2			F 2011 S 2012	41 41
ENGL 111G, Rhetoric and Composition	R			4		F 2011 S 2012	27 27
Year 1, Semester 2 (15 credits)							
MATH 192G, Calculus and Analytic Geometry II	R	4				F 2011 S 2012	40 40
PHYS 214 (or 216), Electricity and Magnetism	R		3			S 2011 S 2012	21 16
PHYS 214 (or 216L)L, Electricity and Magnetism Laboratory	R		1			S 2011 S 2012	21 12
CHEM 111G, General Chemistry	R	4				F 2011 S 2012	131 168
Written Communications Elective	SE			3		F 2011 S 2012	n/a n/a
Year 2, Semester 3 (16 credits)							

MATH 291G, Calculus and Analytic Geometry III	R	3				F 2011 S 2012	40 40
PHYS 217, Heat, Light, and Sound	R		3			F 2010 F 2011	29 30
PHYS 217L, Experimental Heat, Light, and Sound	R		1			F 2010 F 2011	17 15
M E 236, Engineering Mechanics I	R		3			F 2011 S 2012	45 38
M E 240, Thermodynamics	R		3			F 2011 S 2012	40 41
Oral Communication Elective	SE			3		F 2011 S 2012	n/a n/a
Year 2, Semester 4 (18 credits)							
MATH 392, Introduction to Ordinary Differential Equations	R	3				F 2011 S 2012	40 40
PHYS 315, Modern Physics	R		3			S 2011 S 2012	33 33
PHYS 315L, Experimental Modern Physics	R		3			S 2011 S 2012	20 23
M E 237, Engineering Mechanics II	R		3			F 2011 S 2012	38 27
C E 301, Mechanics of Materials	R		3			F 2011 S 2012	87 80
General Education Core Elective	SE			3		F 2011 S 2012	n/a n/a
Year 3, Semester 5 (18 credits)							
PHYS 395, Intermediate Math. Methods of Physics	R		3			-- F 2011	-- 21
PHYS 461, Intermediate Electricity and Magnetism I	R		3			F 2010 F 2011	14 17
A E 339, Aerodynamics I	R		3			F 2011 S 2012	59 39
A E 363, Aerospace Structures	R		3			F 2011 S 2012	47 38
A E 364, Flight Dynamics and Controls	R		3			F 2011 S 2012	50 26

General Education Core Elective	SE			3		F 2011 S 2012	n/a n/a
Year 3, Semester 6 (15 credits)							
PHYS 462, Intermediate Electricity and Magnetism II	R		3			S 2011 S 2012	11 16
M E 345, Experimental Methods I	R		3			F 2011 S 2012	39 44
A E 362, Orbital Mechanics	R		3			F 2011 S 2012	28 77
A E 439, Aerodynamics II	R		3			F 2011 S 2012	49 54
General Education Core Elective	SE			3		F 2011 S 2012	n/a n/a
Year 4, Semester 7 (18 credits)							
PHYS 454, Intermediate Modern Physics I	R		3			F 2010 F 2011	13 14
A E 419, Propulsion	R		3			F 2011 S 2012	35 29
A E 424, Aerospace Systems Engineering	R		3			F 2011 S 2012	43 40
A E 447, Aerofluidics Laboratory	R		3			F 2011 S 2012	37 32
PHYS / A E / M E, Technical Elective	E		3			F 2011 S 2012	n/a n/a
General Education Core Elective	SE			3		F 2011 S 2012	n/a n/a
Year 4, Semester 8 (15 credits)							
PHYS 455, Intermediate Modern Physics II	R		3			S 2011 S 2012	12 13
A E 428, Aerospace Capstone Design	R		3			F 2011 S 2012	28 41
Viewing a Wider World Elective (2 courses)	SE				3	F 2011 S 2012	n/a n/a
Viewing a Wider World Elective (2 courses)	SE				3	F 2011 S 2012	n/a n/a

General Education Core Elective	SE			3		F 2011 S 2012	n/a n/a
TOTAL CREDIT HOURS FOR THE DEGREE	133	18	84	25	6		
PERCENT OF TOTAL		14%	63%	19%	4%		

Table 5.1.b. Curriculum for Bachelor of Science in Engineering Physics – *Chemical Concentration*

Course (Department, Number, Title) List all courses in the program by term starting with first term of first year and ending with the last term of the final year.	Indicate Whether Course is Required, Elective, or a Selective Elective by an R, an E or an SE ²	Curricular Area (Credit Hours)				Last Two Terms the Course was Offered: Year and, Semester, or Quarter	Average Section Enrollment for the Last Two Terms the Course was Offered ¹
		Math & Basic Sciences	Discipline Specific Topics	General Education	Other		
Year 1, Semester 1 (15 credits)							
MATH 191G, Calculus and Analytic Geometry I	R	4				F 2011 S 2012	40 40
PHYS 213 (or 215), Mechanics	R		3			F 2010 F 2011	28 28
PHYS 213L (or 215L), Experimental Mechanics	R		1			F 2010 F 2011	22 24
CH E 111, Introduction to Computer Calculations in CH E	R		3			F 2010 F 2011	25 31
CHEM 115, Principles of Chemistry I	R		4			F 2010 F 2011	58 51
Year 1, Semester 2 (16 credits)							
MATH 192G, Calculus and Analytic Geometry II	R	4				F 2011 S 2012	40 40
PHYS 214 (or 216), Electricity and Magnetism	R		3			S 2011 S 2012	21 16

PHYS 214L (or 216), Electricity and Magnetism Laboratory	R		1			S 2011 S 2012	21 12
CHEM 116, Principles of Chemistry II	R		4			S 2011 S 2012	41 33
ENGL 111G, Rhetoric and Composition	R			4		F 2011 S 2012	27 27
Year 2, Semester 3 (17 credits)							
MATH 291G, Calculus and Analytic Geometry III	R	3				F 2011 S 2012	40 40
PHYS 217, Heat, Light, and Sound	R		3			F 2010 F 2011	29 30
PHYS 217L, Experimental Heat, Light, and Sound	R		1			F 2010 F 2011	17 15
CH E 201, Material and Energy Balances	R		4			F 2010 S 2012	32 30
CHEM 313, Organic Chemistry I	R		3			F 2011 S 2012	149 143
Written Communication Elective	SE			3		F 2011 S 2012	n/a n/a
Year 2, Semester 4 (18 credits)							
MATH 392, Introduction to Ordinary Differential Equations	R	3				F 2011 S 2012	40 40
PHYS 315, Modern Physics	R		3			S 2011 S 2012	33 33
PHYS 315L, Experimental Modern Physics	R		3			S 2011 S 2012	20 23
CH E 301, Chemical Engineering Thermodynamics I	R		3			S 2011 S 2012	20 27
CH E 305, Transport Operations I	R		3			S 2011 S 2012	20 28
Oral Communication Elective	SE			3		F 2011 S 2012	n/a n/a
Year 3, Semester 5 (18 credits)							
PHYS 395, Intermediate Math. Methods of Physics	R		3			-- F 2011	-- 21

PHYS 461, Intermediate Electricity and Magnetism I	R		3			F 2010 F 2011	14 17
CH E 302, Chemical Engineering Thermodynamics II	R		3			F 2010 F 2011	21 17
CH E 302L, Thermodynamic Models of Phys. Properties	R		1			-- F 2011	-- 17
CH E 306, Transport Operations II	R		3			F 2010 F 2011	18 17
CHEM 314, Organic Chemistry II	R		3			F 2011 S 2012	46 65
CHEM 315, Organic Chemistry Laboratory	R		2			F 2011 S 2012	21 20
Year 3, Semester 6 (16 credits)							
PHYS 462, Intermediate Electricity and Magnetism II	R		3			S 2011 S 2012	11 16
CH E 307, Transport Operations III	R		3			S 2011 S 2012	22 14
CH E 352L, Simulation of Unit Operations	R		1			-- S 2012	-- 15
CH E 361, Engineering Materials	R		3			F 2011 S 2012	73 81
CH E 441, Chemical Kinetics and Reactor Engineering	R		3			S 2011 S 2012	20 17
General Education Core Elective	SE			3		F 2011 S 2012	n/a n/a
Year 4, Semester 7 (15 credits)							
PHYS 454, Intermediate Modern Physics I	R		3			F 2010 F 2011	13 14
PHYS 451, Intermediate Mechanics	R		3			F 2010 F 2011	5 12
Viewing a Wider World Elective	SE				3	F 2011 S 2012	n/a n/a
General Education Core Elective	SE			3		F 2011 S 2012	n/a n/a
General Education Core Elective	SE			3		F 2011 S 2012	n/a n/a

Year 4, Semester 8 (15 credits)							
PHYS 455, Intermediate Modern Physics II	R		3			S 2011 S 2012	12 13
PHYS 475, Advanced Physics Laboratory	R		3			S 2011 S 2012	8 11
Viewing a Wider World Elective	SE				3	F 2011 S 2012	n/a n/a
General Education Core Elective	SE			3		F 2011 S 2012	n/a n/a
General Education Core Elective	SE			3		F 2011 S 2012	n/a n/a
TOTAL CREDIT HOURS FOR THE DEGREE		134	14	89	25	6	
PERCENT OF TOTAL			10%	68%	18%	4%	

Table 5.1.c. Curriculum Bachelor of Science in Engineering Physics – *Electrical Concentration*

Course (Department, Number, Title) List all courses in the program by term starting with first term of first year and ending with the last term of the final year.	Indicate Whether Course is Required, Elective, or a Selective Elective by an R, an E or an SE ²	Curricular Area (Credit Hours)				Last Two Terms the Course was Offered: Year and, Semester, or Quarter	Average Section Enrollment for the Last Two Terms the Course was Offered ¹
		Math & Basic Sciences	Discipline Specific Topics	General Education	Other		
Year 1, Semester 1 (16 credits)							
MATH 191G, Calculus and Analytic Geometry I	R	4				F 2011 S 2012	40 40
PHYS 213 (or 215), Mechanics	R		3			F 2010 F 2011	28 28
PHYS 213L (or 215L), Experimental Mechanics	R		1			F 2010 F 2011	22 24

E E 161, Computer Aided Problem Solving	R		4			F 2011 S 2012	66 50
ENGL 111G, Rhetoric and Composition	R			4		F 2011 S 2012	27 27
Year 1, Semester 2 (16 credits)							
MATH 192G, Calculus and Analytic Geometry II	R	4				F 2011 S 2012	40 40
PHYS 214 (or 216), Electricity and Magnetism	R		3			S 2011 S 2012	21 16
PHYS 214L (or 216L), Electricity and Magnetism Laboratory	R		1			S 2011 S 2012	21 12
E E 162, Digital Circuits Design	R		4			F 2011 S 2012	34 26
CHEM 111G, General Chemistry	R	4				F 2011 S 2012	131 168
Year 2, Semester 3 (18 credits)							
MATH 291G, Calculus and Analytic Geometry III	R	3				F 2011 S 2012	40 40
PHYS 217, Heat, Light, and Sound	R		3			F 2010 F 2011	29 30
PHYS 217L, Experimental Heat, Light, and Sound	R		1			F 2010 F 2011	17 15
E E 210, Engineering Analysis I	R		4			F 2011 S 2012	43 43
E E 260, Embedded Systems	R		4			F 2011 S 2012	46 29
Written Communication Elective	SE			3		F 2011 S 2012	n/a n/a
Year 2, Semester 4 (16 credits)							
MATH 392, Introduction to Ordinary Diff. Equations	R	3				F 2011 S 2012	40 40
PHYS 315, Modern Physics	R		3			S 2011 S 2012	33 33
PHYS 315L, Experimental Modern Physics	R		3			S 2011 S 2012	20 23

E E 280, DC and AC Circuits	R		4			F 2011 S 2012	25 23
Oral Communication Elective	SE			3		F 2011 S 2012	n/a n/a
Year 3, Semester 5 (16 credits)							
PHYS 395, Intermediate Math. Methods of Physics	R		3			-- F 2011	-- 21
PHYS 451, Intermediate Mechanics	R		3			F 2010 F 2011	5 12
PHYS 461, Intermediate Electricity and Magnetism I	R		3			F 2010 F 2011	14 17
E E 312, Signals and Systems I	R		3			F 2011 S 2012	41 40
E E 380, Electronics I	R		4			F 2011 S 2012	26 30
Year 3, Semester 6 (18 credits)							
PHYS 480, Thermodynamics	R		3			S 2010 S 2012	13 18
PHYS 475, Advanced Physics Laboratory	R		3			S 2011 S 2012	8 11
PHYS 462, Intermediate Electricity and Magnetism II	R		3			S 2011 S 2012	11 16
PHYS / E E, Technical Elective	E		3			F 2011 S 2012	n/a n/a
General Education Core Elective	SE			3		F 2011 S 2012	n/a n/a
General Education Core Elective	SE			3		F 2011 S 2012	n/a n/a
Year 4, Semester 7 (15 credits)							
PHYS 454, Intermediate Modern Physics I	R		3			F 2010 F 2011	13 14
E E 418, Capstone Design I	R		3			F 2011 S 2012	4 4
Viewing a Wider World Elective	SE				3	F 2011 S 2012	n/a n/a

General Education Core Elective	SE			3		F 2011 S 2012	n/a n/a
General Education Core Elective	SE			3		F 2011 S 2012	n/a n/a
Year 4, Semester 8 (15 credits)							
PHYS 455, Intermediate Modern Physics II	R		3			S 2011 S 2012	12 13
E E 419, Capstone Design II	R		3			F 2011 S 2012	4 4
PHYS / E E, Technical Elective	E		3			F 2011 S 2012	n/a n/a
Viewing a Wider World Elective	SE				3	F 2011 S 2012	n/a n/a
General Education Core Elective	SE			3		F 2011 S 2012	n/a n/a
TOTAL CREDIT HOURS FOR THE DEGREE	133	18	84	25	6		
PERCENT OF TOTAL		14%	63%	19%	4%		

Table 5.1.d. Curriculum for Bachelor of Science in Engineering Physics – Mechanical Concentration

Course (Department, Number, Title) List all courses in the program by term starting with first term of first year and ending with the last term of the final year.	Indicate Whether Course is Required, Elective, or a Selective Elective by an R, an E or an SE ²	Curricular Area (Credit Hours)				Last Two Terms the Course was Offered: Year and, Semester, or Quarter	Average Section Enrollment for the Last Two Terms the Course was Offered ¹
		Math & Basic Sciences	Discipline Specific Topics	General Education	Other		
Year 1, Semester 1 (15 credits)							
MATH 191G, Calculus and Analytic Geometry I	R	4				F 2011	40

						S 2012	40
PHYS 213 (or 215), Mechanics	R		3			F 2010 F 2011	28 28
PHYS 213L (or 215L), Experimental Mechanics	R		1			F 2010 F 2011	22 24
M E 102, Mechanical Engineering Orientation	R		1			F 2011 S 2012	53 32
M E 159, Graphical Communication and Design	R		2			F 2011 S 2012	41 41
CHEM 111G, General Chemistry	R	4				F 2011 S 2012	131 168
Year 1, Semester 2 (15 credits)							
MATH 192G, Calculus and Analytic Geometry II	R	4				F 2011 S 2012	40 40
PHYS 214 (or 216), Electricity and Magnetism	R		3			S 2011 S 2012	21 16
PHYS 214L (or 216L), Electricity and Magnetism Laboratory	R		1			S 2011 S 2012	21 12
M E 240, Thermodynamics	R		3			F 2011 S 2012	40 41
ENGL 111G, Rhetoric and Composition	R			4		F 2011 S 2012	27 27
Year 2, Semester 3 (17 credits)							
MATH 291G, Calculus and Analytic Geometry III	R	3				F 2011 S 2012	40 40
PHYS 217, Heat, Light, and Sound	R		3			F 2010 F 2011	29 30
PHYS 217L, Experimental Heat, Light, and Sound	R		1			F 2010 F 2011	17 15
M E 236, Engineering Mechanics I	R		3			F 2011 S 2012	45 38
M E 261, Mechanical Engineering Problem Solving	R		4			F 2011 S 2012	33 40
Written Communication Elective	SE			3		F 2011 S 2012	n/a n/a

Year 2, Semester 4 (18 credits)							
MATH 392, Introduction to Ordinary Diff. Equations	R	3				F 2011 S 2012	40 40
PHYS 315, Modern Physics	R		3			S 2011 S 2012	33 33
PHYS 315L, Experimental Modern Physics	R		3			S 2011 S 2012	20 23
M E 237, Engineering Mechanics II	R		3			F 2011 S 2012	38 27
C E 301, Mechanics of Materials	R		3			F 2011 S 2012	87 80
Oral Communication Elective	SE			3		F 2011 S 2012	n/a n/a
Year 3, Semester 5 (18 credits)							
PHYS 395, Intermediate Math. Methods of Physics	R		3			-- F 2011	-- 21
PHYS 461, Intermediate Electricity and Magnetism I	R		3			F 2010 F 2011	14 17
M E 326, Mechanical Design	R		3			F 2011 S 2012	25 27
M E 328, Engineering Analysis I	R		3			F 2011 S 2012	49 42
M E 338, Fluid Mechanics	R		3			F 2011 S 2012	34 25
General Education Core Elective	SE			3		F 2011 S 2012	n/a n/a
Year 3, Semester 6 (15 credits)							
PHYS 462, Intermediate Electricity and Magnetism II	R		3			S 2011 S 2012	11 16
M E 341, Heat Transfer	R		3			F 2011 S 2012	31 37
PHYS / M E, Technical Elective	E		3			F 2011 S 2012	n/a n/a
General Education Core Elective	SE			3		F 2011 S 2012	n/a n/a

General Education Core Elective	SE			3		F 2011 S 2012	n/a n/a
Year 4, Semester 7 (18 credits)							
PHYS 454, Intermediate Modern Physics I	R		3			F 2010 F 2011	13 14
PHYS 451, Intermediate Mechanics	R		3			F 2010 F 2011	5 12
M E 426, Design Project Laboratory I	R		3			F 2011 S 2012	40 24
Viewing a Wider World Elective	SE				3	F 2011 S 2012	n/a n/a
General Education Core Elective	SE			3		F 2011 S 2012	n/a n/a
General Education Core Elective	SE			3		F 2011 S 2012	n/a n/a
Year 4, Semester 8 (16 credits)							
PHYS 455, Intermediate Modern Physics II	R		3			S 2011 S 2012	12 13
PHYS 475, Advanced Physics Laboratory	R		3			S 2011 S 2012	8 11
M E 427, Design Project Laboratory II	R		3			F 2011 S 2012	18 38
M E 449, Mechanical Engineering Senior Seminar	R		1			F 2011 S 2012	38 41
Viewing a Wider World Elective	SE				3	F 2011 S 2012	n/a n/a
TOTAL CREDIT HOURS FOR THE DEGREE		132	18	83	25	6	
PERCENT OF TOTAL			14%	63%	19%	4%	

- For courses that include multiple elements (lecture, laboratory, recitation, etc.), indicate the average enrollment in each element.
- Required courses are required of all students in the program, elective courses are optional for students, and selected electives are courses where students must take one or more courses from a specified group.

1. Describe how the curriculum aligns with the program educational objectives.

The *Program Educational Objectives* of the Engineering Physics program at New Mexico State University are: (1) competitiveness, (2) adaptability, and (3) teamwork and leadership. These objectives are consistent with and supportive of the institutional educational objectives of the College of Engineering, the College of Arts & Sciences, and New Mexico State University.

Objective 1: Competitiveness. The curriculum of the Engineering Physics program has been specifically designed to enable students acquire strong fundamental knowledge in physics and the chosen engineering field, adopt effective communication and problem-solving skills, develop the ability to tackle new problems, and achieve a level of preparation that allows continuation to advanced studies after graduation. Each of the four program concentrations requires students to complete at least 14-18 credits of mathematics and basic sciences, 36 credit hours of physics, and 33-45 credit hours of specialized engineering courses. The strong foundation of fundamental science courses and a broad range of specialized engineering courses help ensure that the Engineering Physics graduates are competitive in internationally-recognized academic, government and industrial environments.

Objective 2: Adaptability. The Engineering Physics program at New Mexico State University offers a broad selection of courses that cover a variety of engineering and scientific disciplines. The Engineering Physics program entails more than 50 specialized technical and engineering courses that cover the areas of aerospace, chemical, electrical, and mechanical engineering. The wide selection of specialized courses offered by the program curriculum broadens the range of the potential employment opportunities for Engineering Physics graduates. These opportunities include employment in research and development, energy and utility, manufacturing, automotive, photonics, aerospace, defense and space, sensor technology, and many other fields.

Objective 3: Teamwork and Leadership. As a part of the Engineering Physics curriculum, students are required to take a sequence of physics and engineering laboratory and capstone courses. In the format of these courses students learn to work in teams, collaborate with other students, and lead a team of students toward successful completion of the project. In order to complete project requirements successfully, the student must demonstrate practical application of relevant knowledge and skills, such as standard analysis techniques, design principles, as well as teamwork, communication, problem solving, and critical thinking. This approach enables Engineering Physics graduates to have an ability to function as part of and/or lead interdisciplinary teams.

The *Educational Objectives* of the Engineering Physics program and the methods of their evaluation are described in more detail in *Criterion 2 – Educational Objectives* and *Criterion 4 – Continuous Improvement*.

2. Describe how the curriculum and its associated prerequisite structure support the attainment of the student outcomes.

A list of the physics and engineering courses with the measured program outcomes is shown in the outcome matrix table attached below. In order to achieve the desired outcomes, a path of

core courses (having pre-requisites) has become essential within an integrated, cumulative educational process (see flow charts above). Each course is expected to measure certain *Program Outcomes (a)-(k)*. The assessment matrix for physics courses is given in Table 5.2. Assessment matrices for the engineering courses are given in *Criterion 3 – Program Outcomes* (Tables 3.2.b-e) and the results of course assessments are presented and discussed in *Criterion 4 – Continuous Improvement*.

Table 5.2: Assessment Matrix showing the correspondence of *Program Outcomes (a) thru (k)* to (required and elective) physics courses of the Engineering Physics program. Note, this is the essentially the same table as Table 3.2.a. Unlike this table, Table 3.2.a lists possible physics electives.

<i>Physics Course</i>	<i>Program Outcomes</i>										
	<i>(a)</i>	<i>(b)</i>	<i>(c)</i>	<i>(d)</i>	<i>(e)</i>	<i>(f)</i>	<i>(g)</i>	<i>(h)</i>	<i>(i)</i>	<i>(j)</i>	<i>(k)</i>
PHYS 213 or 215,	X										
PHYS 213L or 215L		X									
PHYS 214 or 216	X										
PHYS 214L or 216L		X									
PHYS 217	X										
PHYS 217L		X	N	N							
PHYS 315	X					X		X	X	X	
PHYS 315L		X	a	X			X				X
PhHYS 395 (new)						N					
PHYS 451					X						
PHYS 454 & 455,					X						
PHYS 450 - Capstone			X	X			X				X
PHYS 461 a & 462					X						
PHYS 475		X	a	X			X				X
PHYS 480					X						
Physics Electives			a	a		a		a	a	a	a

a: whether this Program Outcome is measured depends on the individual instructor and/or the course
 N: indicates new assessment

3. Attach a flowchart or worksheet that illustrates the prerequisite structure of the program's required courses.

Suggested flowcharts for each of the four concentrations (*Aerospace, Chemical, Electrical and Mechanical*) of the Engineering Physics program are given in Diagram 5.1.a-d.

Diagram 5.1.a. Proposed Schedule for *Engineering Physics with the Aerospace Concentration*. Arrows coming in from the top indicate pre-requisite requirements. Arrows from the side indicate co-requisites.

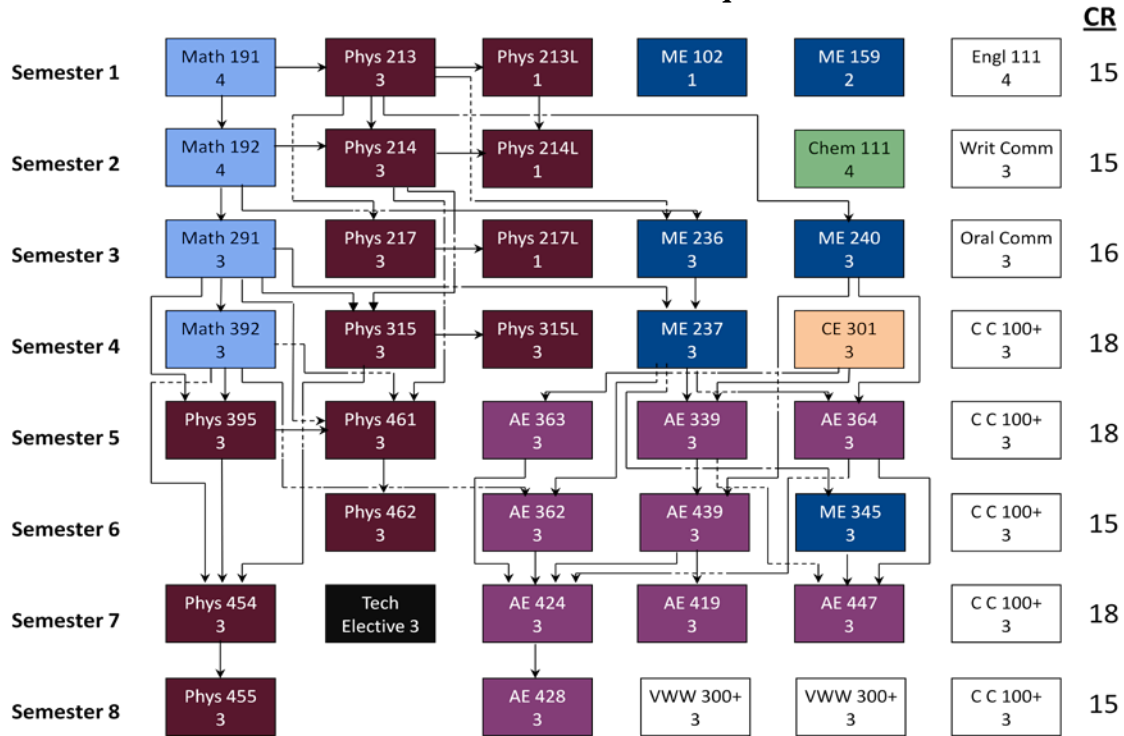


Diagram 5.1.b. Proposed Schedule for *Engineering Physics with the Chemical Concentration*. Arrows coming in from the top indicate pre-requisite requirements. Arrows from the side indicate co-requisites.

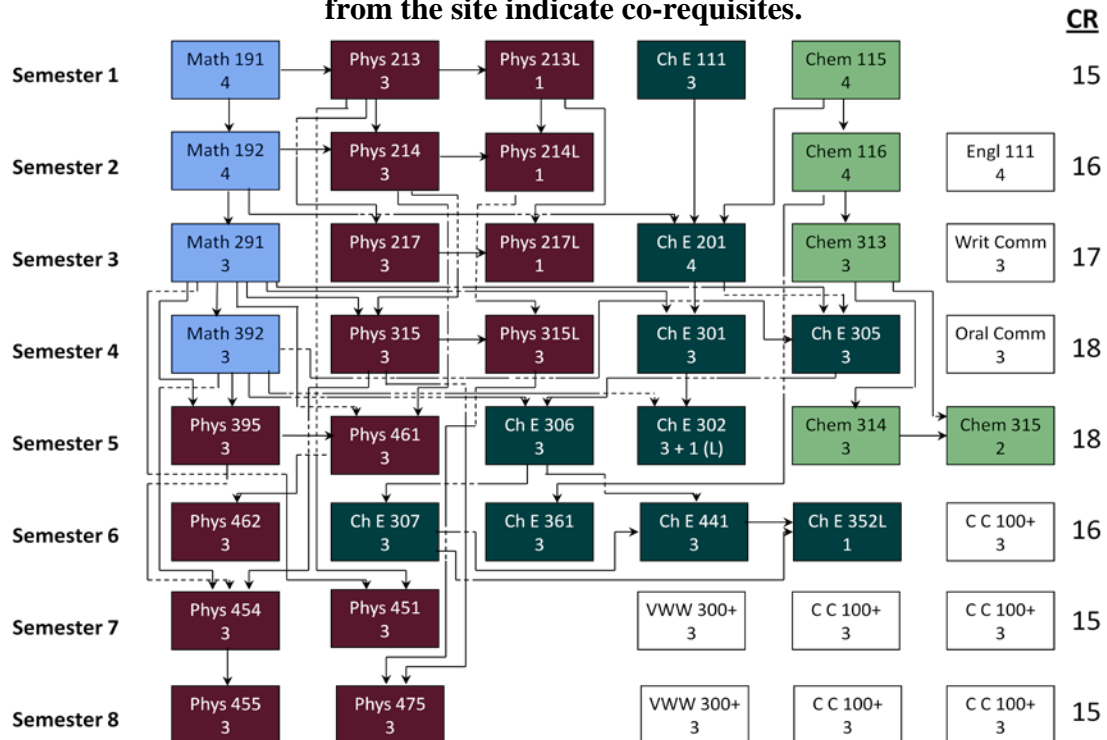


Diagram 5.1.c. Proposed Schedule for *Engineering Physics with the Electrical Concentration*. Arrows coming in from the top indicate pre-requisite requirements. Arrows from the side indicate co-requisites.

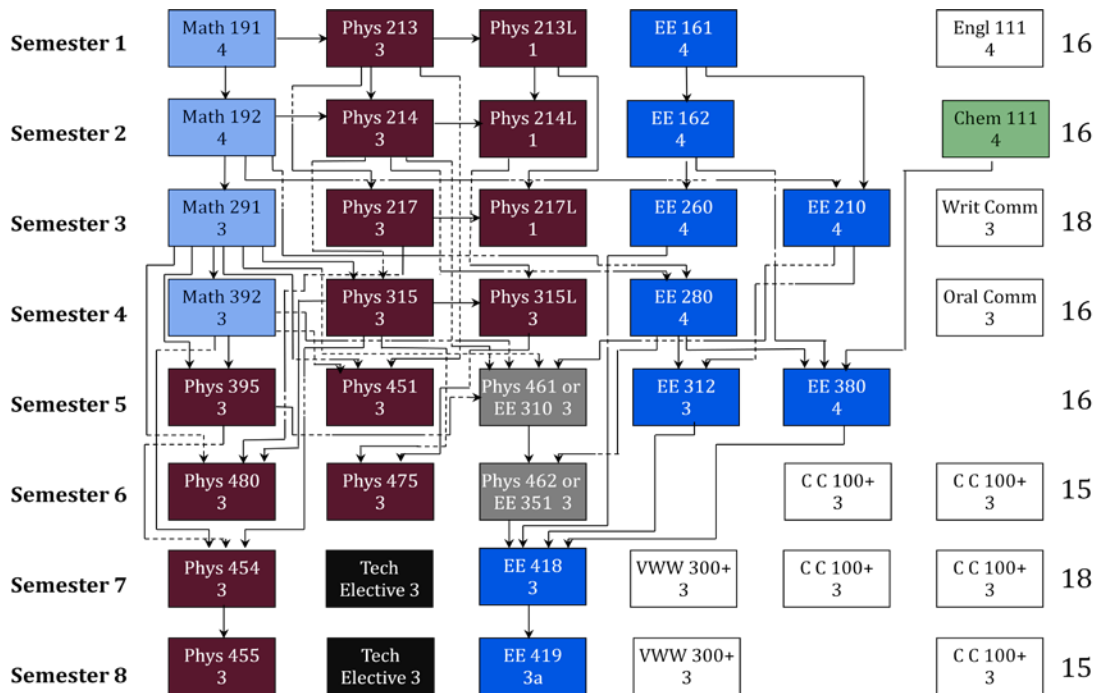
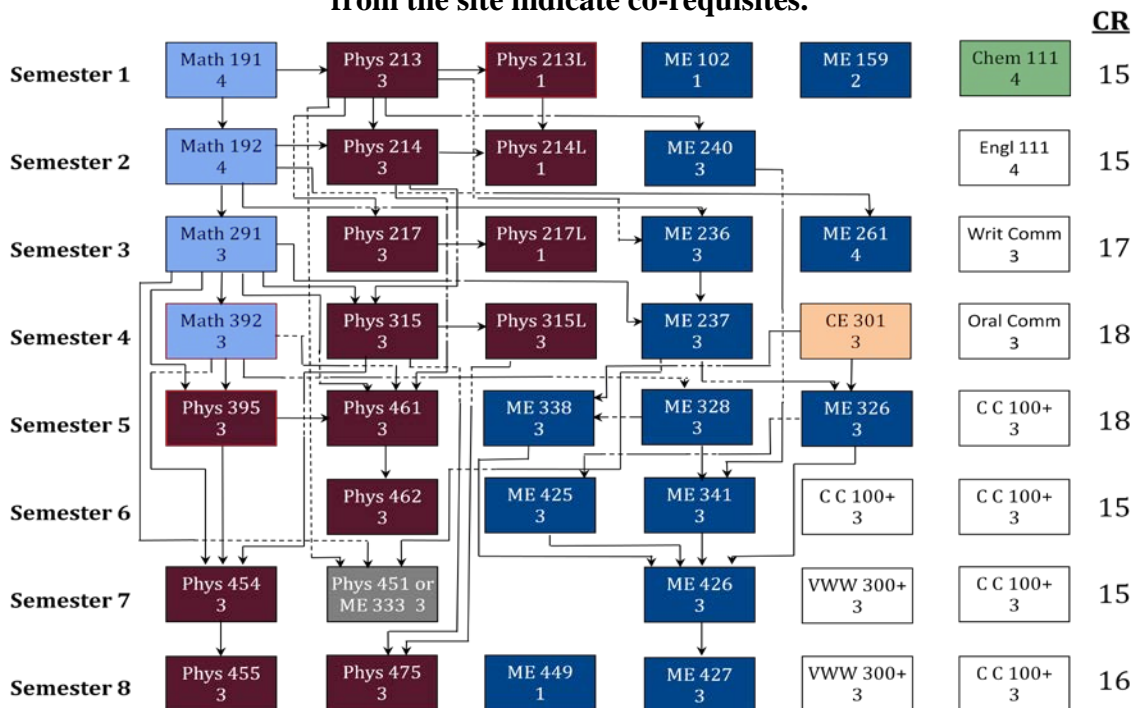


Diagram 5.1.d. Proposed Schedule for *Engineering Physics with the Mechanical Concentration*. Arrows coming in from the top indicate pre-requisite requirements. Arrows from the side indicate co-requisites.



4. For each curricular area specifically addressed by either the general criteria or the program criteria as shown in Table 5-1, describe how your program meets the specific requirements for this program area in terms of hours and depth of study.

Physics Courses (33-42 credits)

Students enrolled in each of the four Engineering Physics concentrations are required to complete 36 credits of physics courses. The central part of this requirement is represented by the core sequence of physics courses offered to the physics majors. The sequence includes 3 introductory level physics courses combined with physics laboratories, 2 intermediate level courses designed to prepare students for the upper division physics classes, and 5-7 advanced physics courses that cover a variety of subjects, including classical mechanics, quantum mechanics, electromagnetic theory, thermodynamics, and advanced physics laboratory. For the individual Engineering Physics concentrations, the physics sequence is designed to complement, rather than duplicate, the engineering sequence so that students gain a broad physics background.

Specialized Engineering Courses (33-44 credits)

A broad-based foundation in technical and engineering courses prepares Engineering Physics graduates for a variety of employment opportunities. The Engineering Physics program at New Mexico State University offers students a selection of four different concentrations: *Aerospace*, *Chemical*, *Electrical*, and *Mechanical*. Students electing the *Mechanical concentration* are required to complete 38 credits of mechanical and civil engineering courses. The *Electrical concentration* requires students to complete 33 credits of electrical engineering courses. Students enrolled in the *Aerospace concentration* have to complete 18 credits of mechanical and 27 credits of aerospace engineering courses. The *Chemical concentration* requires students to complete 16 credits of chemistry and 30 credits of chemical engineering courses. The selection of specialized courses is aligned with the *Educational Objectives* of the Engineering Physics program at New Mexico State University.

Mathematics (14 credits)

All students enrolled in the Engineering Physics program at New Mexico State University are required to complete four semesters of mathematics courses, including three semesters of calculus and analytical geometry and one semester of ordinary differential equations. Advanced mathematical methods that are needed for the upper-level physics courses are covered in *PHYS 395* and this course is counted toward the physics requirements.

Chemistry (4-16 credits)

Engineering Physics students enrolled in the *Aerospace*, *Electrical* and *Mechanical concentrations* are required to complete one semester of general chemistry. Engineering Physics students with the *Chemical concentration* are required to complete 16 credits of chemistry.

English and Communications (10 credits)

EP students are required to complete two courses in English (*ENGL 111G* and typically *ENGL 218G*) and one course in Communication (typically: *COMM265G – Technical Writing*).

General Education Courses in Common Core Areas IV and V (15 credits)

The general education requirements at New Mexico State University specify that students of all majors select courses that inherently expose them to diversity, and both global and societal issues. These requirements are now part of the New Mexico State Common Core so that these credits can be transferred between institutions. Students are required to take a total of 25 credit hours of humanities and social science electives, as well as complete courses in composition and rhetoric, technical writing, and oral communications.

Viewing a Wider World Courses (6 credits)

In addition to general education courses, students are required to complete 6 credits of Viewing a Wider World courses. The Viewing a Wider World program fosters intelligent inquiry, abstract logical thinking, critical analysis, and the integration of knowledge.

5. If your program has a capstone or other culminating experience for students specifically addressed by either the general or program criteria, describe how this experience helps students attain the student outcomes.

Capstone design courses are project-based courses typically centered on a societal or engineering need. This is the students' opportunity to put their skills to test by addressing *Program Outcomes (h) - Societal Impact* and *(j) - Contemporary Issues*. The capstone design course challenges the student to reflect back on prerequisite topics and apply cumulative knowledge that have previously been developed as part of *Program Outcome (a) - Scientific Expertise*, *Program Outcome (e) - Problem Solving*, and *Program Outcome (k) - Technical Know-how*. However, such background itself is not enough, as capstone projects require students to build on their backgrounds through research and development therefore *Program Outcomes (i) - Lifelong learning*, *Program Outcome (b) - Experimental Training* and most importantly *Program Outcome (c) - Design Abilities*. Moreover, capstone courses require that students work in teams, often with students who have different backgrounds, thus addressing *Program Outcome (d) - Teamwork* and *Program Outcome (g) - Communication Skills*. The need to work in teams also develops the students' sense of *Program Outcome (f) - Professional Responsibility*. In other words, capstone design courses expose students (often for the first time) to demands and expectations that they would likely encounter in their future profession.

The College of Arts & Sciences still enforces a 10-student minimum for undergraduate courses, and this poses a problem for a still relatively small program, such as Engineering Physics where we currently have just ~4-5 seniors, who take the capstones in the same semester. Moreover, this number is further diluted by the fact that our Engineering Physics students are distributed over the four different concentrations. It should be pointed out that the low number of Engineering Physics students does not pose a problem for lecture courses and instructional labs, since these are taken by the physics majors as well. The 10-student minimum had been the main reason that we had originally envisioned capstones to be run fully in the participating engineering departments, where sufficient enrollment is ensured due to the much larger numbers of their majors. While each engineering capstone consists of 3-5 students, the engineering departments offer all of their capstones under one course number, thus easily escaping the 20-student minimum requirement.

On the other hand, not having a dedicated capstone in the Engineering Physics program itself was considered an *area of concern* in the 2006 ABET review, a viewpoint that was also shared with our External Advisory Board in 2010. Recognizing its importance, the Engineering Physics Program Committee came up with the following approaches:

- 1) Try to offer a capstone design course (*PHYS 450 – Capstone*) that attract large numbers of other engineering students as well;
- 2) Offer capstone design projects (also under *PHYS 450*) as part of (independently funded) research or demonstration -equipment development activities (which don't provide course credit for the instructor anyway);
- 3) Suggest capstone design projects through any of the participating engineering departments;
- 4) Participate in the evaluation of engineering capstone projects taken by one or more Engineering Physics students.

The course number *PHYS 450* is listed in the Undergraduate Catalog as a general *Selected Topics* course, and it is used for a variety of specialized courses. Subtitles, such as *Capstone I* or *Capstone II* are to be provided by the instructor and they will be listed on the student's transcript.

Although we were able to attract some engineering students into *PHYS 450*, the first approach proved to be too optimistic with current enrollments. However, we did have some success with each of the other approaches. Table 5.3 provides a list of capstone design courses, where physics faculty members were involved in recent years,

Table 5.3 indicates that physics faculty members have participated and will continue to participate (in one way or another) in the capstone design projects of our Engineering Physics students. In recent years, physics faculty members were involved in capstone projects for more than half our Engineering Physics students. The percentage would have been even higher if it wasn't for the period between Fall of 2009 and Spring of 2011, where the Department of Physics had limited space and resources because of the renovation of Gardiner Hall. Moreover, we expect the Engineering Physics enrollment to further increase, which in turn will allow holding more own capstone projects in future. Several of the members of the 2012/2012 External Advisory Board have shown great interest in proposing capstones with NMSU's Engineering Physics program in future (for example, Ron Tafoya from Intel, Steve Castillo from Sandia National Laboratories and

Table 5.3. Capstone Design Courses with involvement of physics faculty. Names of physics faculty members involved in project evaluation are indicated in brackets.

Project Title	Semesters offered	Course	Faculty Advisor	Total number of Students	Number of EP students	Physics Faculty Involvement
<i>Software Suite for scattering data from liquids and amorphous materials</i>	Fall 07	PHYS 450	Jacob Urquidi (Physics)	3	1 ^{a)}	Fully run by Physics
<i>HIVE: Hub Integrated Visual Extension</i>	Spring 08	EE 418/419	Mike DeAntonio (Physics)	6	0 ^{b)}	Fully run by Physics
<i>GM Engine Development – Improve Fuel Efficiency</i>	Fall 07 and Spring 08	ME 426/427	Young-Ho Park (ME)	4	2	Participated in Evaluation (Nakotte)
<i>Biomass: Generator fueled with cow manure</i>	Fall 07 and Spring 08	ME 426/427	Young-Ho Park (ME)	4	2	Participated in Evaluation (Pate)
<i>Network Camera – Sky Imaging</i>	Fall 09 and Spring 10	EE 418/419	Steve Stochaj (EE)	5	1	Participated in Evaluation (Nakotte)
<i>Physics Demo: Crashing Al cans with Electromagnetic Induction</i>	Spring 10 and Fall 12 ^{c)}	PHYS 450	Steve Kanim (Physics)	3	2	Fully run in Physics
<i>Physics Demo: Circular 24-pendulum assembly</i>	Spring 12 and Fall 12	PHYS 450	Steve Kanim (Physics)	4	3	Fully run in Physics
<i>Landmine seeker – Ordnance Bot</i>	Fall 11 and Spring 12 ^{c)}	EE 418/419	Steve Stochaj (EE)	4	2	Participated in Evaluation (Nakotte)

^{a)}EP student did not finish the capstone project, ^{b)}no EP student enrolled, but offered by physics faculty member, ^{c)}2nd part of capstone is scheduled in Fall 2012

6. *If your program allows cooperative education to satisfy curricular requirements specifically addressed by either the general or program criteria, describe the academic component of this experience and how it is evaluated by the faculty.*

Cooperative education experience does not currently fulfill any part of the Engineering Physics curriculum requirements. However, individual faculty members work with both students and employers to help facilitate appropriate opportunities.

7. *Describe by example how the evaluation team will be able to relate the display materials, i.e. course syllabi, textbooks, sample student work, etc., to each student outcome. (See the 2011-2012 APPM section II.G.6.b.(2) regarding display materials.)*

Display materials include two sets of folders for each course taken by Engineering Physics students as part of the program requirement: the *'Maroon' Instructor Notebooks* and the *'White' Course Notebooks*. The actual contents of such folders are described in greater detail in *Criterion 4 – Continuous Improvement*. The folders will contain general information, instructional material and student work verifying compliance with ABET criteria for the categories indicated above. Textbooks, laboratory manuals and other instructional materials are also available at the time of the review visit.

B. Course Syllabi

In Appendix A, include a syllabus for each course used to satisfy the mathematics, science, and discipline-specific requirements required by Criterion 5 or any applicable program criteria. For required courses with multiple sections that do not use a common syllabus, please include a syllabus for each of the different sections.

Course syllabi of all required and the most popular elective courses are provided in *Appendix A*.