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 maximum section enrollments for all courses in the program for the last two terms the course was taught. If there is more than one curricular path or option for a program, a separate Table 5-1 should be provided for each path or option. State whether the institution operates on quarters or semesters.

The curricula for all *EP Concentrations* are designed such that EP majors take approximately equal portions of physics courses, together with their physics peers, and engineering courses, together with the engineering peers of their respective concentrations, to fulfill their major requirements. In other words, there are no courses that are specifically designed and taught to EP students only. Typically, EP majors complete the major-design experience (capstone) requirement within an engineering department.

There have been significant changes to the EP curriculum, compared to the 2012 SSR of the *EP Program*. Particularly, there was a complete overhaul of the curricula in *Chemical Engineering* and *Electrical Engineering*, which greatly affected the corresponding EP concentration curricula. For those engineering subjects, some courses were eliminated, others were combined and new ones were introduced. Although not as wide-ranging, there were also changes in the requirements for *Mechanical Engineering* and *Aerospace Engineering*, some of which were adopted for EP majors with those concentrations. Compared the 2012 SSR, the physics content remained largely unchanged, with just a few changes in course contents, delivery methods and/or streamlining of assessment processes.

Table 5.1 provides a list of required and elective courses and their classification as *Math & Basic Sciences*, *Engineering*, *General Education* or *Viewing the Wider World*. The classification of each course is consistent with its classification for any of the engineering majors at NMSU.

In collaboration with the associated engineering departments, the *EP Program Committee* engaged in a continuous effort on the evaluation and needed modifications of mostly upper-level physics courses, such that they could be counted toward the contingent of 'engineering' courses, without adversely affecting the basic-physics knowledge that physics majors are expected to have after taking such courses. This has been an important process since the 2012 SSR, where the distinction between basic sciences and engineering for physics courses was raised as a concern by ABET. A discussion of the classification of physics courses is provided below.

Physics courses counting toward science contingent in Table 5.1

All EP students are required to take PHYS 213/213L or PHYS 215G/215GL, PHYS 214/214L or PHYS 216/216GL, and PHYS 217/217L. The former two sets of courses and their associated labs are required courses for most engineering majors; they can be counted toward the *State's General Education – Area III (Laboratory Science experience).* For all engineering majors, these courses count toward their Math & Basic Sciences contingent.

PHYS 395 *(Math Methods in Physics)*, PHYS 454 and PHYS 455 *(Intermediate Modern Physics I and II)* are required for all EP majors, PHYS 451 *(Mechanics)* is required for EP students with

the *Aerospace and Mechanical Concentrations*, and PHYS 480 *(Thermodynamics and Statistical Physics)* is required for EP students with the *Electrical Concentration*. These courses are currently taught such that the focus is mostly on the fundamental physics phenomena and theoretical/mathematical approach treatment of those courses. Therefore, these courses count toward the general *Math & Science* contingent in Table 5.1.

Physics courses with significant engineering components

PHYS 315/315L and PHYS 461 are required courses for all EP majors. PHYS 462 is required for all EP majors, except those with the *Electrical Concentration*, who can choose between this course and EE 351. An *Advanced Physics Laboratory*, i.e. PHYS 471, PHYS 475 or PHYS 493, is required for EP students with the *Electrical Concentration.*

PHYS 315 is the *Modern Physics* course and PHYS 315L is its associated laboratory. One third of the course teaches modern-physics applications, such as *Solid-State Physics* (including structure characterization, magnetic materials, superconductors, and semiconductors) and *Nuclear Physics* (including particle detectors, nuclear fission and fusion). The lab consists of experiments related to modern-physics phenomena and students are required to design, complete and present on a more challenging study as their final assignment. The *Department of Chemical & Materials Engineering* has accepted PHYS 315 and PHYS 315L in a list of *Technical Electives* for their *Minor in Materials Engineering*. Since the PHYS 315L laboratory has stringent project reporting requirements and some project-management components, the *EP Program* accepts passing the PHYS 315L as an alternative to passing all pre-requisite requirements for the *Senior-Design (Capstone) Course*. This is particularly important for EP majors with the *Chemical Concentration*, who typically don't fulfill the pre-requisite requirements imposed to *Chemical Engineering* majors.

PHYS 461 is a course on *Electrostatics and Magnetostatics*. The engineering content of that course was expanded in recent years, and it now includes homework assignments and/or projects focused on engineering applications. The *Department of Electrical and Computer Engineering* accepts PHYS 461 as a *Technical Elective* for their *Minor in Electrical Engineering*.

PHYS 462 is the continuation of *PHYS 461* with a focus on electrodynamics. Like PHYS 461, the engineering content of *PHYS 462* was recently expanded, and it will count as a *Technical Elective* toward a *Minor in Electrical Engineering*.

The *Department of Physics* currently offers three upper-level *Advanced Physics Laboratories*, all of which are cross-listed with the equivalent 500-level graduate labs: PHYS 471/571 is an *Optics Laboratory*, PHYS 475/575 a *Solid-State / Materials Physics Laboratory* and PHYS 493/593 a *Nuclear Physics Laboratory*. In each of the labs, the undergraduate and graduate students work together on the same set of experiments and/or projects; however, the graduate students get more difficult assignments and expectations are slightly higher. The main reason for cross-listing is to meet the minimum enrollment requirements for courses to run, i.e. enrollment minimum of 10 with each graduate student counting double. Our *Advanced Physics Laboratories* are accepted as *Technical Electives* for the *Minor in Materials Engineering* and the *Minor in Electrical Engineering*, thereby justifying that they have significant engineering content.

Several upper-level cross-listed physics courses offered by the *Department of Physics* contain significant engineering components as well, and they are accepted *Technical Electives* of various engineering minors. The following courses are offered as electives: PHYS 467/567 *(Nanoscience*

and Nanotechnology), PHYS 468/568 *(Elements of X-ray Diffraction),* PHYS 473/473 *(Optics),* PHYS 476/576 *(Computational Physics),* PHYS 477/577 *(Fiber Optic Communication Systems),* PHYS 478/578 *(Fundamentals of Photonics),* PHYS 479/579 *(Lasers and Applications),* PHYS 488/588 *(Condensed Matter Physics),* PHYS 489/589 *(Introduction to Modern Materials),* PHYS 491/591 *(High-Energy Physics)* and PHYS 497/597 *(Introduction to Plasma Physics)*. Several of those courses are cross-listed with courses in different engineering departments (see *Appendix A: Course Syllabi*).

Physics courses counting toward Viewing-the-Wider-World (VWW) courses

NMSU requires all the majors to take the equivalent of two VWW courses. These courses should not be counted toward either the Math & Sciences or Engineering contingents for ABET purposes. However, these courses can provide data for the *Program Outcomes Assessment*, if such assessments have been implemented by the instructors of such courses.

The *Department of Physics* has offered a couple of *VWW* courses in recent years, such as PHYS 303V *(Energy and Society)* and PHYS 305V *(Search for Water in the Solar System)*.

Substitutions, Exceptions and Waivers

Each of the departments involved in the *EP Program* (*Physics, Aerospace & Mechanical Engineering, Chemical & Materials Engineering, Electrical & Computer Engineering*) perform their own separate scheduling of courses for their respective majors. This often leads to unavoidable time conflicts for courses that EP students are required to take. In many cases, however, the students and their advisors may be able to identify alternative scheduling or other courses that may be considered as equivalent. The *College of Engineering* implemented the system *Exception-Ease*, where EP advisors may submit substitution or exception requests for approval to the *Academic Dean of the College of Engineering* for consideration and approval. Aside from substitutions/exceptions of major's courses, the most common substitutions are the 9-credit rule for one of the *VWW* course or transfer credits from another institution. *Exception-Ease* also allows requests for waivers; however, waivers are granted only under very unusual circumstances.

Tables 5.1.a-d provide the plan of study for each of the four EP concentrations (in alphabetical order), namely *Aerospace*, *Chemical*, *Electrical*, and *Mechanical*. NMSU operates on a semester system with spring and fall semesters of approximately 14 weeks of instruction each. For some of the lower-level courses, students also can take classes during summer.

__Required__ courses are required of all students in the program, __elective__ courses (often referred to as open or free electives) are optional for students, and __selected elective__ courses are those for which students must take one or more courses from a specified group.
For courses that include multiple elements (lecture, laboratory, recitation, etc.), indicate the maximum enrollment in each element. For selected elective courses, indicate the maximum enrollment for each option.

Instructional materials and student work verifying compliance with ABET criteria for the categories indicated above will be required during the campus visit.

Table 5.1.a. *Curriculum for Bachelor of Science in Engineering Physics – Aerospace Concentration (133 credits)*

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 R, E or SE[1]	***Subject Area (Credit Hours)***				**Year and, Semester, or Quarter** last two terms the course was offered:	**maximum section enrollment** for the last two terms the course was offered[2]
		Math & Basic Sciences	**Engineering Topics** check if contains significant design (√)	**General Education**	**Other** (VWW)		
Year 1, Semester 1 (15 credits)							
MATH 191G, Calculus and Analytic Geometry I	R	4				F 2017 S 2018	40 40
PHYS 213 (or 215), Mechanics	R	3				F 2016 F 2017	22 18
PHYS 213L (or 215L), Experimental Mechanics	R	1				F 2016 F 2017	22 18
ENGR 100, Introduction to Engineering	R		3			F 2017 S 2018	32 16
ENGL 111G, Rhetoric and Composition	R			4		F 2017 S 2018	27 27
Year 1, Semester 2 (18 credits)							
MATH 192G, Calculus and Analytic Geometry II	R	4				F 2017 S 2018	40 40
PHYS 214 (or 216), Electricity and Magnetism	R	3				S 2017 S 2018	21 12
PHYS 214L (or 216GL), Electricity and Magnetism Laboratory	R	1				S 2017 S 2018	21 12
ME 240, Thermodynamics	R		3			F 2017 S 2018	46 50
CHEM 111G (or 115G), General Chemistry	R	4				F 2017 S 2018	142 166
Written Communications Elective	SE			3		F 2017 S 2018	n/a n/a

Table 5.1.a. *- continued*

Course (Department, Number, Title)	R, E or SE[1]	***Subject Area (Credit Hours)***				**Year and, Semester, or Quarter** last two terms	**maximum section enrollment** last two terms[2]
		Math & Basic Sciences	**Engineering Topics** significant design (√)	**General Education**	**Other** (VWW)		
Year 2, Semester 3 (16 credits)							
MATH 291G, Calculus and Analytic Geometry III	R	3				F 2017 S 2018	40 40
PHYS 217, Heat, Light, and Sound	R	3				F 2016 F 2017	28 29
PHYS 217L, Experimental Heat, Light, and Sound	R	1				F 2016 F 2017	15 16
ME 236, Engineering Mechanics I	R		3			F 2017 S 2018	48 45
ME 261, Mechanical Engineering Problem Solving	R		3			F 2017 S 2018	95 95
Oral Communication Elective	SE			3		F 2017 S 2018	n/a n/a
Year 2, Semester 4 (18 credits)							
MATH 392, Introduction to Ordinary Differential Equations	R	3				F 2017 S 2018	40 40
PHYS 315, Modern Physics	R		3			S 2017 S 2018	32 33
PHYS 315L, Experimental Modern Physics	R		3			S 2017 S 2018	15 16
ME 237, Engineering Mechanics II	R		3			F 2017 S 2018	53 43
CE 301, Mechanics of Materials	R		3			F 2017 S 2018	44 59
General Education Core Elective	SE			3		F 2017 S 2018	n/a n/a

Table 5.1.a. *- continued*

Course (Department, Number, Title)	R, E or SE[1]	***Subject Area (Credit Hours)***				**Year and, Semester, or Quarter** last two terms	**maximum section enrollment** last two terms[2]
		Math & Basic Sciences	**Engineering Topics** significant design (√)	**General Education**	**Other** (VWW)		
Year 3, Semester 5 (18 credits)							
PHYS 395, Intermediate Math. Methods of Physics	R	3				F 2016 F 2017	12 11
PHYS 461, Intermediate Electricity and Magnetism I	R		3			F 2016 F 2017	17 15
AE 339, Aerodynamics I	R		3			F 2016 F 2017	40 37
AE 362, Orbital Mechanics	R		3			F 2016 F 2017	47 46
AE 364, Flight Dynamics and Controls	R		3			F 2016 F 2017	41 45
General Education Core Elective	SE			3		F 2017 S 2018	n/a n/a
Year 3, Semester 6 (18 credits)							
PHYS 462, Intermediate Electricity and Magnetism II	R		3			S 2017 S 2018	13 13
ME 345, Experimental Methods I	R		3			F 2017 S 2018	55 62
AE 363, Aerospace Structures	R		3			S 2017 S 2018	45 48
AE 439, Aerodynamics II	R		3			S 2017 S 2018	49 45
General Education Core Elective	SE			3		F 2017 S 2018	n/a n/a
General Education Core Elective	SE			3		F 2017 S 2018	n/a n/a

Table 5.1.a. *- continued*

Course (Department, Number, Title)	R, E or SE[1]	***Subject Area (Credit Hours)***				**Year and, Semester, or Quarter** last two terms	**maximum section enrollment** last two terms[2]
		Math & Basic Sciences	**Engineering Topics** significant design (√)	**General Education**	**Other** (VWW)		
Year 4, Semester 7 (15 credits)							
PHYS 454, Intermediate Modern Physics I	R	3				F 2016 F 2017	13 12
AE 419, Propulsion	R		3			F 2016 F 2017	35 37
AE 424, Aerospace Systems Engineering	R		3			S 2017 S 2018	40 38
AE 447, Aerofluids Laboratory	R		3			F 2017 S 2018	29 24
Capstone Design I (Engineering-Wide)	R		3 (√)			F 2017 S 2018	28 41
Year 4, Semester 8 (15 credits)							
PHYS 455, Intermediate Modern Physics II	R	3				S 2017 S 2018	13 12
Capstone Design II (Engineering-Wide)	R		3 (√)			F 2017 S 2018	28 41
Viewing a Wider World Elective	SE				3	F 2017 S 2018	n/a n/a
Viewing a Wider World Elective	SE				3	F 2017 S 2018	n/a n/a
General Education Core Elective	SE			3		F 2017 S 2018	n/a n/a
TOTALS - ABET BASIC-LEVEL REQUIREMENTS		**39**	**63**	**25**	**6**		
TOTAL CREDIT HOURS FOR COMPLETION	**133**						
PERCENT OF TOTAL		**29.3%**	**47.4%**	**18.8%**	**4.5%**		
Total must satisfy either credit hours or percentage	**Minimum Semester Credit Hours**	**32**	**48**				
	Minimum Percentage of Total Credits Required	**25%**	**37.5%**				

Table 5.1.b. *Curriculum for Bachelor of Science in Engineering Physics – Chemical Concentration (132 credits)*

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 required, elective, or a selective elective by R, E or SE[1]	***Subject Area (Credit Hours)***				**Year and, Semester, or Quarter** last two terms the course was offered:	**maximum section enrollment** for the last two terms the course was offered[2]
		Math & Basic Sciences	**Engineering Topics** check if contains significant design (√)	**General Education**	**Other** (VWW)		
Year 1, Semester 1 (17 credits)							
MATH 191G, Calculus and Analytic Geometry I	R	4				F 2017 S 2018	40 40
PHYS 213 (or 215), Mechanics	R	3				F 2016 F 2017	22 18
PHYS 213L (or 215L), Experimental Mechanics	R	1				F 2016 F 2017	22 18
ENGR 100, Introduction to Engineering	R		3			F 2017 S 2018	32 16
CHME 101, Introduction to Chemical Engineering Calculations	R		2			-- F 2017	-- 67
CHEM 115, Principles of Chemistry I	R	4				F 2016 F 2017	62 70
Year 1, Semester 2 (18 credits)							
MATH 192G, Calculus and Analytic Geometry II	R	4				F 2017 S 2018	40 40
PHYS 214 (or 216), Electricity and Magnetism	R	3				S 2017 S 2018	21 12
PHYS 214L (or 216), Electricity and Magnetism Laboratory	R	1				S 2017 S 2018	21 12
CHME 102, Materials Balances	R		2			S 2017 S 2018	38 40
CHEM 116, Principles of Chemistry II	R	4				S 2017 S 2018	41 53
ENGL 111G, Rhetoric and Composition	R			4		F 2017 S 2018	27 27

Table 5.1.b. *- continued*

Course (Department, Number, Title)	R, E or SE[1]	***Subject Area (Credit Hours)***				**Year and, Semester, or Quarter** last two terms	**maximum section enrollment** last two terms[2]
		Math & Basic Sciences	**Engineering Topics** significant design (√)	**General Education**	**Other** (VWW)		
Year 2, Semester 3 (16 credits)							
MATH 291G, Calculus and Analytic Geometry III	R	3				F 2017 S 2018	40 40
PHYS 217, Heat, Light, and Sound	R	3				F 2016 F 2017	28 29
PHYS 217L, Experimental Heat, Light, and Sound	R	1				F 2016 F 2017	15 16
CHME 201, Energy Balances & Basic Thermodynamics	R		3			F 2016 F 2017	36 41
General Education Core Elective	SE			3		F 2017 S 2018	n/a n/a
Written Communication Elective	SE			3		F 2017 S 2018	n/a n/a
Year 2, Semester 4 (16 credits)							
MATH 392, Introduction to Ordinary Differential Equations	R	3				F 2017 S 2018	40 40
PHYS 315, Modern Physics	R		3			S 2017 S 2018	32 33
PHYS 315L, Experimental Modern Physics	R		3			S 2017 S 2018	15 16
CHME 301[a)], Chemical Engineering Thermodynamics	R		4			S 2017 S 2018	30 34
CHME 305, Transport Operations I: Fluid Flow	R		3			S 2017 S 2018	28 34

[a)]will be offered as part of CHME 303, starting Spring 2019.

Table 5.1.b. *- continued*

Course (Department, Number, Title)	R, E or SE[1]	***Subject Area (Credit Hours)***				**Year and, Semester, or Quarter** last two terms	**maximum section enrollment** last two terms[2]
		Math & Basic Sciences	**Engineering Topics** significant design (√)	**General Education**	**Other** (VWW)		
Year 3, Semester 5 (16 credits)							
PHYS 395, Intermediate Math. Methods of Physics	R	3				F 2016 F 2017	12 11
PHYS 461, Intermediate Electricity and Magnetism I	R		3			F 2016 F 2017	17 15
CHME 306, Transport Operations II: Heat & Mass Transfer	R		4			F 2016 F 2017	28 34
CHEM 313, Organic Chemistry I	R	3				F 2017 S 2018	117 90
General Education Core Elective	SE			3		F 2017 S 2018	n/a n/a
Year 3, Semester 6 (16 credits)							
PHYS 462, Intermediate Electricity and Magnetism II	R		3			S 2017 S 2018	13 13
CHME 307, Transport Operations III: Staged Operations	R		3			S 2017 S 2018	26 32
CHME 352L, Simulation of Unit Operations	R		1			S 2017 S 2018	28 31
CHME 361, Engineering Materials	R		3			F 2017 S 2018	178 95
CHME 441, Chemical Kinetics and Reactor Engineering	R		3			S 2017 S 2018	26 32
Oral Communication Elective	SE			3		F 2017 S 2018	n/a n/a

Table 5.1.b. *- continued*

Course (Department, Number, Title)	R, E or SE[1]	***Subject Area (Credit Hours)***				**Year and, Semester, or Quarter** last two terms	**maximum section enrollment** last two terms[2]
		Math & Basic Sciences	**Engineering Topics** significant design (√)	**General Education**	**Other** (VWW)		
Year 4, Semester 7 (18 credits)							
PHYS 454, Intermediate Modern Physics I	R	3				F 2016 F 2017	13 12
PHYS 451, Intermediate Mechanics	R	3				F 2016 F 2017	15 17
Capstone Design I (Engineering-Wide)	R		3 (√)			S 2017 S 2018	8 4
PHYS / CHME, Technical Elective	E		3			F 2017 S 2018	n/a n/a
Viewing a Wider World Elective	SE				3	F 2017 S 2018	n/a n/a
General Education Core Elective	SE			3		F 2017 S 2018	n/a n/a
Year 4, Semester 8 (15 credits)							
PHYS 455, Intermediate Modern Physics II	R	3				S 2017 S 2018	13 12
Capstone Design II (Engineering-Wide)	R		3 (√)			S 2017 S 2018	4 4
Viewing a Wider World Elective	SE				3	F 2017 S 2018	n/a n/a
General Education Core Elective	SE			3		F 2017 S 2018	n/a n/a
General Education Core Elective	SE			3		F 2017 S 2018	n/a n/a
TOTALS - ABET BASIC-LEVEL REQUIREMENTS		**49**	**52**	**25**	**6**		
TOTAL CREDIT HOURS FOR COMPLETION	**132**						
PERCENT OF TOTAL		**37.1%**	**39.5%**	**18.9%**	**4.5%**		
Total must satisfy either credit hours or percentage	**Minimum Semester Credit Hours**	**32**	**48**				
	Minimum Percentage of Total Credits Required	**25%**	**37.5%**				

Table 5.1.c. *Curriculum Bachelor of Science in Engineering Physics – Electrical Concentration (129-131 credits)*

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 required, elective, or a selective elective by R, E or SE[1]	***Subject Area (Credit Hours)***				**Year and, Semester, or Quarter** last two terms the course was offered:	**maximum section enrollment** for the last two terms the course was offered[2]
		Math & Basic Sciences	**Engineering Topics** check if contains significant design (√)	**General Education**	**Other** (VWW)		
Year 1, Semester 1 (15 credits)							
MATH 191G, Calculus and Analytic Geometry I	R	4				F 2017 S 2018	40 40
PHYS 213 (or 215), Mechanics	R	3				F 2016 F 2017	22 18
PHYS 213L (or 215L), Experimental Mechanics	R	1				F 2016 F 2017	22 18
ENGR 100, Introduction to Engineering	R		3			F 2017 S 2018	32 16
ENGL 111G, Rhetoric and Composition	R			4		F 2017 S 2018	27 27
Year 1, Semester 2 (16 credits)							
MATH 192G, Calculus and Analytic Geometry II	R	4				F 2017 S 2018	40 40
PHYS 214 (or 216), Electricity and Magnetism	R	3				S 2017 S 2018	21 12
PHYS 214L (or 216L), Electricity and Magnetism Laboratory	R	1				S 2017 S 2018	21 12
EE 100, Introduction to Electrical Engineering	R		4			F 2017 S 2018	54 33
CHEM 111G (or 115), General Chemistry	R	4				F 2017 S 2018	142 166

Table 5.1.c. *- continued*

Course (Department, Number, Title)	R, E or SE[1]	***Subject Area (Credit Hours)***				**Year and, Semester, or Quarter** last two terms	**maximum section enrollment** last two terms[2]
		Math & Basic Sciences	**Engineering Topics** significant design (√)	**General Education**	**Other** (VWW)		
Year 2, Semester 3 (18 credits)							
MATH 291G, Calculus and Analytic Geometry III	R	3				F 2017 S 2018	40 40
PHYS 217, Heat, Light, and Sound	R	3				F 2016 F 2017	28 29
PHYS 217L, Experimental Heat, Light, and Sound	R	1				F 2016 F 2017	15 16
EE 112, Embedded Systems	R		4			F 2017 S 2018	17 33
EE 200, Linear Algebra, Probability & Statistics Applications	R	4				F 2017 S 2018	36 20
Written Communication Elective	SE			3		F 2017 S 2018	n/a n/a
Year 2, Semester 4 (16 credits)							
MATH 392, Introduction to Ordinary Diff. Equations	R	3				F 2017 S 2018	40 40
PHYS 315, Modern Physics	R		3			S 2017 S 2018	32 33
PHYS 315L, Experimental Modern Physics	R		3			S 2017 S 2018	15 16
EE 212, Intro to Computer Architecture and Organization	R		4			F 2017 S 2018	33 29
Oral Communication Elective	SE			3		F 2017 S 2018	n/a n/a

Table 5.1.c. *- continued*

Course (Department, Number, Title)	R, E or SE[1]	***Subject Area (Credit Hours)***				**Year and, Semester, or Quarter** last two terms	**maximum section enrollment** last two terms[2]
		Math & Basic Sciences	**Engineering Topics** significant design (√)	**General Education**	**Other** (VWW)		
Year 3, Semester 5 (16 credits)							
PHYS 395, Intermediate Math. Methods of Physics	R	3				F 2016 F 2017	12 11
PHYS 451, Intermediate Mechanics	R	3				F 2016 F 2017	15 17
PHYS 461, Intermediate Electricity & Magnetism I	R		3			F 2016 F 2017	17 15
EE 230, AC Circuit Analysis & Introduction to Power Systems	R		4			F 2017 S 2018	16 36
General Education Core Elective	SE			3		F 2017 S 2018	n/a n/a
Year 3, Semester 6 (16-17 credits)							
PHYS 480, Thermodynamics	R		3			S 2017 S 2018	13 11
PHYS 462, Intermediate Electricity & Magnetism II, or EE 351[a)] - Applied Electromagnetics	R		3-4			S 2017 S 2018	13 13
EE 312[b)], Signals and Systems I	R		3			F 2017 S 2018	28 33
EE 380[c)], Semiconductor Devices and Electronics	R		4			F 2017 S 2018	33 25
General Education Core Elective	SE			3		F 2017 S 2018	n/a n/a

[a)]now offered under EE 340
[b)]now offered under EE 320
[c)]now offered under EE 317

Table 5.1.c. *- continued*

Course (Department, Number, Title)	R, E or SE[1]	***Subject Area (Credit Hours)***				**Year and, Semester, or Quarter** last two terms	**maximum section enrollment** last two terms[2]
		Math & Basic Sciences	**Engineering Topics** significant design (√)	**General Education**	**Other** (VWW)		
Year 4, Semester 7 (18 credits)							
PHYS 454, Intermediate Modern Physics I	R	3				F 2016 F 2017	13 12
Capstone Design I (EE 300, EE 418, or Engineering-Wide)	R		2-3 (√)			F 2017 S 2018	4 4
PHYS / EE, Technical Elective	E		3			F 2017 S 2018	n/a n/a
Viewing a Wider World Elective	SE				3	F 2017 S 2018	n/a n/a
General Education Core Elective	SE			3		F 2017 S 2018	n/a n/a
General Education Core Elective	SE			3		F 2017 S 2018	n/a n/a
Year 4, Semester 8 (15 credits)							
PHYS 455, Intermediate Modern Physics II	R	3				S 2017 S 2018	13 12
PHYS 475 (or 471, 493), Advanced Physics Laboratory	R		3			F 2017 S 2018	8 4
Capstone Design II (EE 402, EE 419, or Engineering-Wide)	R		3 (√)			F 2017 S 2018	4 4
Viewing a Wider World Elective	SE				3	F 2017 S 2018	n/a n/a
General Education Core Elective	SE			3		F 2017 S 2018	n/a n/a
TOTALS - ABET BASIC-LEVEL REQUIREMENTS		**46**	**52-56**	**25**	**6**		
TOTAL CREDIT HOURS FOR COMPLETION	**129-131**						
PERCENT OF TOTAL		**35.7%**	**40.3%**	**19.4%**	**4.6%**		
Total must satisfy either credit hours or percentage	**Minimum Semester Credit Hours**	**32**	**48**				
	Minimum Percentage of Total Credits Required	**25%**	**37.5%**				

Table 5.1.d. *Curriculum for Bachelor of Science in Engineering Physics – Mechanical Concentration (129 credits)*

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 required, elective, or a selective elective by R, E or SE[1]	***Subject Area (Credit Hours)***				**Year and, Semester, or Quarter** last two terms the course was offered:	**maximum section enrollment** for the last two terms the course was offered[2]
		Math & Basic Sciences	**Engineering Topics** check if contains significant design (√)	**General Education**	**Other** (VWW)		
Year 1, Semester 1 (17 credits)							
MATH 191G, Calculus and Analytic Geometry I	R	4				F 2017 S 2018	40 40
PHYS 213 (or 215), Mechanics	R	3				F 2016 F 2017	22 18
PHYS 213L (or 215L), Experimental Mechanics	R	1				F 2016 F 2017	22 18
ENGR 100, Introduction to Engineering	R		3			F 2017 S 2018	32 16
ME 159, Graphical Communication and Design	R		2			F 2017 S 2018	31 47
CHEM 111G, General Chemistry	R	4				F 2017 S 2018	142 166
Year 1, Semester 2 (15 credits)							
MATH 192G, Calculus and Analytic Geometry II	R	4				F 2017 S 2018	40 40
PHYS 214 (or 216), Electricity and Magnetism	R	3				S 2017 S 2018	21 12
PHYS 214L (or 216L), Electricity and Magnetism Laboratory	R	1				S 2017 S 2018	21 12
ME 240, Thermodynamics	R		3			F 2017 S 2018	46 50
ENGL 111G, Rhetoric and Composition	R			4		F 2017 S 2018	27 27

Table 5.1.d. *- continued*

Course (Department, Number, Title)	R, E or SE[1]	***Subject Area (Credit Hours)***				**Year and, Semester, or Quarter** last two terms	**maximum section enrollment** last two terms[2]
		Math & Basic Sciences	**Engineering Topics** significant design (√)	**General Education**	**Other** (VWW)		
Year 2, Semester 3 (16 credits)							
MATH 291G, Calculus and Analytic Geometry III	R	3				F 2017 S 2018	40 40
PHYS 217, Heat, Light, and Sound	R	3				F 2016 F 2017	28 29
PHYS 217L, Experimental Heat, Light, and Sound	R	1				F 2016 F 2017	15 16
ME 236, Engineering Mechanics I	R		3			F 2017 S 2018	48 45
ME 261, Mechanical Engineering Problem Solving	R		3			F 2017 S 2018	95 95
Written Communication Elective	SE			3		F 2017 S 2018	n/a n/a
Year 2, Semester 4 (18 credits)							
MATH 392, Introduction to Ordinary Diff. Equations	R	3				F 2017 S 2018	40 40
PHYS 315, Modern Physics	R		3			S 2017 S 2018	32 33
PHYS 315L, Experimental Modern Physics	R		3			S 2017 S 2018	15 16
ME 237, Engineering Mechanics II	R		3			F 2017 S 2018	53 43
CE 301, Mechanics of Materials	R		3			F 2017 S 2018	44 59
Oral Communication Elective	SE			3		F 2017 S 2018	n/a n/a

Table 5.1.d. *- continued*

Course (Department, Number, Title)	R, E or SE[1]	***Subject Area (Credit Hours)***				**Year and, Semester, or Quarter** last two terms	**maximum section enrollment** last two terms[2]
		Math & Basic Sciences	**Engineering Topics** significant design (√)	**General Education**	**Other** (VWW)		
Year 3, Semester 5 (15 credits)							
PHYS 395, Intermediate Math. Methods of Physics	R	3				F 2016 F 2017	12 11
PHYS 461, Intermediate Electricity and Magnetism I	R		3			F 2016 F 2017	17 15
ME 326, Mechanical Design	R		3			F 2017 S 2018	42 50
ME 338, Fluid Mechanics	R		3			F 2017 S 2018	58 40
General Education Core Elective	SE			3		F 2017 S 2018	n/a n/a
Year 3, Semester 6 (15 credits)							
PHYS 462, Intermediate Electricity and Magnetism II	R		3			S 2017 S 2018	13 13
ME 341, Heat Transfer	R		3			F 2017 S 2018	45 65
ME 345, Experimental Methods I	R		3			F 2017 S 2018	55 62
ME 425, Design of Machine Elements	R		3			F 2017 S 2018	51 38
General Education Core Elective	SE			3		F 2017 S 2018	n/a n/a

Table 5.1.d. *- continued*

Course (Department, Number, Title)	R, E or SE[1]	***Subject Area (Credit Hours)***				**Year and, Semester, or Quarter** last two terms	**maximum section enrollment** last two terms[2]
		Math & Basic Sciences	**Engineering Topics** significant design (√)	**General Education**	**Other** (VWW)		
Year 4, Semester 7 (18 credits)							
PHYS 454, Intermediate Modern Physics I	R	3				F 2016 F 2017	13 12
PHYS 451, Intermediate Mechanics	R	3				F 2016 F 2017	15 17
Capstone Design I (ME 426, or Engineering-Wide)	R		3 (√)			F 2017 S 2018	4 4
Viewing a Wider World Elective	SE				3	F 2017 S 2018	n/a n/a
General Education Core Elective	SE			3		F 2017 S 2018	n/a n/a
General Education Core Elective	SE			3		F 2017 S 2018	n/a n/a
Year 4, Semester 8 (15 credits)							
PHYS 455, Intermediate Modern Physics II	R	3				S 2017 S 2018	13 12
Capstone Design II (ME 427, or Engineering-Wide)	R		3 (√)			S 2017 S 2018	4 4
PHYS / ME, Technical Elective	R		3			F 2017 S 2018	n/a n/a
Viewing a Wider World Elective	SE				3	F 2017 S 2018	n/a n/a
General Education Core Elective	SE			3		F 2017 S 2018	n/a n/a
TOTALS - ABET BASIC-LEVEL REQUIREMENTS		**42**	**56**	**25**	**6**		
TOTAL CREDIT HOURS FOR COMPLETION	**129**						
PERCENT OF TOTAL		**32.6%**	**43.4%**	**19.4%**	**4.6%**		
Total must satisfy either credit hours or percentage	**Minimum Semester Credit Hours**	**32**	**48**				
	Minimum Percentage of Total Credits	**25%**	**37.5%**				

Describe how the curriculum aligns with the program educational objectives.

The three *Program Educational Objectives* of the *EP Program* at NMSU are *Competitiveness*, *Adaptability*, and *Teamwork & Leadership*. The *Educational Objectives* of the EP Program and the methods of their evaluation are described in more detail in *Criterion 2 – Program Educational Objectives*. The objectives are consistent with the institutional educational objectives of the *College of Engineering*, the *College of Arts & Sciences*, and *New Mexico State University*.

Educational Objective 1: Competitiveness. The curriculum of the *EP Program* has been specifically designed to enable students to 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. The four *EP Concentrations* require students to complete 39-49 credits of mathematics and basic sciences (including fundamental physics courses), 42-63 credit hours of engineering courses (including physics courses with significant engineering content), 25 credits of general education courses (*English*, *Communication* and *General Education Areas IV and V*), and 6 credits of *Viewing the Wider World* courses. The strong foundation of fundamental science and a broad range of specialized engineering courses help ensure that the EP graduates are competitive in internationally-recognized academic, government, and industrial environments.

Educational Objective 2: Adaptability. The *EP Program* at NMSU offers a broad selection of courses that cover a variety of engineering and scientific disciplines. The *EP Program* entails more than 60 fundamental-science, technical and engineering courses that cover the areas of *Physics*, *Aerospace*, *Chemical*, *Electrical*, and *Mechanical Engineering*. The wide selection of courses offered by the EP curriculum broadens the range of the potential employment opportunities for EP graduates. These opportunities include employment in R & D, energy and utility, manufacturing, automotive, photonics, aerospace, defense and space, sensor technology, and many other fields.

Educational Objective 3: Teamwork and Leadership. As a part of the EP curriculum, students are required to take several physics and engineering laboratory courses as well as the Capstone Deign course. Most of those laboratories expect students to work in teams, collaborate with other students, and lead a team of students toward successful completion of the project. To complete project requirements successfully, the student must demonstrate practical application of relevant knowledge and skills, such as standard analysis techniques, and design principles, as well as teamwork, communication, problem solving, and critical thinking. This approach enables EP graduates to have an ability to function as part of and/or lead interdisciplinary teams.

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

Program Outcomes Matrices of all physics and engineering courses for the *EP Program* are provided in Tables 3.2.a-f in *Criterion 3 – Program Outcomes*. Each course is expected to measure certain *Program Outcomes (a)-(k)*, the results of which are discussed in *Criterion 4 – Continuous Improvement.* To achieve the desired outcomes, a path of core courses (having pre-requisites) has become essential within an integrated, cumulative educational process: see flowchart 5.1.a for *Engineering Physics* with the *Aerospace Concentration*, 5.1.b with the *Chemical Concentration*, 5.1.c with the *Electrical Concentration*, and 5.1.d with the *Mechanical Concentration.*

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

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

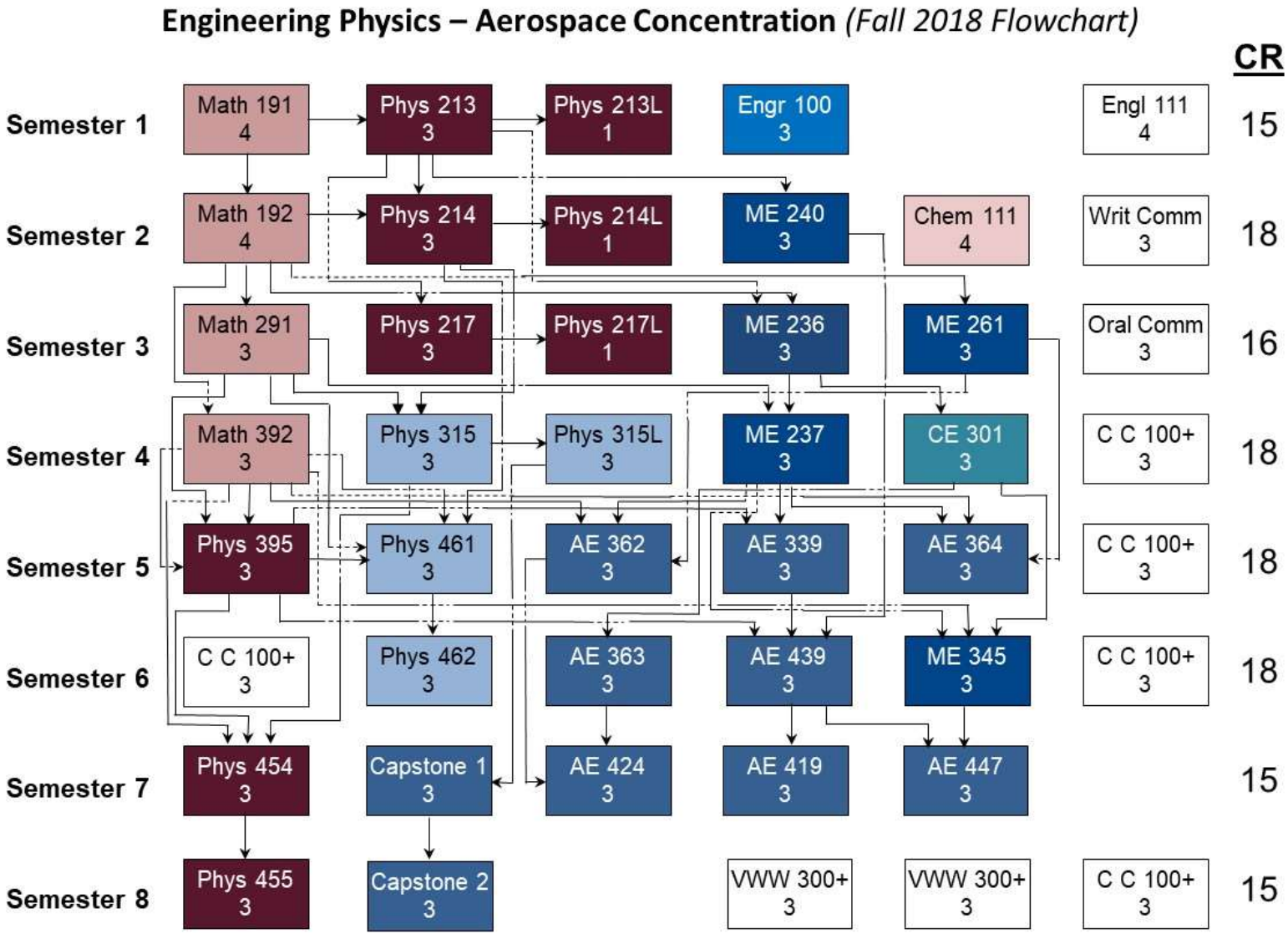


Diagram 5.1.b. *Proposed Schedule for Engineering Physics with the Chemical Concentration. Arrows coming in from the top indicate pre-requisites, arrows from the side co-requisites.*

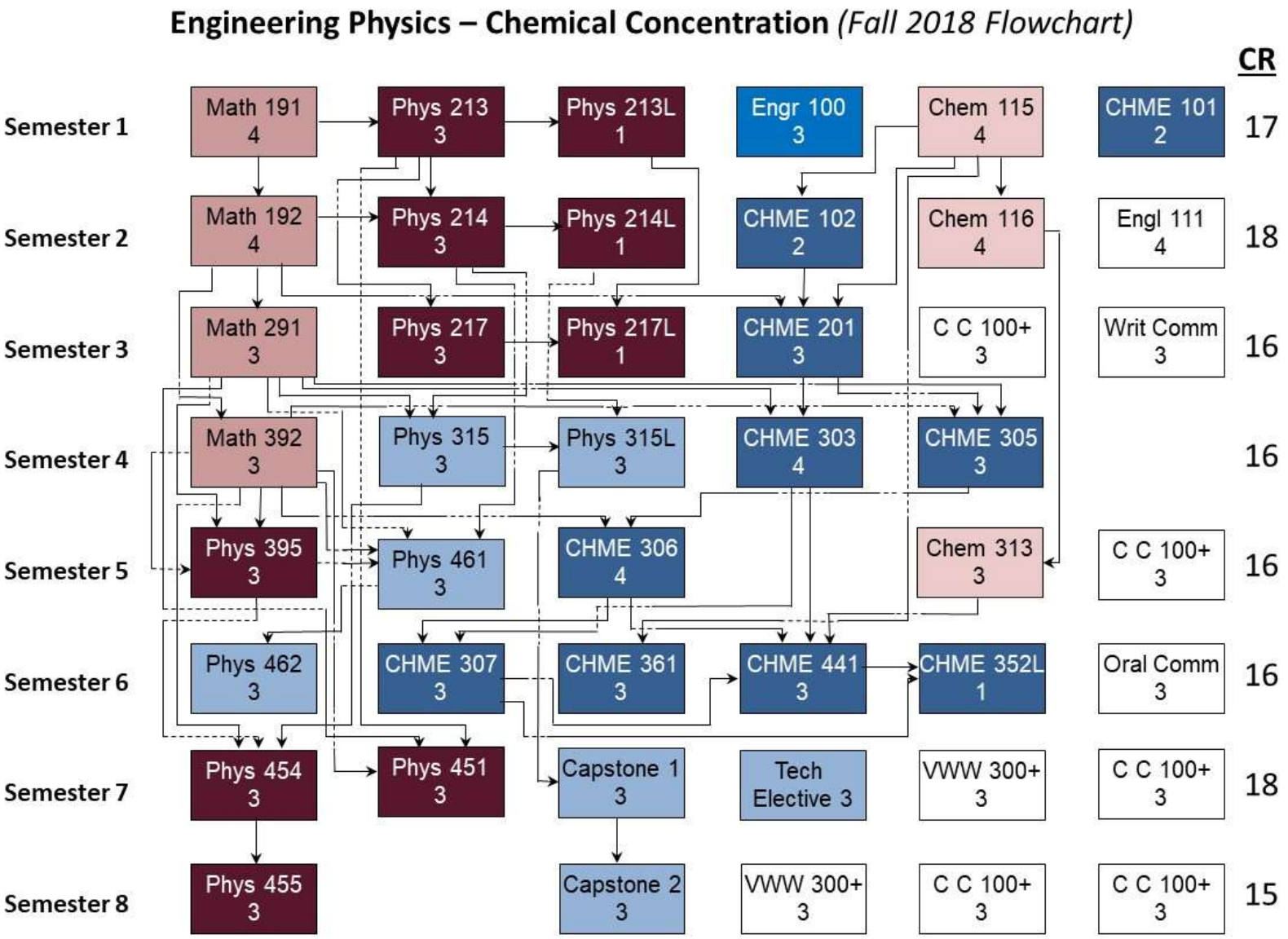


Diagram 5.1.c. *Proposed Schedule for Engineering Physics with the Electrical Concentration. Arrows coming in from the top indicate pre-requisites, arrows from the side co-requisites.*

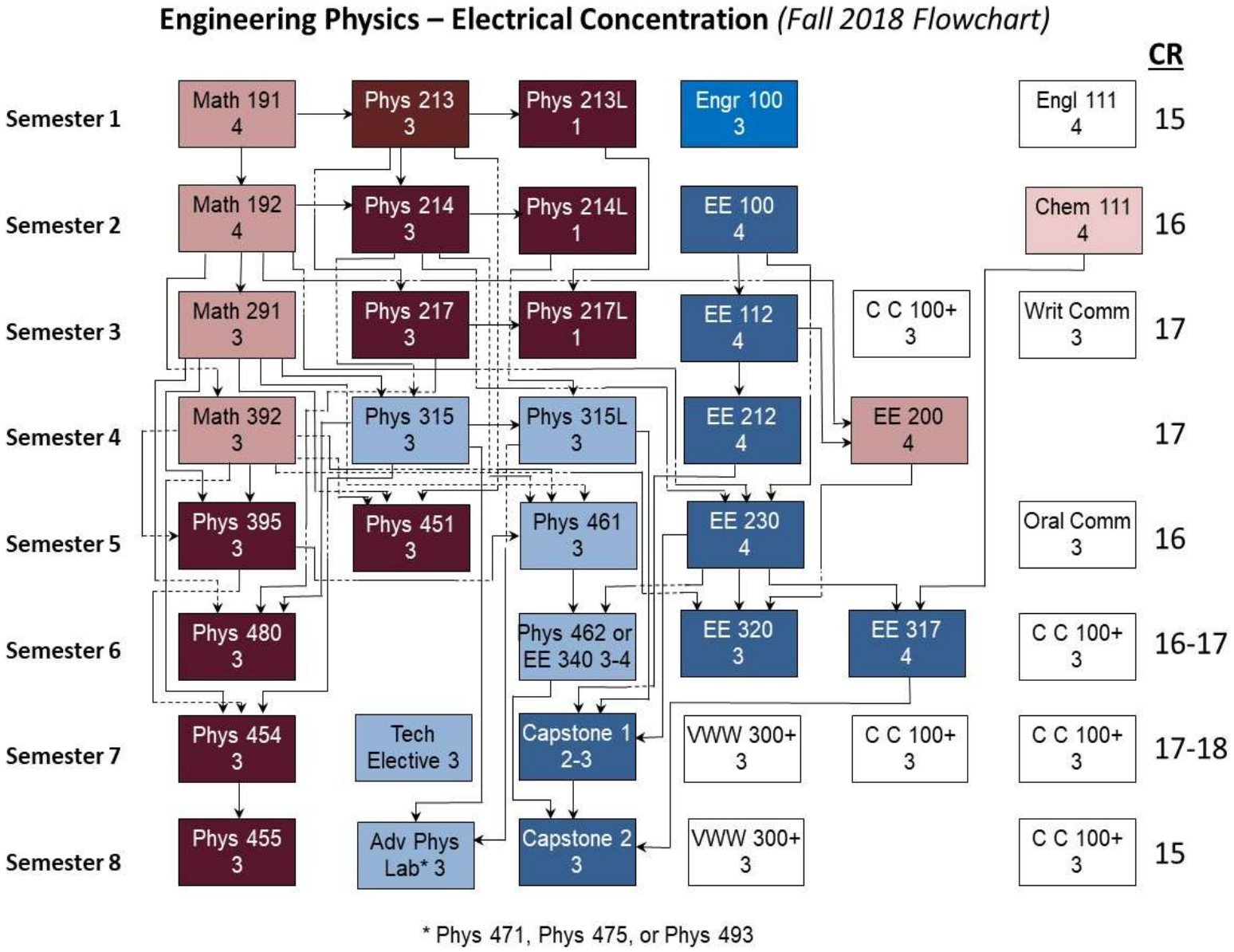
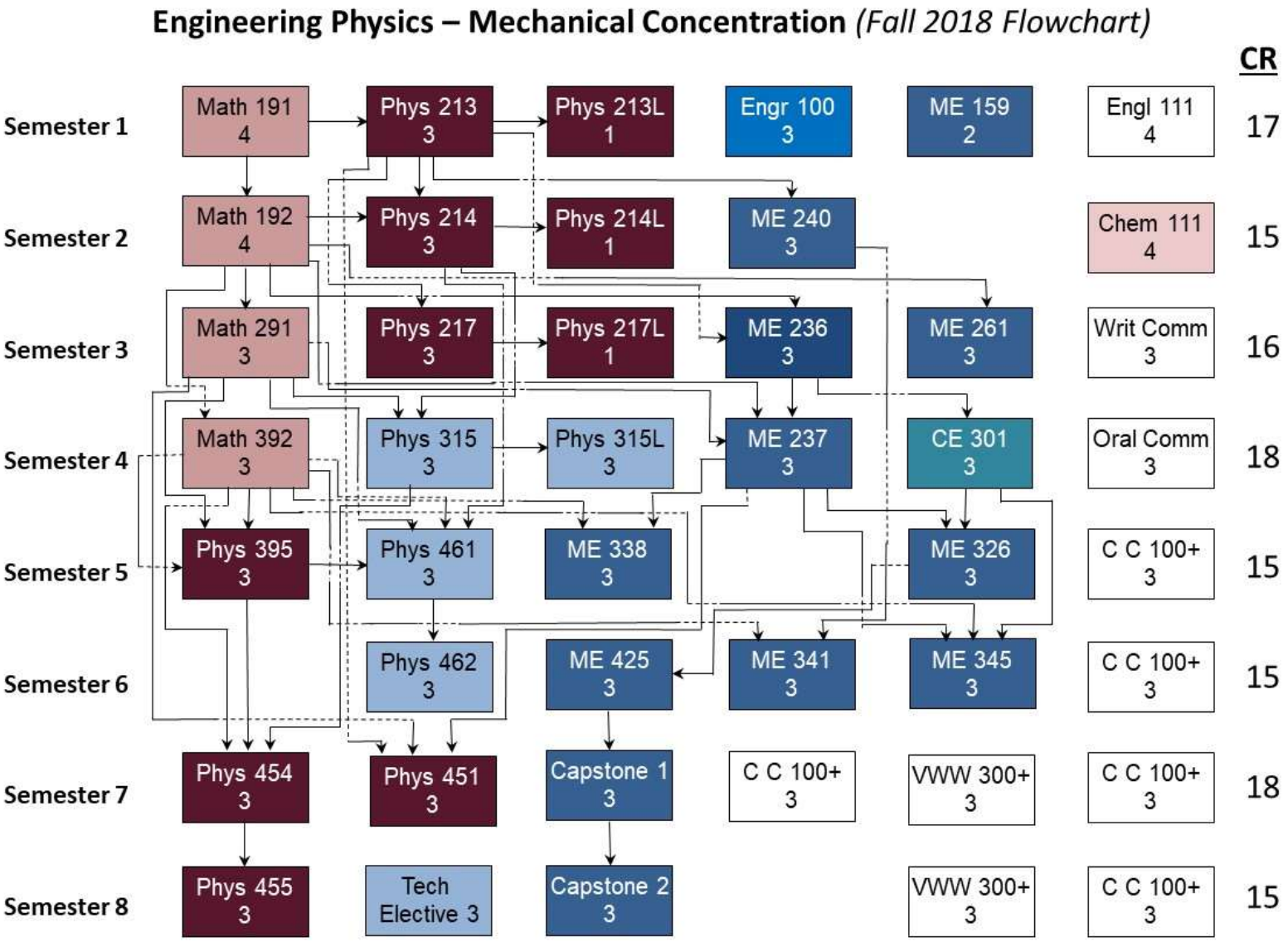


Diagram 5.1.d. Proposed Schedule for Engineering Physics with the Mechanical Concentration. *Arrows coming in from the top indicate pre-requisites, arrows from the side co-requisites.*



Describe how the program meets the requirements in terms of hours and depth of study for each subject area (Math and Basic Sciences, Engineering Topics, and General Education) specifically addressed by either the general criteria or the program criteria.

Math and Basic Sciences (39-49 credits)

Mathematics

All students enrolled in the *EP Program* at NMSU 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. EP students with the *Electrical Concentration* also take EE 200, which is counted as a math course.

Physics

Students enrolled in each of the four EP concentrations are required to complete 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, electromagnetism, thermodynamics, and advanced physics-laboratory practices. For each *EP Concentration*, the physics sequence is designed to complement, rather than duplicate, the engineering sequence so that students gain a broad physics background.

Chemistry

EP students enrolled in the *Aerospace*, *Electrical*, and *Mechanical concentrations* are required to complete one semester of general chemistry, CHEM 111. EP students with the *Chemical concentration* are required to complete 11 credits of more advanced chemistry.

Engineering Topics

A broad-based foundation in technical and engineering courses prepares EP graduates for a variety of employment opportunities. The *EP Program* offers four concentrations: *Aerospace, Chemical*, *Electrical*, and *Mechanical*. All EP students are required to complete the ENGR 100 (*Introduction to Engineering*) course. In addition to ENGR 100, EP students with *Aerospace Concentration* must complete 16 separate aerospace engineering, mechanical and civil engineering, engineering laboratory, and *Capstone Design* courses. The *Chemical Concentration* requires students to complete 12 separate chemical engineering, engineering laboratory, and *Capstone Design* courses. The *Electrical Concentration* requires students to complete 9 (or 10) separate electrical engineering, engineering laboratory, and *Capstone Design* courses. The *Mechanical Concentration* requires students to complete 13 separate mechanical engineering, civil engineering, engineering laboratory, and *Capstone Design* courses. The selection of engineering courses is aligned with the *Educational Objectives* of the *EP Program* at NMSU.

General Education Courses (25 credits)

English and Communications

EP students are required to complete two courses in *English* (ENGL 111G and typically ENGL 218G) and one course in *Communication* (typically: COMM 265G – *Technical Writing*).

General Education Courses in Common Core Areas IV and V

The general education requirements at NMSU 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 15 credit hours of humanities and social science electives, in addition to the courses in composition and rhetoric, technical writing, and oral communications that are mentioned above.

Viewing the Wider World **Courses (6 credits)**

Aside from the state-wide *General Education Common Core* (GenEd) requirements, NMSU students are required to complete 6 credits of *Viewing the Wider World* courses (300+ level), typically taken in the junior or senior years. Acceptable GenEd courses and their requirements are listed in the NMSU *Undergraduate Catalog*. The *Viewing the Wider World* program fosters intelligent inquiry, abstract logical thinking, critical analysis, and the integration of knowledge.

Describe the major design experience that prepares students for engineering practice. Describe how this experience is based upon the knowledge and skills acquired in earlier coursework and incorporates appropriate engineering standards and multiple design constraints.

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 on prerequisite topics and apply cumulative knowledge that has 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 exercising *Program Outcomes (i) - Lifelong learning*, Prog*ram 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 EP, where we currently have just few seniors taking the capstones in the same semester. Moreover, EP students are distributed over the four different concentrations. The low number of EP 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 is the main reason why most EP students take *Capstone Design* courses in the participating engineering departments, where sufficient enrollment is ensured due to the much larger numbers of students. While each engineering capstone consists of 3-8 students, the engineering departments offer all their capstones under one course number, thus easily escaping the 10-student minimum requirement.

The *College of Engineering* has started exploring the introduction of *College-Wide Capstone* courses that will allow students from different engineering programs (including EP) to participate in joint (and multi-disciplinary) design projects.

If the 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 EP curriculum requirements. However, individual faculty members work with both students and employers to help facilitate appropriate internship opportunities.

Describe the materials (course syllabi, textbooks, sample student work, etc.), that will be available for review during the visit to demonstrate achievement related to this criterion. (See the 2018-2019 APPM Section I.E.5.b.(2) regarding display materials.)

Display materials include two sets of folders for each course taken by EP students as part of the program requirement: the *'Maroon'* I*nstructor Notebooks* and the *'White' Course Notebook*s. The contents of both folders are listed in *Appendix E – Supplementary Documents*. In general, the folders contain general information, instructional materials 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 of the Self-Study Report, include a syllabus for each course used to satisfy the mathematics, science, and discipline-specific requirements required by Criterion 5 or by any applicable program criteria.

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