2020-2021 Annual Assessment Report for the Bachelor of Science in Engineering

Name of program: B.S. in Engineering
Type of program: Major
College of Arts and Sciences

I. Logistics

1. Contact information

Feedback should be sent to the Chair of the department, Prof. Hana Böttger (hana.bottger@usfca.edu).

2. Type of program

This is a report for the B.S. in Engineering major. The B.S. in Engineering does not house minors yet.

Affiliated minors not discussed here:

- Engineering Physics minor, housed under the department of Physics & Astronomy
- Architectural Engineering minor, housed under the department of Art + Architecture
- Environmental Engineering minor, housed under the department of Engineering. The minor is in the process of being approved.

3. Curriculum

The engineering program has three concentrations: environmental engineering, sustainable built environments engineering*, and electrical and computer engineering.

* starting AY23, this concentration will be called Sustainable Civil Engineering.

Curriculum Map

Tables 1-3 show the curricular maps for the three concentrations. The maps describe the level at which each ENGR course addresses each of the seven learning outcomes in each of the concentrations. The curricular maps for the three concentrations were approved in the department meeting on November 2, 2021.

Legend for Tables 1-3

●	introducing
o	developing
M	mastery

Table 1: Curriculum map for Environmental Engineering (EnvE) courses

YEAR	Semester	Credits	Course	course/type	ABET Student Outcomes 1. identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	2. apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	3. communicate effectively with a range of audiences	4. recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	5. function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	6. develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	7. acquire and apply new knowledge as needed, using appropriate learning strategies.
1	Fall	2	Becoming an Engineer	ENGR 100		•	•	•	•		•
1	Fall	4	Calculus I	MATH 109/B1	•		•				•
1	Fall	4	Gen Physics I for Engineers	PHYS 150/B2	•		•		•	•	•
1	Spring	4	Calculus II	MATH 110	•		•				•
1	Spring	2	Programming for Engineers	ENGR 102	•						•
1	Spring	4	Gen Physics II for Engineers	PHYS 151	•					•	
1	Spring	4	Engineering Project and Design I	ENGR 110/A1		•	•	•	•		•
2	Fall	4	Multivariable Calc	MATH 211	o	o	o		o	o	o
2	Fall	4	Sensors through History	ENGR 234	•	•				•	
2	Fall	4	Gen Chemistry I for Engineers	CHEM 150	•					•	
2	Fall	4	Modeling Sustainable Systems	ENGR 202	o	•					o
2	Spring	4	Math Methods for Scientists & Engineers	PHYS 371	o					o	
2	Spring	2	Scientific Computation	ENGR 302	o		o		o		o
2	Spring	4	Engineering Project and Design II	ENGR 210	o	o	o	o	o	o	o
2	Spring	0	Engineering Fabrication Lab	ENGR 010							•
2	Spring	4	Gen Chem II for engineers (with lab)	CHEM 151	o					o	
3	Fall	4	Probability & Stats for Engineers	MATH 3xx						o	
3	Fall	4	Environmental Engineering		o	•	o		o	•	
3	Spring	4	Engineering Project and Design III	ENGR 310	o	o	o	o	o	o	o
3	Spring	4	Water and Wastewater Treatment		o	•	•	•	o		o
4	Fall	4	Project IV: capstone part I	ENGR 410	M	M	M	M	M	M	M
4	Fall	4	Contaminant Fate and Transport		o	o	•	o	•		M
4	Spring	4	Project IV: capstone part II	ENGR 411	M	M	M	M	M	M	M

Table 2: Curriculum map for Sustainable Built Environment (SBE) Engineering Courses

YEAR	Semester	Credits	Course	course/type	ABET Student Outcomes 1. identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	2. apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	3. communicate effectively with a range of audiences	4. recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	5. function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	6. develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	7. acquire and apply new knowledge as needed, using appropriate learning strategies.
1	Fall	2	Becoming an Engineer	ENGR 100			•	•	•		•
1	Fall	4	Calculus I	MATH 109	•		•				•
1	Fall	4	Gen Physics I for Engineers	PHYS 150	•		•		•	•	•
1	Spring	4	Calculus II	MATH 110	•		•				•
1	Spring	2	Programming for Engineers	ENGR 102	•						•
1	Spring	4	Gen Physics II for Engineers	PHYS 151	•					•	
1	Spring	4	Engineering Project and Design I	ENGR 110/A1		•	•	•	•		•
2	Fall	4	Multivariable Calc	MATH 211	o	o	o		o	o	o
2	Fall	4	Sensors through History	ENGR 234	•	•				•	
2	Fall	4	Gen Chemistry I for Engineers	CHEM 150	•					•	
2	Spring	4	Modeling Sustainable Systems	ENGR 202	o		•			o	o
2	Spring	4	Math Methods for Scientists & Engineers	PHYS 371	o					o	
2	Spring	2	Scientific Computation	ENGR 302	o		o		o		o
2	Spring	4	Engineering Project and Design II	ENGR 210	o	o	o	o	o	o	o
2	Spring	0	Engineering Fabrication Lab	ENGR 010							•
2	Spring	4	Intro to Structural Engineering	ENGR 242	o	o			o		o
3	Fall	4	Probability & Stats for Engineers	MATH 3xx							
2	Spring	4	Intro to Construction Materials	ENGR 244			o	o		o	o
3	Spring	4	Engineering Project and Design III	ENGR 310	o	o	o	o	o	o	o
3	Spring	4	Experimental Methods & Design	ENGR 346	M	M	M	M	M	M	M
4	Fall	4	Project IV: capstone part I	ENGR 410	M	M	M	M	M	M	M
4	Fall	4	Sustainable Urban Systems	ENGR 348	M		M	M	M		M
4	Spring	4	Project IV: capstone part II	ENGR 411	M	M	M	M	M	M	M

Table 3: Curriculum map for Electrical Engineering (EE) courses

					ABET Student Outcomes						
YEAR	Semester	Credits	Course	course/type	1. identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	2. apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	3. communicate effectively with a range of audiences	4. recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	5. function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	6. develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	7. acquire and apply new knowledge as needed, using appropriate learning strategies.
1	Fall	2	Becoming an Engineer	ENGR 100			•	•	•		•
1	Fall	4	Calculus I	MATH 109	•		•				•
1	Fall	4	Gen Physics I for Engineers	PHYS 150	•		•		•	•	•
1	Spring	4	Calculus II	MATH 110	•		•				•
1	Spring	2	Programming for Engineers	ENGR 102	•						•
1	Spring	4	Gen Physics II for Engineers	PHYS 151	•					•	
1	Spring	4	Engineering Project and Design I	ENGR 110/A1		•	•	•	•		•
2	Fall	4	Multivariable Calc	MATH 211	o	o	o		o	o	o
2	Fall	4	Sensors through History	ENGR 234	•	•				•	
2	Fall	4	Gen Chemistry I for Engineers	CHEM 150	•					•	
2	Spring	4	Modeling Sustainable Systems	ENGR 202	o		•			o	o
2	Spring	4	Math Methods for Scientists & Engineers	PHYS 371	o					o	
2	Spring	2	Scientific Computation	ENGR 302	o		o		o		o
2	Spring	4	Engineering Project and Design II	ENGR 210	o	o	o	o	o	o	o
2	Spring	0	Engineering Fabrication Lab	ENGR 010							•
2	Spring	4	Introduction to Digital Electronics	ENGR 262	o		o		o	o	o
3	Fall	4	Probability & Stats for Engineers	MATH 3xx							
3	Fall	4	Analog Electronics	ENGR 264	o	o	o	•	o	o	o
3	Spring	4	Engineering Project and Design III	ENGR 310	o	o	o	o	o	o	o
3	Spring	4	Advanced Sensors	ENGR 36x	M	o	o	o	o	o	o
4	Fall	4	Project IV: capstone part I	ENGR 410	M	M	M	M	M	M	M
4	Fall	4	Feedback controls	ENGR 36x	M	o	o	o	o	M	o
4	Spring	4	Project IV: capstone part II	ENGR 411	M	M	M	M	M	M	M

PLOs to ILOs mapping

Table 4 describes when and how each program learning outcomes (PLOs) for the B.S. in ENGR degree maps onto the Institutional Learning Outcomes (ILOs) for the University of San Francisco.

Table 4: Mapping of ENGR PLOs to USF ILOs

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
ILO1				x			
ILO2	x					x	
ILO3		x					
ILO4			x		x		
ILO5	x	x				x	
ILO6	x	x				x	x
ILO7				x			

Institutional Learning Outcomes (ILOs) for the University of San Francisco

1. Students reflect on and analyze their attitudes, beliefs, values and assumptions about diverse communities and cultures and contribute to the common good (Critical Thinking)
2. Students explain and apply disciplinary concepts, practices and ethics of their chosen academic discipline in diverse communities (Critical Thinking)
3. Students construct, interpret, analyze and evaluate information and ideas derived from a multitude of sources (Critical thinking; quantitative reasoning; information literacy)
4. Students communicate effectively in written and oral forms to interact with their personal and professional communities (Written and oral communication)
5. Students use technology to access and communicate information in their personal and professional lives (component of information literacy)
6. Students use multiple methods of inquiry and research processes to answer questions and solve problems (Critical thinking; quantitative reasoning; information literacy)
7. Students describe, analyze, and evaluate global interconnectedness in social, economic, environmental and political systems that shape diverse groups within the San Francisco Bay Area and the world (Critical Thinking)

II. Mission statement and Program Learning Outcomes

1. Changes in mission statement since last assessment cycle

No changes since the last assessment cycle.

Mission Statement

USF Engineering's mission is to educate the whole person in the Ignatian tradition of transforming the world and ourselves. Through an innovative, inclusive, and applied education focusing on design, creation, and resourcefulness, it provides students the skills and perspective they need to succeed as professionals and the self-confidence, sensitivity, empathy, and cultural competency necessary to be ethical and responsible engineers empowered to effect meaningful change. It is distinguished by its high quality community-engaged scholarship, teaching, and research, and its interdisciplinary programming relevant to real projects locally, regionally, and internationally.

2. Changes in program learning outcomes since last assessment cycle

No changes to PLOs since the last assessment cycle. We are working on creating appropriate performance indicators for each PLO.

Program Educational Objectives

USF Engineering succeeds in its mission by graduating students who meet our four educational objectives to:

1. Demonstrate fluency with design thinking, systems thinking, creative problem solving, and self-directed scholarship as modes of approaching the engineering process.
2. Implement a holistic approach to engineering which values context, integrates multiple perspectives through collaborative teamwork, questions need, and considers impacts on both individuals and society at large.
3. Lead responsibly through a fusion of engineering judgement, practice, and entrepreneurship, while representing the engineer's critical role in projects, organizations, the environment, and society.
4. Exhibit a professional and personal identity which upholds values of social justice, environmental sustainability, and respectful service even under unknown and challenging conditions.

Program Learning Outcomes ("Student Outcomes")

Our degree program will be meeting the requirements for professional accreditation by ABET, the agency which oversees accreditation of engineering programs. ABET requires a two-part statement of outcomes – in addition to the *Program Educational Objectives* stated above as part of the Mission, we will meet the following *Student Outcomes*.

Students will achieve an ability to:

- PLO1: Identify, formulate and solve complex engineering problems by applying principles of engineering, science and mathematics
- PLO2: Apply engineering design to produce solutions that meet specified needs with consideration of public health, safety and welfare, as well as global, cultural, social, environmental and economic factors
- PLO3: Communicate effectively with a range of audiences
- PLO4: Recognize ethical and professional responsibilities in engineering situations and make informed judgements, which must consider the impact of engineering solutions in global, economic, environmental and societal contexts
- PLO5: Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks and meet objectives

- PLO6: Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions
- PLO7: Acquire and apply new knowledge as needed, using appropriate learning strategies.

These program learning outcomes were approved by the department in a general meeting of the curriculum committee in the Fall of 2018.

Program Learning Outcomes assessed in 2019-2020

In 2019-2020 we assessed PLO1 and PLO3. The learning outcomes were chosen based on the outcomes assessed in first year courses. Between PLO3, PLO5, and PLO7, we chose PLO3 as a priority to establish a baseline that we can compare to next year.

1. PLO1: Identify, formulate and solve complex engineering problems by applying principles of engineering, science and mathematics
2. PLO3: Communicate effectively with a range of audiences

Program Learning Outcomes to be assessed in 2020-2021

In the second year, we are going to be assessing PLO2 and PLO6 for the first time based on the course offerings. In addition, we will assess PLO1 and PLO3 again to be able to compare to the first-year results and to continue improving the methodology based on feedback from the first assessment cycle.

1. PLO1: Identify, formulate and solve complex engineering problems by applying principles of engineering, science and mathematics
2. PLO3: Communicate effectively with a range of audiences
3. PLO2: Apply engineering design to produce solutions that meet specified needs with consideration of public health, safety and welfare, as well as global, cultural, social, environmental and economic factors
4. PLO6: Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions

Table 5 shows the mapping of the assessed PLOs to courses taught during the academic year 2020-2021 and the PLOs that we plan to assess in 2021/2022.

Table 5: PLOs assessed in 2020/2021 (green) and PLOs to be assessed in 2021/2022 (green and yellow)

		PHYS 150 (Fall)	ENGR 234 (Fall)	ENGR 202 (Fall)	CHEM 150 (Fall)	ENGR110 (Spring)	ENGR 210 (Spring)	PHYS 151 (Spring)	CHEM 151 (Spring)	Physics 371 (Spring)	ENGR 102 (Spring)
	USF ENG outcomes: A student who has mastered this level should be able to										
PLO1	**identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics**	x	x		x		x	x	x	x	x
PLO2	**of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors**		x	x		x	x				
PLO3	**communicate effectively with a range of audiences**	x		x		x	x				
PLO4	judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts					x	x				
PLO5	leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	x				x	x				
PLO6	**develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions**	x	x		x		x	x	x	x	
PLO7	acquire and apply new knowledge as needed, using appropriate learning strategies.	x		x		x		x			x

III. Methodology for assessment

Overview and Rationale

As outlined above, Engineering will use the seven program learning outcomes as defined by ABET. In our original assessment design we wanted to explicitly consider pedagogical considerations and be aligned with the revised Bloom's taxonomy, which offers assessment endpoints in the cognitive and knowledge dimensions (Anderson & Bloom, 2001). In revising our assessment design, while we continue to consider learning theory considerations in our language, we are organizing our assessment by the seven PLOs, each of which will have a set of 4-5 performance indicators. Performance indicators are specific measurable endpoints for each PLO, and provide a common agreement as to what specific performances should be expected from students around each of the outcomes, which allows temporal comparisons and program-level assessment.

Upon collecting our data each year, we will consider how the two dimensions of our original assessment matrix (Table 6) are addressed within the curriculum and can drive curriculum changes between ABET assessment cycles. At the end of the fourth year, we would like students to be able to demonstrate achievement on all knowledge dimensions, and at the highest cognitive process dimension that is reasonable. For example, we may find that the "designing" level of the cognitive process dimension is appropriate for a graduate degree.

Table 6: Mapping of ENGR PLOs to USF ILOs

		Cognitive Process Dimension -->			
		Formative assessment		**Summative assessment**	
USF ENG outcomes: A student who has mastered this level should be able to		**Understanding: recall what you learn and define, explain or give examples to others**	**Applying: using information to accomplish something concrete**	**Analyzing: being able to extract meaning from a collection of information**	**Designing: creating something new under constraints to achieve a near optimal outcome**
PLO description	**Knowledge dimension**	Factual (1-4)	Factual (1-4)	Factual (1-4)	Factual (1-4)
		Conceptual (1-4)	Conceptual (1-4)	Conceptual (1-4)	Conceptual (1-4)
		Procedural (1-4)	Procedural (1-4)	Procedural (1-4)	Procedural (1-4)

Criteria and Rubrics for assessment

During the academic year 2020-2021, assessment criteria were developed for the assessment of every knowledge-cognitive process dimension combination for PLOs 1 and 3. Each participating instructor chose one or more of these criteria to assess either PLO1 or PLO3, depending on the nature of their course. General rubrics for each criterion were provided by the assessment committee, but instructors were given the freedom to adjust or modify based on the needs of their course and provide feedback.

1. PLO#1 for the B.S. in Engineering

PLO1 was assessed in three classes during the first year of the program: PHYS150/150L, PHYS151/151L and ENGR102 Programming for Engineers. The instructors of these courses chose to assess the following knowledge dimensions:

- PHY150/150L: Conceptual knowledge, applying and understanding
- PHYS151/151L: Conceptual knowledge, applying and understanding
- ENGR102: Conceptual and procedural knowledge, applying

The rubrics for each of the above were provided by the assessment committee as a csv file, was imported into Canvas by each faculty member, and was used simultaneously with grading work products.

Sample question assessing conceptual knowledge, at the <u>understanding</u> level.

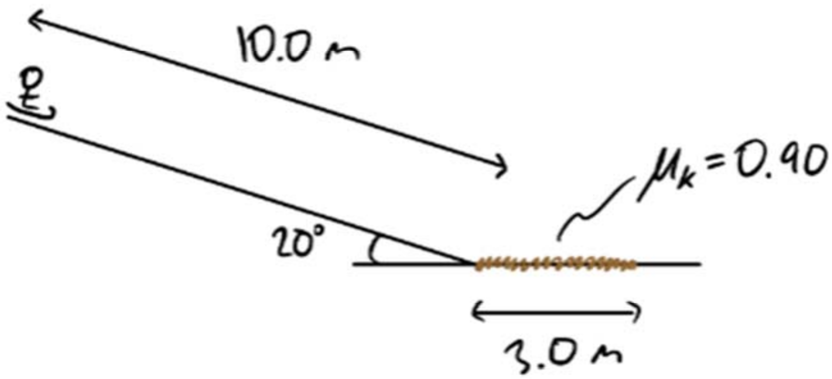
“ Tarzan swings through the jungle on a vine. At the lowest point of his swing, is the tension in the vine greater than, less than, or equal to the gravitational force of Tarzan? Explain”
“A spring is compressed by 1.0cm. How far must you compress a spring with twice the spring constant to store the same amount of energy?”

Rubric in Canvas

PLO1-Understanding-Conceptual explain a concept or interrelation between ideas correctly in their own words or through a drawing or example. threshold: 3.0 pts	4 pts * complete and succinct problem formulation * all relevant criteria presented for critiquing alternatives * all relevant constraints & assumptions identified	3 pts * adequate problem formulation * most key issues/variables identified * almost all constraints and assumptions there	2 pts * gaps in the problem formulation * able to identify key issues/variables *identify few key constraints and assumptions	1 pts * basic problem formulation * some issues identified, many missing * many constraints and assumptions missing	4 pts

Sample question assessing conceptual knowledge, at the <u>applying</u> level.

5) The first snow has just fallen and Jack has eagerly run up to the top of his favorite sledding hill. Unfortunately, it barely snowed at all and there's a big patch of dirt and mud at the bottom of the slope. The hill has a slope of 20° and the mud patch with $\mu_k = 0.90$ is 3 m wide, as shown below. Jack and his sled have a combined mass of 75 kg.



a) If Jack starts 10 m up the slope what will be his speed when he reaches the bottom, right before hitting the mud?

Rubric

PLO1-Applying-Procedural demonstrate proper use of math, science and engineering knowledge to obtain desired performance goals threshold: 3.0 pts	4 pts * complete knowledge of how to apply facts in model * understands limitations of models * obtains desired goals * validates/justifies obtained goals	3 pts * adequate understanding of relationship between inputs and performance goals * obtains key performance goals	2 pts * Some knowledge of the relation between inputs and performance behaviors in models • Obtains some performance behaviors correctly from inputs, but either miss some performance behaviors or obtain some wrong performance behaviors	1 pts * superficial understanding of relationship between inputs and performance goals * obtains some performance goals but misses some or obtains some wrong outputs	4 pts

2. PLO#3 for the B.S. in Engineering

PLO3 was assessed in one class during the first year of the program: ENGR110, Project & Design. The instructor of these courses chose to assess the following knowledge dimensions:

- ENGR 110: Applying Concept, and Applying Procedure

The assignment and rubrics were written in collaboration with David Ryan in Rhetoric. Each of the above were provided by the assessment committee as a csv file, was imported into Canvas by each faculty member, and was used simultaneously with grading work products.

Sample question assessing both conceptual and procedural knowledge, at the <u>applying</u> level.

Directions: for this assignment, compose a 500-word reflective paper that explains your project in relation to the discussions you and your team has had with your users.

To help compose your reflection, think about the ways in which, you:

- interacted and interviewed your client(s) by asking questions that helped them explain their perspectives on the project;
- gathered information that helped your understanding of the project;
- integrated their ideas in your project;
- considered some of their ideas but ultimately did not use their ideas, and;
- learned to use an empathic understanding of audience-related needs to improve your communication skills

Rubric

Performance Indicator	1: Introducing	2: Developing	3: Competence	4- Exemplary
Primary Research Method: Audience Assessment by Empathetic Interviewing to understand user experience.	Research method is not conducted, or is poorly formulated and/or explained.	Research method is partially formulated and/or conducted; demonstrates partial understanding of empathic interview process.	Research method mostly explains audience needs; demonstrates sufficient understanding of empathic interview process.	Research method is primary by conducting mediated interviews; and integrates audience needs and priorities within problem-solving design scheme.
Problem-Solving and Writing: design, problem-solving and user experience language use empathy and storytelling to demonstrate sensitivity and understanding toward audience and stakeholder needs.	Design, problem-solving and user experience language are either not explained or is insufficiently described; user experience may also be actively discounted or invalidated.	Writer identifies design, problem-solving and user experience language by using paraphrase and/or summary techniques, yet does not integrate audience needs or findings into design or other problem-solving decisions.	The user experience is recognized as valuable to design and problem-solving, and writer sufficiently integrates user experience in paper. There may be some confusion in terms of comprehension, but writer uses empathetic techniques, such as paraphrasing and mirroring in clear, useful ways.	The user experience is empathically accounted for in multiple ways; language integrates client-based experiences by using summary, paraphrase, and quotations to provide attribution to client, stakeholder and/or audience-related statements; audience needs are wholly integrated in problem-solving design.

Process followed to collect data

The following steps outline the process that was followed for identification of courses to be assessed, data collection and reporting.

At registration time (two months in advance of the beginning of each semester):

1. The assessment committee requests for each course to identify the PLOs that each instructor will be assessing in their course the upcoming year. Based on this, PLOs to be assessed for the upcoming year will be decided.

During the semester:

2. Each instructor chooses a cognitive and a knowledge dimension for assessment as outlined in the previous section.

3. The instructor creates a work product to assess the chosen criterion. The instructor may need to adapt the rubric to make it more specific to their work product.
4. At the time of grading of the work product, the instructor assesses the work product for each student directly on Canvas on the following scale, Introductory (1) , Developing (2), Meets expectations (3), Exceed expectations (4) according to the rubric provided.\
5. The instructor will submit the following to the assessment team:
   - The work products assessed (for QA/QC)
   - A description of which part of the work products was assessed (e.g., question 1 of part 2 of work product 1)
   - Students responses (raw data)
   - A reflection on the experience + feedback for next year

   We expect the instructor will spend about 2-3 hours for preparation (steps 2-3) and another 2-3 hours on assessment of their work products while grading (step 4).

At the end of the semester:

6. The assessment team collects the data (work products and corresponding assessments) and creates a summary presentation including the following:
   - Make map of what has been assessed (chosen dimensions)
   - Complete quantitative analysis of the data
   - Assemble and summarize any relevant qualitative data
7. Assessment committee submits annual assessment report (this document)

At the beginning of the upcoming semester:

8. Two department meetings (one per semester) are devoted to the discussion of the assessment report, and the collection of feedback for upcoming rounds of assessment.
9. Modifications were proposed for improvement of the process and/or rubrics.

Based on feedback we received during this year's assessment process, we will be making changes to our methodology, as discussed in the Closing the Loop section.

IV. Results and major findings

Through the 2020/21 academic year, we collected data from four classes. The resulting findings included: 1. improvements in teaching and learning practices, and 2. Reflections on the assessment methodologies. These results were shared individually with the faculty members teaching the course, to gather any insights, and then presented at faculty department meetings in April and December. Findings are summarized below.

1. Results from Classes

As mentioned in the methodology section, we focused on two PLOs in four classes. All classes assessed are required for engineering majors. Below is the summary:

*1- Introducing, 2- Developing, 3- Understanding, 4- Exemplary

		Rubric outcomes*				
Course	**PLO & Indicator**	**1**	**2**	**3**	**4**	**% Competency**
Physics 150	PLO1 - Applying Concept	1	5	10	3	63%
Physics 150	PLO1 - Conceptual Understanding	1	9	7	2	47%
Physics 151	PLO1 - Applying Concept	1	7	5	2	47%
Physics 151	PLO1 - Conceptual Understanding	2	4	8	2	67%
ENGR 102: Programming	PLO 1- Understanding Concept	8	1	8	12	69%
ENGR 102: Programming	PLO 1- Applying Concept	8	2	6	13	66%
ENGR 102: Programming	PLO 1- Applying Procedure	8	2	7	12	66%
ENGR 110: Project 1- Project & Design	PLO 3- Applying Concept	0	1	9	16	97%
ENGR 110: Project 1 - Project & Design	PLO 3- Applying Procedure	0	5	12	9	81 %

2. Results from instructor feedback

Upon collecting the data, we met with the instructors of each course to review the data and see if it made sense in terms of overall class performance. This was used to guide understanding of where the students are, and any improvements they wanted to focus on. Below is a summary of some items discussed:

PLO1:

- Students were not performing well on physics concepts. This was representative on the quizzes and tests.

- Students had a difficult time understanding physics concepts in terms of symbolic equations. Students tended to not see equations as a description of a problem, but rather as a numerical tool. This difficulty may be correlated to their stage of learning as first year students.
- Students struggled with applying and recognizing concepts to new situations (i.e. transferring concepts from one problem to a new, slightly different, problem)
- Try more practice problems and varied practice problems. Ideally, write problems for homework problems so students can get familiar with personal style as well as the style in the book.
- Make expectations of student work clearer at the beginning of the semester
- Find ways to ensure they are reading the textbook
- Increase time working on problems in class
- There are students who have regular jobs and do not have the capacity to both study and work long hours. There are also students who do not recognize the level of work required to study.
- Students who didn't do well, did not spend as much time with the material. This has various reasons such as time management, family emergencies, remote learning, family responsibilities, and internet access.
- As an instructor, it can help to focus more more explicitly on why the work is done, summary work. It's easy to focus on the weeds, and needing to look at the larger picture. Building in reflective components can support this larger system piece.

PLO3:

- Most students understood concepts of empathetic communication integrated into design thinking. In their write up of interviews, students adequately gathered and integrated information from interviews and recognized the importance of listening and respecting stakeholders.

3. Reflections on the Assessment Methodology

As members of the assessment committee, we learned a lot about the assessment process through this year. Below is a summary of what worked well throughout the assessment process:

- One on one discussions- This was a faculty driven process. We connected through zoom to chat about our process with faculty providing data. Starting the conversation early with faculty members allowed for adjustments clarifying the expectations in terms of rubric and assignments.
- The assessment committee helped with intentional assignment creation that supported the assessment process
- The integrating in canvas was straightforward
    a. We created a guidance document that faculty members could use
- Consistent with guidance given at ABET symposium
- Canvas Infrastructure set up, to be utilized after testing
- Engaged in Having conversations around student learning/ bloom's taxonomy

Elements of the assessment process we will be changing and improving:

- Clarify and emphasize the purpose of the committee in department meetings and in one on one discussion. Our goals are to:
    a. Create culture of continuous improvements
    b. Ensure that we are meeting accreditation criteria
- Remove qualitative survey and write up results together with instructor
- Clarification/update of Formative & Summative steps in the assessment process
- Spread out workload to engage more faculty members in the assessment process
- Update performance indicators based on faculty input

V. Closing the loop

As the engineering program is still new, we are actively in the process of developing, refining and building out our program and the assessment process. In the subsections following we outline how we integrated feedback from the FDCD, findings from our strategic plan, and our 2021/22 goals.

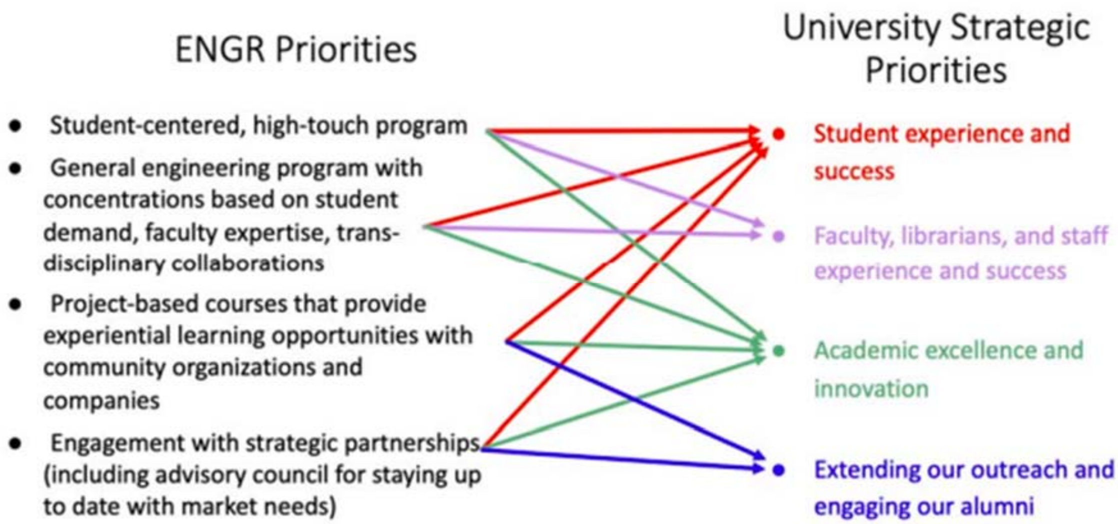
Feedback from the FDCD

The feedback from last year's report emphasized the need to simplify the methodology and analysis required to assess our Program Learning Outcomes. The first presentation of our methodology was based on pedagogical considerations and on following Bloom's taxonomy and the different learning levels at each stage of our curriculum. After implementing the methodology during the first year, we reframed our assessment plan to simplify its presentation and to prioritize efforts. In short:

- We will follow the typical assessment protocol as outlined by ABET, based on which we will choose two of the seven PLOs to assess each year. This will provide enough data for each PLO until the ABET visit.
- For each PLO, faculty are involved in creating performance indicators that are meaningful to our program and consistent with our values. This will allow us to demonstrate specifically the skills and knowledge our students are gaining in our program.
- For some PLOs, we will collect data on a higher frequency to allow us to track longitudinal progress. To reduce complexity and time requirements, this data will only be analyzed on a biannual basis and are only used for internal assessment purposes.
- The data collection from Canvas streamlines the process of collecting and storing work products and raw data, minimizing the time investment required each assessment cycle.
- An annual assessment conversation ensures that our process is improved iteratively, and that opportunities to increase efficiency are identified.

Strategic Plan

As part of the strategic plan development, the faculty members engaged in a SWOT analysis and strategic planning over the 2020/21 academic year. Below are the list of engineering priorities and how they relate to university priorities. Full report is available upon request.



Goal 2021/22- Continuous improvement

The engineering department is creating a framework for continuous improvement, as outlined by ABET requirements. Program assessment is one element of this framework, but we aim to incorporate several other elements that will help us iteratively enhance the student experience and demonstrate student learning, while also taking into account faculty engagement, professional growth and time limitations.

This past year, in addition to collecting and assessing PLO1 and PLO3 in our program, we initiated paths to have regular input that will result in continuous improvement of our program. These steps include:

- Annual faculty workshops to discuss assessment requirements (e.g. performance indicators)
- One on one discussions with faculty about assessment results that includes conversations about the assessment process
- Collection of annual data for repeated assessment
- We worked with ITS to set up canvas, so assessment rubrics are easy to integrate into classes

2021-22 Goal: Revise and refine four performance indicators

Upon attending the ABET consortium meeting during the Summer of 2021, it was clear that we needed to be developing performance indicators that represented the values of the USF program that were clear and measurable. We included all interested faculty in the redesign process through a workshop and one-on-one meetings. The redesigned indicators will be used for data collection and assessment in the 2021/22 assessment cycle. The redesign process is iterative and will be continued over several assessment cycles. More specifically:

Redesign of performance indicators for each assessed PLO

The department hosted a workshop in August before Fall semester started during which faculty teaching foundational courses for the program worked on redesigning the performance indicators for PLOs 1,2,3 and 6 with the intention to make them more specific, more measurable and aligned with our mission and the curricular priorities. The objective is to have 4-5 performance indicators per PLO. We are aiming for performance indicators that have enough breadth to be applicable to multiple classes, but are specific enough and with limited redundancy amongst them, to ensure measurability and interpretability.

After design, the performance indicators will be utilized in our classes and will be adapted in the next annual assessment based on the feedback we receive. The redesign involves assessing the rubrics that have been used by faculty for each indicator. At initial deployment of performance indicators, faculty will utilize their own rubric. We will gather and evaluate rubrics from different classes, in order to create a standardized rubric for each performance indicator that works for all classes.

When this process is complete, the PLO and its associated performance indicators will be incorporated into Canvas centrally, through the assessment admin account for all engineering classes to access.

Creating a performance indicator map across the curriculum

With the new performance indicators, we will create a performance indicator map to ensure that all important elements related to each PLO are covered in the curriculum. Based on the curriculum map and the feedback from faculty after using the indicators, we may need to merge or expand performance indicators. For example, if there are indicators that are only assessed by one class, we will consider merging and generalizing the wording.

Revised performance indicators

PLO1: identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

1. Explain key science or engineering concepts that inform the solution to a problem.
2. Identify key variables (knowns and unknowns) and how they relate to each other with a flow diagram, equation or map of steps needed to solve an engineering problem.
3. Execute calculations with unit and dimensional consistency.
4. Quantitatively solve multi-step engineering problems by integrating knowledge.
5. Assess the appropriateness of an approach or solution (includes choice of method, validity of assumptions etc).
6. Design a system or experiment to address an engineering problem.

Examples of how these performance indicators would be assessed:

Indicator 2: ENGR202: Assessed by quiz question where students are given a description of a system, and they create a systems diagram with stocks and flows.

Indicator 3: ENGR 242: midterm exams

Indicator 4: PHYS 151: Final exam question

Indicator 5: ENGR 234: Initial idea - assessed by thermometer lab, where students will test different temperature Indicator 5: measurement techniques and discuss the appropriateness of each.

Indicator 6: ENGR 242: project to design small structure with full gravity and lateral load calcs given conditions & requirements

PLO2: apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors

1. Gather information to understand context of design
2. Analyze context to specify needs
3. Propose a plan that integrates societal and environmental justice factors
4. Create a product in which social justice factors are embedded within the design solution

PLO3: communicate effectively with a range of audiences

1. Representing data and information succinctly using principles of visual design and clear organization.
2. Empathizing with an audience/user group to understand what they find important.
3. Preparing material to deliver content with confidence.
4. Active listening to engage in critical dialog and discourse.
5. Synthesizing content with tools of rhetoric to communicate a point.

PLO6: develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

1. Conduct an experiment according to a given procedure
2. Compare experimental results to hypothesis or appropriate theoretical models
3. Evaluate results in the context of the technique used to collect or model the data
4. Interpret the modeled or experimental data to draw conclusions/explain results/reject hypothesis/ in the context of differences between measured and predicted values
5. Design an experiment specifying appropriate (dependent and independent) variables and tools for data collection.

Examples of how these performance indicators would be assessed:

Indicator 2: PHYS 150L: Momentum and collisions lab.
Indicator 3: PHYS 151L: Diffraction lab (measure the width of a human hair). The distance measurements are subject to user error and the manual alignment is a large source of error.
Indicator 3: ENGR 234: initial idea - microscope lab, students will assess resolution and contrast using different types of lenses and lighting.
Indicator 5: CHEM 150L: There is a 2 week lab on making slime (polymers). The first week the students follow a procedure so that could be used for #1 and then the second week students design a lab to optimize a parameter which could be used to evaluate #5.