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ABET Update

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This accreditation update presents a case study by the speakers and does not necessarily reflect ABET's official views.

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Changes to the ABET Criteria

- Criteria for Accrediting Engineering Programs for implementation in the 2019 -2020 accreditation cycle
- We will focus on Student Outcomes Criteria

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Old Student Outcomes

A. Fundamentals - an ability to apply knowledge of mathematics, science, and engineering

B. Experimentation - an ability to design and conduct experiments, as well as to analyze and interpret data

C. Design - an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

D. Teamwork - an ability to function on multidisciplinary teams

E. Problem Solving - an ability to identify, formulate, and solve engineering problems

F. Ethics - an understanding of professional and ethical responsibility

G. Communication - an ability to communicate effectively

H. Global Awareness - the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

I. Life-Long Learning - a recognition of the need for, and an ability to engage in life-long learning

J. Contemporary Issues - a knowledge of contemporary issues

K. Modern Tools - an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

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New Student Outcomes

1. Problem Solving - an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. Design - an ability to 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. Communication - an ability to communicate effectively with a range of audiences
4. Ethical and Professional Responsibility - an ability to 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. Teamwork - an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. Experimentation - an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. Learning - an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

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- ABET visit in Fall 2017
- Student outcomes assessment then:
  - Half of the outcomes are assessed every year
  - Each outcome is assessed in 3-4 classes
  - Performance Indicators and rubric assigned to each outcome
  - Faculty retreat every year to discuss results/close the loop
- Fall 2017: transition to new outcomes

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Outcome 1

- The new Outcome 1 is a combination of old Outcome E (Problem Solving) and old Outcome A (Fundamentals) and the addition of the word "complex". The two rubrics for Outcomes E and A had to be combined to reflect the wording of Outcome 1.

- Outcome 1: Problem Solving: an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

- Outcome E: Problem Solving — an ability to identify, formulate, and solve engineering problems

- Outcome A: Fundamentals - an ability to apply knowledge of mathematics, science, and engineering

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Outcome 2

- The new Outcome 2 is similar to the old Outcome C with some differences:

a) “ability to apply engineering design to produce solutions” (new) vs “ability to design a system, component, or process” (old)

b) “meet specified needs” (new) vs “meet desired needs within realistic constraints” (old)

c) “public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors” (new) vs “such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability” (old)

d) the phrase “such as” is missing from the new rubric, all of the factors needed to be considered have and listed in the rubric.

- Outcome 2: Design - an ability to 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

- Outcome C: Design - an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

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Outcome 3

- Outcome 3 is very similar to the old Outcome G with one difference: “range of audiences”. We need to make sure that the assessment assignments are taking into consideration different audiences. No changes are needed for the two rubrics for Outcome G.

- Outcome 3: Communication - an ability to communicate effectively with a range of audiences

- Outcome G: Communication - an ability to communicate effectively

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Outcome 4

- New Outcome 4 is a combination of old Outcomes F and H with modifications:

a) “ability to recognize ethical and professional responsibilities” (new) vs “understanding of professional and ethical responsibility” (old)

b) “make informed judgments, which must consider the impact of engineering solutions” vs “understand the impact of engineering solutions”

- Outcome 4: Professional Responsibility - an ability to 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

- Outcome F: Ethics - an understanding of professional and ethical responsibility

- Outcome H: Global Awareness - the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

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Outcome 5

- Outcome 5 is derived from Outcome D but the old rubric has to be modified to include the following:

a) “function effectively”

b) “members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives”.

- Outcome 5: Teamwork - an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

- Outcome D: Teamwork - an ability to function on multidisciplinary team

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Outcome 6

- Outcome 6 is similar to Outcome B with the following changes:

a) “develop and conduct appropriate experimentation” (new) vs “design and conduct experiments” (old)

b) “use engineering judgment to draw conclusions” (new)

- Outcome 6: Experimentation - an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

- Outcome B: Experimentation — an ability to design and conduct experiments, as well as to analyze and interpret data

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Outcome 7

- Outcome 7 is quite different from Outcome I but it refers to the same concept of learning. It is not abut life-long learning anymore. Two themes that need to be addressed in the new rubric:

a) “ability to acquire and apply new knowledge as needed”

b) “appropriate learning strategies”

- Outcome 7: Learning - an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

- Outcome I: Life-Long Learning: a recognition of the need for, and an ability to engage in life-long learning

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Example: Outcome 4

- Professional Responsibility - an ability to 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

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Performance Indicators	4 Points Above Expectations	3 Points Meeting Expectations	2 Points Approaching Expectations	1 Point Below Expectations
1. Ability to identify ethical responsibilities and professional responsibilities in engineering situations.	The student independently recognizes both their ethical responsibilities to society, the world, and the environment, and their responsibilities to their profession, their organization, and other stakeholders.	The student independently recognizes either their ethical responsibilities to society, the world, and the environment, or their responsibilities to their profession and other stakeholders.	With some help, the student can recognize either ethical responsibilities to society, the world, and the environment, or their responsibilities to their profession, their organization, and other stakeholders.	The student's ability to recognize ethical or professional responsibilities is limited to interpreting the benefits of new technology in terms of the profit of the organization in charge.
2. Ability to make informed engineering judgments using multiple ethical frameworks when ethical and professional responsibilities conflict.	The student is able to recognize conflicts between ethical and professional responsibilities, and uses several ethical frameworks to make informed and defensible judgments.	With assistance, the student is able to recognize conflicts between ethical and professional responsibilities, and uses no more than two ethical frameworks to make informed judgments.	In the presence of ethical–professional conflict, the student is only able to use their native ethical framework or perspective, and cannot find empathy for other frameworks or perspectives.	The student is unable to express their ethical perspective or consider frameworks, or the student does not perceive that frameworks based on reason are any stronger than unexamined ones.
3. Ability to make informed judgments about the global, economic, environmental, and societal impacts of engineering solutions, and explain broad social changes brought about by new technology.	The student appropriately evaluates engineered systems in terms of their adverse and beneficial global, economic, environmental and societal impacts, and can identify and explain technology's secondary effects on cultural norms.	The student appropriately evaluates engineered systems in terms of their adverse and beneficial global, economic, environmental and societal impacts with some assistance. The student can identify technology's secondary effects on cultural norms.	The student evaluates engineered systems in terms of global, economic, environmental and societal impacts through uninformed judgments, inappropriate axioms, superficial relationships, or neglecting one or more of the four types of impact.	The student is unable to evaluate engineered systems in terms of their adverse global, economic, environmental and societal impacts, or to effectively describe recent social changes due to technological advances.

Student Outcomes Assessment Schedule

	Outcome						
	1. Problem Solving	2. Design	3. Communication	4.Ethics and Professional Responsibility	5. Teamwork	6. Experimentation	7. Learning
2017-18	x		x			x	
2018-19		x		x	x		x
2019-20	x		x			x	
2020-21		x		x	x		x
2021-22	x		x			x	
2022-23		x		x	x		x

Courses Used to Assess Outcomes

Course Number and Name	Quarter	Student Outcomes						
		1	2	3	4	5	6	7
ECEGR 1000 Computing for Engineers	F/W					x	x	
ECEGR 3000 Introduction to MATLAB	F/W					x	x	
ECEGR 1200 Digital Operations & Computation	F		x				x	
ECEGR 2010 Computer Tools	F/S							x
ECEGR 2210 Programmable DevicQes	W					x		
ECEGR 2220 Microprocessor Design	S	x	x					
ECEGR 3110 Electrical Circuits II	F	x						x
ECEGR 3111 Laboratory I: Circuits	F			x				x
ECEGR 3120 Semiconductor Devices & Circuits	W	x			x			
ECEGR 3121 Laboratory II: Electronics	W			x		x		
ECEGR 3210 Embedded Systems	F				x			
ECEGR 3500 Electrical Energy SysAtems	W				x			
ECEGR 3710 Signals and Systems	S			x				x
ECEGR 3711 Laboratory III: Signals and Systems	S		x				x	
ECEGR 4870 Engineering Design I	F	x			x			
ECEGR 4880 Engineering Design II	W					x	x	
ECEGR 4890 Engineering Design III	S		x	x				

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Criteria

- 70% of students achieve an average score of 2.01 or higher on each outcome ("meet expectations")

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Example: Outcome 6

Experimentation - an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

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Example: Outcome 6

Performance Indicator	4 Points Above Expectations	3 Points Meeting Expectations	2 Points Approaching Expectations	1 Point Below Expectations
1. Ability to plan experiment to collect data to support or refute the hypothesis or inquiry.	Clear understanding of hypothesis or inquiry. Plan is thoughtful, thorough and complete (no unnecessary steps). Experiment is rigorous. Appropriate data-collection methods and instruments are identified.	Plan addresses collecting all of the required data. Demonstrates an understanding of the hypothesis or inquiry. Minimal unnecessary steps. Plan calls for appropriate equipment used in an efficient manner.	Plan would collect most or all of the required data. Either unnecessary steps are present, or some equipment choices are inappropriate.	No discernible plan. Little foresight. Plan would result in incomplete or erroneous data. Plan may be dangerous to execute.
2. Ability to execute experimental plan using tools and instruments.	Follows experimental plan, making corrections as needed. Uses appropriate tools and instruments safely and effectively. Data recorded with high regard for fidelity.	No unwarranted deviation from plan. Little or no assistance in using tools and instruments. Tools and instruments are used properly. Data recorded in an organized manner.	Minor unwarranted deviation from plan. Requires assistance using tools. Data recorded in an organized manner.	Does not follow plan. Unsafe, ineffective, or improper use of equipment. Requires major assistance using tools and instruments. Sloppy data recording and archival.
3. Ability to use obtained data to draw a conclusion on the hypothesis or inquiry.	Draws clear and defensible conclusions from the data. Understands and articulates the limitations of the data. Does not overstate results.	Conclusions drawn are reasonable, with some additional level of insight. Any limitations in the data set are described.	Conclusions drawn are reasonable given the data.	No real conclusion drawn. Uses illegitimate data or makes dubious claims.

Example: Outcome 6

- Class: Engineering Design II (winter)
- <u>Problem Statement:</u>

1. Identify one technical requirement/specification of your project (for example, the system must operate for three hours on battery power).

2. Describe, in detail, an experimental plan that you (or your team) have or will use to determine if the requirement/specification is met.

3. Provide data supporting your conclusion on whether or not the requirement/specification has been met. In some cases your data might be observational. If you have not yet completed the experiment, describe how you will interpret the data to draw a conclusion.

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Results for This Assessment Activity

			Performance Indicator		
Student ID	Last Name	First Name	Ability to plan experiment to collect data to support or refute the hypothesis or inquiry.	Ability to execute experimental plan using tools and instruments.	Ability to use obtained data to draw a conclusion on the hypothesis or inquiry.
			Score (1-4):	Score (1-4):	Score (1-4):
2171855			2	2	2
2154145			2	2	1
1941854			2	2	1
2215365			3	3	2
2099810			3	3	4
2215020			2	2	2

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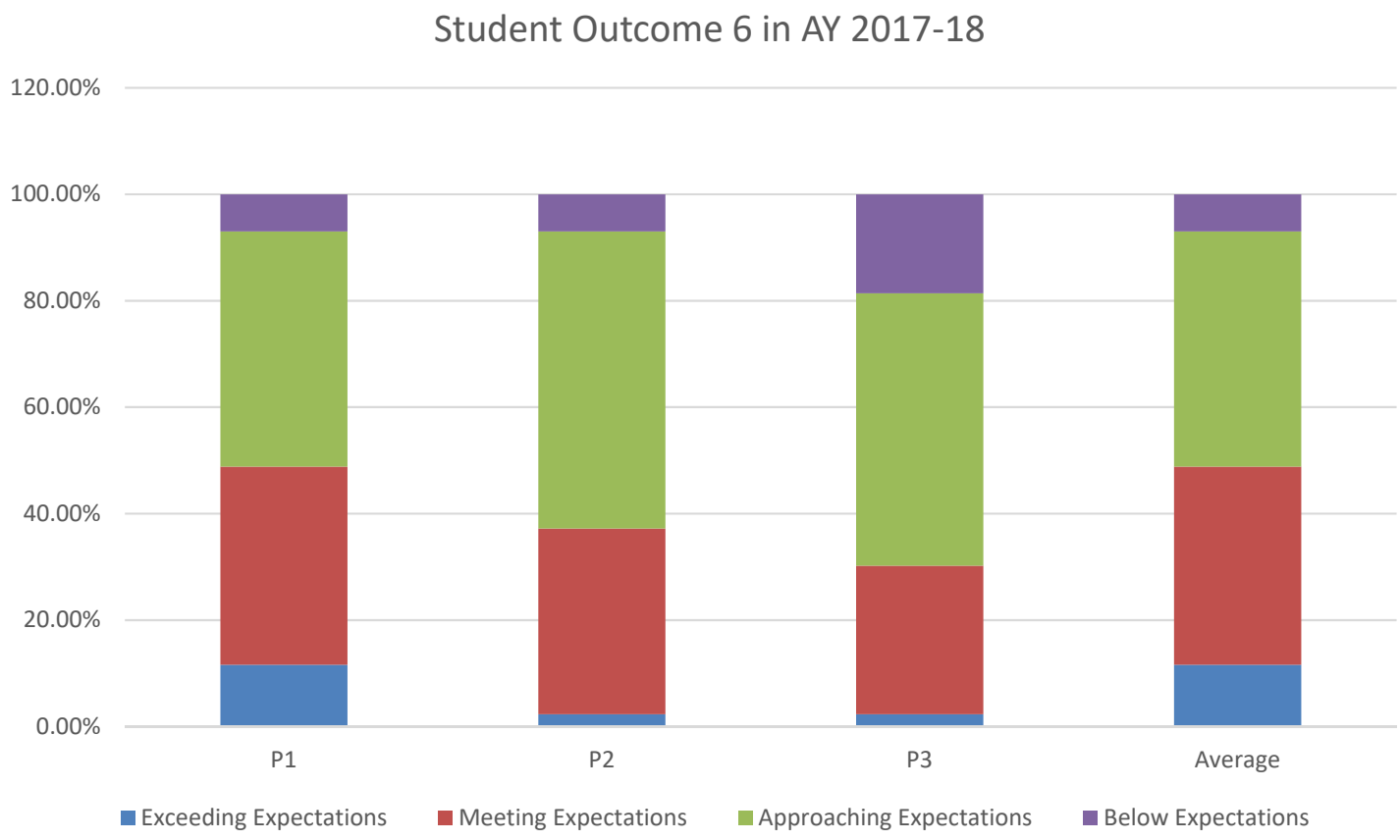
Overall Results for Outcome 6



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Efficient assessment of new outcomes

- Case studies (outcomes 4 & 6) illustrate an efficient method to assess new outcomes
  - Decompose each new outcome statement and map components on old outcome statements
  - Re-use existing methods for previous components
  - Develop new methods for new components

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Other changes in 2019-2020 criteria

- Minor changes
  - Clarify definitions of terms (Complex engineering problems, Engineering design, etc.)
  - Curriculum (criterion 5)
    - 30 semester credit hours (not 32) of Math / Basic Sciences
    - 45 semester credit hours (not 48) of engineering topics
- Hard transition to new criteria immediately

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Summary

- Emphasis on new outcomes
  - Case studies: An efficient method to assess new outcomes
- Previous issues remain, e.g
  - Process documentation
  - Working with individual PEVs

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