BSIE and BSE Assessment Plan
Department of Engineering
Colorado State University-Pueblo

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# Schedule of assessment activities

| | 2011-12 | | 2012-13 | | 2013-14 | | 2014-15 | | 2015-16 | | 2016-17 | | 2017-18 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | FA | SP | FA | SP | FA | SP | FA | SP | FA | SP | FA | SP | FA | SP |
| Evaluate membership of Advisory Boards | | | √ | | | | | | √ | | | | | |
| **Program educational objectives** | | | | | | | | | | | | | | |
| Boards and Faculty evaluate objectives | | √ | | | | | | | | √ | | | | |
| Review info from LinkedIn | | | | | | | | | | | | | | |
| **Program outcomes** | | | | | | | | | | | | | | |
| Faculty review outcomes and course/outcome matrix | x | | | | x | | | | x | √ | | | x | |
| Review student performance in EN 101, EN 215, EN 231 | | x | | x | | x | √ | x | | x | | x | | x |
| **Every semester, assessments are performed according to outcome/course matrix to measure the extent to which that outcome is achieved in that course** | | | | | | | | | | | | | | |
| **Faculty review results of assessments and apply to development of the program** | | | | | | | | | | | | | | |
| Outcome a - apply math, science, and en. | | | √ | | | | | | x | | | | | |
| Outcome b - experiments and data | | | | | √ | | | | | | x | | | |
| Outcome c - design | √ | | | | | | √ | | | | | | x | |
| Outcome d - teams | √ | | | | | | √ | | | | | | x | |
| Outcome e - en problems | | | | | | √ | | | | | | x | | |
| Outcome f - ethics | | | √ | | | | | | x | | | | | |
| Outcome g - communicate | | | | | √ | | | | | | x | | | |
| Outcome h - context | | √ | | | | | | √ | | | | | | x |
| Outcome i - life long learning | | | | √ | | | | | | x | | | | |
| Outcome j - contemporary issues | | | | | √ | √ | | | | | | x | | |
| Outcome k - techniques, skills, tools | | | | √ | | | | | | x | | | | |

## Constituencies

The Program Educational Objectives for the BSE and BSIE programs are based on the needs of the following constituencies:

- Local and regional industry as employers of our alumni,
- Students, and
- Engineering alumni.

Our primary constituency is local and regional industry, as represented on our Advisory Board.

Our students are mostly local residents, recent high school graduates or nontraditional students, with other students from other parts of Colorado and from out of state. Some students, especially the nontraditional students, don't want to leave the Pueblo area because of family and work connections here. Some nontraditional students pursue an engineering degree for advancement in their current jobs. A number of students are transfer students from other universities or from community colleges.

Alumni of the program are our final products. Ultimately, they determine the success of the program as they progress in their engineering careers.

## Educational Objectives

During the first few years after graduation, BSIE and BSE graduates should be able to:

| BSIE Educational Objectives | BSE Educational Objectives |
|---|---|
| 1. Identify root causes and solve engineering problems. | 1. Identify root causes and solve engineering problems. |
| 2. Function well as individual contributors and on multidisciplinary teams, | 2. Function well as individual contributors and on multidisciplinary teams, |
| 3. Obtain jobs of increasing responsibility applying industrial engineering skills and knowledge to a wide range of problems in a wide range of industries, | 3. Obtain jobs of increasing responsibility applying engineering skills and knowledge to a wide range of problems in a wide range of industries, |
| 4. Continue their education at the graduate level, | 4. Continue their education at the graduate level, |
| 5. Obtain additional engineering certifications. | 5. Obtain additional engineering certifications. |
| 6. Design new and improve existing production and service systems. | 6. Design new and improve existing mechatronic systems. |

Educational objectives 1-5 are identical for the two programs.

# Review of performance in EN 101, EN 215, and EN 231

Each spring, the faculty evaluates the following information about the BSIE and BSE programs:

1. the most recent and long-term performance of BSE and BSIE students in EN 101, Introduction to Engineering,
2. the most recent and long-term performance of BSIE students in EN 215, Introduction to Industrial Engineering,
3. the most recent and long-term performance of BSE and BSIE students in EN 231 and EN 231L, Circuit Analysis

In reviewing student performance in courses, the faculty member who taught the course will present his/her overall impressions of the strengths and weaknesses of the student cohort.

The review of EN 101 is to check incoming quality; for example, do students have computer experience and math background to succeed? The review of EN 215 is to check incoming quality of transfer students and preparation of continuing students for the BSIEN program. The review of EN 231 is to check incoming quality of transfer students and preparation of continuing students for the BSE program

# Program Outcomes

For both programs, the Department has adopted ABET's (a)-(k).

At the time they graduate, BSIE and BSE graduates should have:
(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data,
(c) 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) an ability to function on multi-disciplinary teams,
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Evaluation of the Program Outcomes is done in conjunction with the evaluation of the Educational Objectives so that if the Objectives change, the effect on the Outcomes will be considered at that same time.

# Outcome Champions

The following are the designated champions for each outcome:
(a) Apply knowledge of math science and engineering: Prof. DePalma
(b) Design and conduct experiments, analyze and interpret data: Prof. Yuan
(c) Design: Prof. DePalma
(d) Teams: Prof. Wollega
(e) Engineering problems: Prof. Bedoya
(f) Ethics: Prof. Yuan
(g) Communication: Prof. Jaksic
(h) Impact of engineering solutions: Prof Fraser
(i) Life-long learning: Prof Fraser
(j) Contemporary issues: Prof Fraser
(k) Engineering tools: Prof. Jaksic

The champion is expected to:

- Every third year, according to the specified schedule, review assessments for that outcome and report to the faculty.
- Suggest teaching methods and assessment methods (including rubrics) for that outcome.

# Design of program to support outcomes

The overall program is designed to ensure support of all Program Outcomes. The matrix “Course support of outcomes” (shown on the next page) summarizes how strongly each course supports each program outcome, where

- A = considerable content and Assessment is done for this program outcome.
- A* = considerable content and Assessment (separated by BSIE and BSE) is done for this program outcome.
- x = some content concerning this program outcome
- blank = no emphasis on this program outcome

This matrix is evaluated by the faculty at the same time that the Educational Objectives and Program Outcomes are evaluated.

# Matrix showing course support of outcomes for BSIE

| BSIE Program outcome | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A graduate of the program should be able to: | 101 Intro | 103 Progg | 107 Graphics | 211 Statics | 212 Dynamics | 215 IE Intro | 231 Circuits | 321 Thermo | 324 Materials | 343 Econ | 365 Prob/Stat | 420 Simltn | 430 Project | 439 Hum Perf | 440 Safety | 441 manuf | 443 QC | 471 OR | 473 CIM | 475 Fac Plng | 477 Ops Plng | 486 Seminar | 488 Sr Proj | Number of A's |
| a) apply knowledge of math, science, and engineering | x | x | | A* | x | x | A | x | x | x | x | x | x | x | x | x | x | A | x | x | x | | x | 3 |
| b) design and conduct experiments; analyze and interpret data | x | | | | | | x | | x | | A* | A | | A | x | x | A | x | x | x | x | | x | 4 |
| c) design system, component, process to achieve or improve efficiency, quality, and safety. | x | | x | | | x | | | x | | x | x | | x | x | x | x | x | x | A | A | x | A* | 3 |
| d) function on multi-disciplinary teams | x | | x | | | A | x | | | | | x | A* | | x | x | | x | x | x | x | x | | 2 |
| e) identify, formulate, solve engineering problems | x | x | x | x | x | x | A | x | x | x | x | x | x | x | x | x | x | A | x | x | x | x | A* | 3 |
| f) understand professional/ethical responsibility | A | | | | | x | | | | x | | x | x | x | x | | x | x | x | x | x | A* | x | 2 |
| g) communicate effectively | x | | x | | | A | x | | x | | x | x | A | x | x | x | x | x | x | x | x | x | A* | 3 |
| h) understand impact of engineering solutions in global & societal context | x | | | | | x | | | | A | x | x | | x | x | x | x | x | x | x | x | x | A* | 2 |
| i) recognize the need for and be able to engage in life long learning | A | x | | x | x | A | | x | x | x | x | x | | x | x | x | x | x | x | x | x | x | A* | 3 |
| j) use knowledge of contemporary issues | x | | | | | x | | | | A | x | x | | x | x | | x | x | | x | x | | A* | 2 |
| k) use techniques, skills, modern engineering tools necessary for engineering practice | x | A | x | x | x | x | x | x | x | x | x | x | x | x | x | x | A* | x | x | x | x | | x | 2 |

Matrix showing course support of outcomes for BSE

| BSE Program outcome | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A graduate of the program | 101 | 103 | 107 | 211 | 212 | 231 | 260 | 263 | 321 | 324 | 343 | 360 | 361 | 362 | 363 | 365 | 430 | 441 | 443 | 460 | 462 | 473 | 486 | 487 | Number |
| should be able to: | Intro | Progg | Graphics | Statics | Dynamics | Circuits | Electronic | ElecMech | Thermo | Materials | Econ | Contrl I | DigElec | IntroMech | VirtMach | Prob/Stat | Project | manuf | QC | Contrl II | Robots | CIM | seminar | Sr Proj | of A's |
| a) apply knowledge of math, science, and engineering | x | x | | A* | x | A | x | x | x | x | x | x | x | x | | x | x | x | x | A | x | x | | x | 3 |
| b) design and conduct experiments; analyze and | x | | | | | x | | | | x | | x | | | | A* | | x | A | | | x | | x | 2 |
| c) design system, component, process to meet needs. | x | | x | | | | | | | x | | A | x | A | | | | x | x | x | x | x | x | A* | 3 |
| d) function on multi-disciplinary teams | x | | x | | | x | | | | | | | x | | | | A* | x | | | | x | x | | 1 |
| e) identify, formulate, solve engineering problems | x | x | x | x | x | A | x | x | x | x | x | x | x | x | | x | x | x | x | x | x | x | x | A* | 2 |
| f) understand professional/ethical responsibility | A | | | | | | | | | | x | | | | | | x | | x | | | x | A* | x | 2 |
| g) communicate effectively | x | | x | | | x | | | | x | | | x | | | x | A | x | x | | | x | x | A* | 2 |
| h) understand impact of engineering solutions in global & societal context | x | | | | | | | | | | A | | | | | x | | x | x | | | x | x | A* | 2 |
| i) recognize the need for and be able to engage in life long learning | A | x | | x | x | | | | x | x | x | | | x | | x | | x | x | | x | x | x | A* | 2 |
| j) use knowledge of contemporary issues | x | | | | | | | | | | A | | | | | x | | | x | | | | | A | 2 |
| k) use techniques, skills, modern engineering tools necessary for engineering practice | x | A | x | x | x | x | x | x | x | x | x | x | A | x | x | x | x | x | A* | x | x | x | | x | 3 |

## Assessment of Outcomes

The following form is to be completed for each outcome-course combination in which assessment is done. The form is completed each time that course is offered. The completed forms are maintained in notebooks in the Department office.

**Semester**:_____ **Course**: _____

**Outcome**:_____

**Describe the assignment:**

**Attach the assignment and samples of student work: strong, medium, and weak.**

**ANALYSIS:**

**The goal for student performance on this assignment:**

**The degree to which the goal was met:**

**Changes implemented this semester to the process for this outcome:**

**The degree of success of those changes:**

**Suggestions for improvement for the next semester this course is taught:**

**Signature**: _____ **Date**: _____

## Review of outcome/course assessments

The assessments for each outcome are evaluated periodically using the following questions as guidance.

- Is the assessment process for this outcome working well? What can be improved?
- To what extent is this outcome being achieved?
- What changes to the program should be considered based on the results of these assessments?

An example of such an assessment is shown on the next page.

(k): use techniques, skills, and modern engineering tools necessary for engineering practice

| Course | Semester | Goal met? | Notes | IE, E or both | Instructor |
|---|---|---|---|---|---|
| EN103 | Sp13 | Yes | The mean score goal of 75% was surpassed. Actual score was 95% | Both | DePalma |
| | Fa12 | Yes | The mean score goal of 75% was surpassed. Actual score was 91.3% | Both | DePalma |
| | Sp12 | Yes | The mean score goal of 75% was surpassed. Actual score was 95% | Both | DePalma |
| | Fa11 | Yes | The mean score goal of 75% was surpassed. Actual score was 96.2% | Both | DePalma |
| | Sp11 | Yes | The mean score goal of 75% was surpassed. Actual score was 97% | Both | DePalma |
| | Fa10 | Yes | The mean score goal of 75% was surpassed. Actual score was 91% | Both | DePalma |
| | Sp10 | Yes | The mean score goal of 75% was surpassed. Actual score was 100% | Both | DePalma |
| EN107 | Sp13 | Yes | The goal of 80% of students to score at 80% or better was met since 91% of students scored at 80% or better | Both | Paudel |
| | Fa12 | No | The goal of 80% of students to score at 80% or better was not met since 75% of students scored at 80% or better. | Both | Paudel |
| | Sp12 | Yes | The goal of 80% of students to score at 80% or better was met since 80.9% of students scored at 80% or better | Both | Paudel |
| | Fa11 | | not evaluated - adjunct | Both | Cakdi |
| | Sp11 | Yes | The goal of 80% of students to score at 80% or better was met since 83% of students scored at 80% or better | Both | Cakdi |
| | Fa10 | | not evaluated | Both | Bloxsom |
| | Sp10 | No | 90% goal of completion of the final exam was not met since only 84% of the students completed the final exam | Both | Bloxsom |
| EN361 | Sp13 | | not evaluated - adjunct | BSE | Paredes |
| | Sp12 | Yes | The goal of 75% mean score on the assignment was met with 88% actual mean score | BSE | DePalma |
| | Sp11 | Yes | The goal of 75% mean score on the assignment was met with 93% actual mean score | BSE | DePalma |
| | Sp10 | Yes | The mean score goal of 75% was surpassed. Actual score was 87% | BSE | DePalma |
| EN443 | Sp13 | | not evaluated - adjunct | Both | Russel |
| | Sp12 | Yes | The goal of 80% of the students to score 80% or better was met. 13 out of 15 students (87%) scored over 80%. | Both | Sarper |
| | Sp11 | | not evaluated - adjunct | Both | Wiley |
| | Sp10 | | not evaluated - adjunct | Both | Wiley |

| | | |
|---|---|---|
| Analysis: | The goal was met. There were only two instances in which the goal was not met. | N. Jaksic |
| Faculty Discussion: | The only two negative results were in EN 107. Corrective actions in EN 107 were succesful . Also, we addressed students' programming skills and ways to improve them. | |

Go through dept minutes and add more such info.

## Add EN 487/488 rubrics

## Teaching and Assessment of specific outcomes

**(a) an ability to apply knowledge of mathematics, science, and engineering**
6 June 2013. Data supports that we are achieving this outcome. Faculty felt that we were more than adequately meeting this outcome

**(b) an ability to design and conduct experiments, as well as to analyze and interpret data,**
The assessment process is generally working well for this outcome. The evidence we have demonstrates that our graduates have achieved this outcome. On 1/8/2014, the department discussed this report and concluded that we do provide necessary amount of practice to meet this goal.

| Outcome b: Analyze and Interpret Data, Design and Conduct Experiments | | | |
|---|---|---|---|
| **Course** | **Semester** | **Goal met?** | **Notes** |
| EN 101 | Fall 2008 | Partially | Deciding which forecasting method is better |
| EN 365 | Fall 2011 | Yes | Data collection & analysis |
| EN 365 | Fall 2012 | Yes | Data collection & analysis |
| EN 365 | Fall 2013 | Yes | Data collection & analysis |
| EN 473 | Fall 2011 | Yes | CNC Mill Lab exercise to produce a part |
| EN 473 | Fall 2012 | Yes | CNC Mill Lab exercise to produce a part |
| EN 473 | Fall 2013 | Yes | CNC Mill Lab exercise to produce a part |
| EN 443 | Spr. 12 | Yes | Measurement of grains for statistical analysis |
| | | | |

The assessment process is generally working well for this outcome. The evidence we have demonstrates that our graduates have achieved this outcome.

On 1/8/2014, the department discussed this report and concluded that we do provide necessary amount of practice to meet this goal.

**(c) 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.**

23 Jan 2015 department minutes: Ananda said we seem to be using good design problems and the performance satisfies the criteria. We discussed how we teach the design process. We teach it very explicitly in EN 101, EN 486, and then they apply it in EN 487/488. In other classes we might give somewhat different versions of the design process, but we agree that we all teach the same essence of a design process: state the problem, collect data, consider alternatives, evaluate, iterate, one criterion is always cost. In some classes we focus on just part of the design process. We concluded we are being consistent in what we teach students and our students are performing well on this criterion.

| Course | Semester | Goal met? | Notes | IE, E, or both? | Criteria (student/score)% |
|---|---|---|---|---|---|
| EN362 | Fall 13 | yes | Design of a simple digital control system with four inputs and 2 outputs | E | 75/75 |
| EN487 | Spring 13 | yes | Senior design projects: electro mechanical devices | E | 75/75 |
| EN460 | Spring 13 | yes | Find a stable range of a closed loop control system | E | 75/75 |
| | | | | | |
| EN 360 | Fall 12 | yes | Feed back control system design | E | 75/75 |
| EN460 | Fall 12 | yes | Design a digital phase-lead compensator | E | 75/75 |
| EN 362 | Fall 12 | yes | Design START, SWITCH and STOP section using micro-controller | E | 75/75 |
| EN 360 | Spring 12 | yes | Find a stable range of a closed loop control system | E | 75/75 |
| EN362 | Fall 2011 | yes | Design START, SWITCH and STOP section using micro-controller | E | 75/75 |
| EN 475 | Fall 2011 | YES | Block layout of facility | IE | 67/40 |
| EN 475 | Fall 2012 | YES | Block layout of facility | IE | 67/46 |
| EN 475 | Fall 2013 | YES | Block layout of facility | IE | 67/46 |
| EN 477 | Spring 12 | NO | Forecasting and Planning | IE | 67/66 |
| EN 477 | Spring 13 | YES | Forecasting and Planning | IE | 67/66 |
| EN 360 | Fall 14 | YES | Plot graph for the poles of a transfer function so that the system would satisfy given requirements | E | 75/75 |
| EN 460 | Fall 13 | NO | design a digital PD controller | E | 70/70 |
| EN 477 | Fall 13 | yes | Aggregate Planning AND Total cost | IE | 85/75 |
| EN 477 | Fall 14 | yes | Aggregate Planning AND Total cost | IE | 85/75 |
| EN475 | Fall 14 | YES | create a standard facility layout to manufacture the new toolbox | IE | 85/75 |

(d) an ability to function on multi-disciplinary teams,

Outcome d Teamwork

| Course | Semester | Goal met? | Notes | IE, E, or both? | |
|---|---|---|---|---|---|
| EN 215 | Fa11 | No | One mean was below 4.0 on 1-5 scale: "Attends meetings on time." | | |
| EN 215 | Fa12 | Yes | Two students rated low on "Contributes fair share of work." | IE | Fraser |
| EN 215 | Fa13 | Yes | Item averages all above 4.0 on a scale of 1-5. | IE | Fraser |
| EN 215 | Fa14 | Yes | Assessment done by observation of teams. | IE | Fraser |
| EN 430 | Fa11 | | | Both | Paredes |
| EN 430 | Fa12 | | | Both | Russel |
| EN 430 | Sp14 | | | Both | Sarper |

The assessment process in EN 215 has been working well, but that course is only taken by IE students. Material by Lencioni is used.

EN 430 is a good place to do this assessment since both majors take the course, but assessments have not been done mostly because the course was taught by adjuncts.

Based on this evidence, and on frequent faculty discussion of how we have our students work in teams, I believe our students are achieving this outcome, but we need to assess this outcome better.

Jane M. Fraser, 16 December 2014

(e) an ability to identify, formulate, and solve engineering problems

| Outcome e: an ability to identify, formulate, and solve engineering problems | | | | |
|---|---|---|---|---|
| Course | Semester | Goal met? | Notes | |
| EN 231 | Fall 11 | ? | | |
| | Fall 12 | Yes | | |
| | Fall 13 | Yes/No | The mean score for a similar problem given during the final was above the goal | |
| | Fall 14 | ? | | |
| EN 260 | Spring 11 | Yes | | |
| | Spring 12 | Yes | | |
| | Spring 13 | Yes | | |
| | Spring 14 | ? | | |
| EN 471 | Fall 11 | Yes | | |
| | Fall 12 | No | Eighty percent of the students (4 out of 5) were able to formulate, solve and perform sensitivity and duality analysis on several optimization problems. | |
| | Fall 13 | No | Fifty eighty percent of the students (7 out of 12) were able to formulate, solve and perform sensitivity and duality analysis on several optimization problems. | |
| | Fall 14 | Yes | | |
| EN 488-487 | Spring 11 | Yes | All three projects met the goal | |
| | Spring 12 | ? | | |
| | Spring 13 | Yes | All six projects met the goal. However, two of them were not operational | |
| | Spring 14 | Yes | All five projects met the goal | |

The assessment process uses EN 231, EN 471, and EN 488 for BSIE students, for BE students EN 260 is added. The process is working well but adjustment was required to meet (or improve) the goal for student performance in EN 231 and EN 471.

The outcome is not being achieved in EN 471 during some semesters. However, for the last fall semester (2014) 90% of the students achieved the outcome. In this course, the students are getting the problem statements in advance and both their mathematical and LINGO/LINDO/Excel solutions. During class they are discussing the math formulation and the sensitivity and duality analysis for different types of optimization problems.
For EN 231, the evidence shows improvement (goal for student performance meet in the final) when the basics concepts of KVL and KCL are explained in detail.
For EN 488, all the projects have met the goalhowever, some of them are not fully operational but most of their components perform correctly.
Leonardo Bedoya-Valencia, 16 December 2014

(f) an understanding of professional and ethical responsibility

(g) an ability to communicate effectively

| Outcome g: EN215, EN488 - Fall 2013 | | | | |
|---|---|---|---|---|
| Course | Semester | Goal met? | Notes | |
| EN215 | Fall 2013 | No | Three out of five students (60%) received 80% or above | IE |
| | Fall 2012 | Yes | 16 out of 17 students (94%) received 80% or above | IE |
| | Fall 2011 | Yes | Marginally: Out of 5 students one received 60% while others received 80% or higher | IE |
| | | | | |
| EN488 | Spring 2013 | Yes | Thirteen out of fifteen students (87%) wrote professional-grade final project reports. | Both |
| | Spring 2012 | N/A | Assessment of this objective was not performed | Both |
| | Spring 2011 | Yes | All assignments were completed in a professional manner. The weakest part was the final report from a group who added material between the draft the instructor reviewed and the final report. | Both |

Analysis:

The goal was met in each reported instance except one, thus the overall goal was met. During this assessment period, faculty had opportunities to judge all senior project presentations for the ABET communications outcome.

Faculty Discussion:

In EN 215, one student couldn't write well. Even the re-writes couldn't fix the student's run out sentences. So, in a small class this is the law of small numbers. We still think that the students increased their communications skills to justify the statement that the goal was met.

N. Jaksic
12/17/2013

**(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context**

**9 May 2016 discussion:**

We should continue to ask senior project teams to write a separate paragraph, even if the entire project has a focus on such impacts because we want them to recognize and focus on these ideas at some point during the project. We currently ask teams to provide two paragraphs:

> *The report must include a section on the impact of your proposed solution in a **global and societal context**. Issues you may consider include: impact on workers, impact on the local community, environmental issues, and other relevant issues facing the community, state, nation, and world.*
>
> *The report must include a section on **sustainability** aspects of the project. Topics may include optimization of resources, product life cycle, benefits to the current and future generations, etc.*

We will integrate these two paragraphs into one, since sustainability involves a global, economic, environmental and societal context.

We think that our PROPEL funded emphasis on integrating sustainability throughout the curriculum has changed the curriculum and has had an impact on our students. For example, in the senior seminar in fall 2015, Professor Bedoya asked the students to brainstorm sustainability issues in the design of a smart phone and they were successful, with industrial engineering students focusing on manufacturing and material choice and engineering students focusing on design and energy use. We are having an impact on our students. They have to get it: it's their earth.

This section is worth 5 points of the final grade and will be graded using the following rubric:

| Points | |
|---|---|
| 5 | Impacts of science or technology that are mentioned are appropriate, and the explanation of those impacts is complete. Tradeoffs are considered, as well as how the choice of engineering design affects the impacts. |
| 4 | Impacts discussed are appropriate, but explanation is incomplete or unclear. |
| 3 | Explanation is clear, but impacts discussed are incomplete or only somewhat appropriate. |
| 2 | Impacts mentioned are incomplete or only somewhat appropriate, and explanation is incomplete or unclear. |
| 1 | Impacts mentioned are either very obvious or not important, and there is no explanation of them. |
| 0 | Section is omitted or has none of the features described above. |

Also, the report must include a section on **sustainability** aspects of the project. Topics may include optimization of resources, product life cycle, benefits to the current and future generations, etc.

This section is worth 5 points of the final grade and will be graded using the following rubric:

| Points | |
|---|---|
| 5 | Section consists of one or more paragraphs. Sustainability aspects are well documented and integrated within the project. |
| 4 | Section consists of a single paragraph with appropriate examples, but justifications are incomplete or vague. |
| 3 | Section consists of a single paragraph but is not integrated into the project. |
| 2 | Section includes a single sentence. |
| 1 | Sustainability is mentioned only as a part of another objective. |
| 0 | Section is omitted. |

**From 3 April 2012 department minutes: "**We reviewed and approved the report on (h); no changes are needed to our programs or to the assessment method. We had a long discussion of the types of issues we should raise with our students: impacts on jobs, safety, and the environment, for example. For example, Jane discussed global climate change in the special topics course on sustainability. For example, Ding discussed the possible different impacts of the changes in patent law on individuals and corporations. We all agreed that engineering occurs in a social context and we should talk about these issues with students. We should also give our opinions, with justifications, but be open to other opinions.

**(i) a recognition of the need for, and an ability to engage in life-long learning**

We focus on a recognition of the need for life-long learning in EN 101 and assess it by asking on the midterm why engineers need to engage in life-long learning. We all reinforce life-long learning in all Engineering courses. In EN 487/488, the students discuss how you detect and remedy a gap in knowledge; we will make sure the discussion covers the points we discussed. We will assess lifelong learning in EN 487/488 by having the students include a section on it in their reports.

Points we will stress in EN 487/488 discussion:
You detect a gap in knowledge when someone point it out to you, when you feel a lack of certainty, or when you have questions you can't answer. You fill a gap in knowledge by reading books, industry publications, and articles. You can find and ask an expert. In some cases you can learn by trial and error: you can try, make errors, and fix what you did. If you forget something from a previous course, you need to learn it again. Part of life-long learning is reviewing what you knew once so you can apply it again. As you progress in your career, you will accumulate knowledge, but you will also gain professional wisdom. Remembering concepts is more important than details. You need to know where you can find answers. You need to know who you can ask to find answers.

Assessment in EN 487/488: The Senior Design final report must include a section "in which you (briefly) describe knowledge that you did not learn in any engineering course, but that you had to learn in order to complete your project. This section is meant to demonstrate your ability to engage in life-long learning. How did you determine what you needed to learn? How did you select the material and the learning method you used?"

That section is worth 5 points of the final grade and will be graded using the following rubric:

| Points | |
|---|---|
| 5 | Describes clearly knowledge that was needed and why it was needed; how learning material was located and evaluated; how a learning method was selected; material used to learn the new knowledge; and how the knowledge was applied in the project. |
| 4 | All required topics are covered but some are not clearly described. |
| 3 | Description is clear but some required topics are omitted. |
| 2 | Some required topics are omitted and others are not clearly described. |
| 1 | The required section is present, but only minimally completed. |
| 0 | Section is omitted or has none of the features described above. Project did not involve learning and using knowledge not learned in an engineering course. |

From 10 May 2016 department meeting minutes:

Leonardo reported on a discussion at the IISE national meeting. People recommended against using multiple choice questions to assess this outcome (we already do not do this) and recommended getting students into student organizations to promote lifelong learning. Programs assess the outcome by looking at the percent of students in student organizations. Our department pays the first year of student membership in any one

professional organization: IISE, IEEE,ASME, SWE, NSBE, MAES, SHPE; we will put a permanent announcement on the Engineering Majors blackboard so students are aware of this policy.

Jude described how Space Grant projects require lifelong learning. In the required reports, he asks students to answer questions such as: what did you learn, how did you know you needed to learn this material, and how did you choose to learn the material. He doesn't require students to answer all questions. He plans to add examples of good answers to future instructions for the report.

We agreed with Jane's conclusion that we have a good strategy for promoting lifelong learning throughout the program and we have a good method of assessment. The evidence is that our students are meeting this criterion.

We discussed our assessment of lifelong learning in the senior project classes, EN 487 and EN 488. We agreed that most of the attention in that class is appropriately on the project. We will continue to require a paragraph related to lifelong learning: describe what you already knew; describe what you needed to learn to complete the project; and describe how you learning that material. The instructions to students in EN 487/488 and the rubric will be revised to reflect this change.

(j) a knowledge of contemporary issues

| Outcome j: a knowledge of contemporary issues | | | | | |
|---|---|---|---|---|---|
| Course | Semester | Goal met? | Notes | | |
| EN 343 | Fa11 | Yes | Pick and track a stock | Both | Sarper |
| EN 343 | Fa12 | Yes | Pick and track a stock | Both | Sarper |
| EN 343 | Sp14 | | | | Sarper, not do |
| EN 487/488 | Sp11 | Yes | All three projects discussed contemporary issues, such as jobs and the environment | | Fraser |
| EN 487/488 | Sp12 | | | | Fraser, not do |
| EN 487/488 | Sp13 | Yes | All reports discussed contemporary issues, mostly sustainability | Both | Jaksic |
| EN 487/488 | Sp14 | Yes | All reports discussed contemporary issues, mostly sustainability | Both | Jaksic |

The assessment process uses EN 343 and EN 488 for BSE and BSIE students. The process is working well. The senior design project is really the best place to determine if students have a knowledge of contemporary issues since the assessment is done in the context of an engineering design project.

The outcome is being achieved. All EN 488 projects since the last review of this outcome have included discussion of contemporary issues.

No changes need to be made, but we should discuss contemporary issues about which students should have knowledge.

Jane M. Fraser, 16 Dec 2014

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Changes

- 20 October 2007, added material from 1 November 2006 department meeting about which FE afternoon test a Mechatronics student should take.
- 5 December 2008, added description of constituencies, as approved at 19 November 2008 department meeting.
- 21 April 2009, changed “above 30” to “above 40” in II of the FE exam goals.
- 9 September 2009, moved advice about which FE afternoon exam to take to the advising handbook.
- 4 December 2009, aligned outcomes with ABET language and added Outcome Champions.
- 28 January 2010, updated list of Outcome Champions.
- 4 February 2010, added material from 3 February 2010 department meeting about outcome i.
- 29 March 2011, fixed EN 103 on assessment schedule – should be EN 101.
- 6 April 2011, fixed other occurrences of EN 103.
- 14 March 2012, changed sixth BSIE objective. From “achieve management positions” to “lead a project team.” See 13 March 2012 department minutes.
- Spring 2016. Deleted review of FE. Deleted survey of graduates. Reduced number of constituencies. Added review of LinkedIn entries. Revised and aligned PEOs as approved by Advisory Board. Updated champions.
- 9-11 May 2016, added latest evaluations and faculty discussions of all outcomes.