

# Chemical Engineering Assessment Plan

2015

(Excerpted from ABET Self Study)

## A. Student Outcomes

For each Student Outcome, a specific source of student work has been identified (Table 4-1) and random samples of this student work are collected once every three years for each outcome.

Table 4-1: Courses and review years for outcomes A-K.

| Outcome | Student Material   | Review Year | Next Review |
|---------|--|-------------|-------------|
| A       | ECHM 424 Transport: project  | 2011, 2013  | 2016        |
| B       | ECHM 443 Unit Operations Lab: report                                   | 2012, 2015  | 2018        |
| C       | ECHM 412 Design: final report  | 2011, 2014  | 2017        |
| D       | EGEN 310 Engineering Design: final report                              | 2014        | 2017        |
| E       | ECHM 424 Transport: project  | 2011, 2013  | 2016        |
| F       | ECHM 412 Design: ethics case study project                             | 2012, 2015  | 2018        |
| G       | ECHM 443 Unit Operations Lab: report<br>ECHM 412 Design: presentations | 2012, 2015  | 2018        |
| H       | ECHM 412 Design: final report  | 2011, 2014  | 2017        |
| I       | EBIO 438 Bioreactors: research project                                 | 2011, 2013  | 2016        |
| J       | EBIO 438 Bioreactors: research project                                 | 2011, 2013  | 2016        |
| K       | ECHM 323 Separations: HYSYS problem                                    | 2011, 2014  | 2017        |

The collected random samples of student work are maintained electronically and password accessible for the two levels of review (the Department Advisory Committee (DAC) and the assigned faculty).

The first level of review is conducted each year during the first week following the end of the Spring semester (i.e., sometime in early May). Faculty members are assigned to review examples of student work that are not associated with a course that they taught. The reviews are conducted using rubrics that were developed locally and are reviewed every three years. All rubrics are available upon request, and an example rubric for outcome A is shown in Figure 4-2.

After the initial review of the samples of student work by assigned faculty, the DAC conducts an independent review of the samples of student work. The faculty reviews are made available to the DAC so their role is to audit or affirm the faculty review. In most cases, the DAC affirms the assessment of the faculty, but there have been instances where the DAC identified issues that

**Assessment Rubric: Outcome A****Outcome a. ...ability to apply knowledge of mathematics, science and engineering.**

| Outcome element  | Unacceptable (0)  | Marginal (1)  | Acceptable (2)  | Exceptional (3)   | Points |
|--|---|---|---|---|--------|
| Ability to apply knowledge of mathematics – basic math   | Basic math elements are performed incorrectly   | Significant math errors   | Nearly correct solution; occasional small math error  | Solution process includes checks to ensure no math errors   |        |
| Ability to apply knowledge of mathematics – solution process   | No discernable logic in problem solution  | Able to apply a straightforward solution methodology, no evidence of innovation           | Able to develop an appropriate algebraic solution methodology for a novel situation<br>Able to apply a calculus-based solution method                         | Able to develop an appropriate calculus-based solution methodology for a novel situation                                    |        |
| Ability to apply knowledge of science  | The science behind the project is non-existent, erroneous, or trivial   | Some evidence of awareness of science, but poorly incorporated into project               | Knowledge of science clearly articulated and incorporated into project  | Exemplary knowledge of science displayed in project   |        |
| Ability to apply knowledge of engineering – application of math and science to real problems                                     | No evidence of ability to connect math and science with real-world problems   | The student's work provides little insight into the problem addressed.                    | The student's work is clearly relevant to the problem addressed and could contribute to a solution to the problem.  | The student's work shows remarkable insight and helps to solve a real-world problem.  |        |
| Ability to apply knowledge of engineering – ability to make realistic assumptions and simplifications to make problems tractable | The student appears unwilling to make any assumptions or simplifications, resulting in an unsolvable problem.<br>The student has made such sweeping simplifications that the solution has become useless. | The student shows little insight into making appropriate simplifications and assumptions. | Most simplifications and assumptions that were made are appropriate and produce a solution that still has relevance to the problem being considered feasible. | The student displays the ability to discern the major factors relevant to the problem and obtains a highly useful solution. |        |

Figure 4-2: Example evaluation rubric for Outcome A.

were missed in the prior level of review (i.e., the prior level of review was not sufficiently critical) and cases where the DAC felt the prior level of review was too critical.

Both the rubrics and the response thresholds for the direct Student Outcomes assessment are reviewed periodically (approximately once every three years). The current threshold for all direct Student Outcomes assessment is an average score of 2.0 based on the assessment rubric. The rubrics are designed with a scale from 0.0 to 3.0 with a score of 2.0 being considered acceptable (Table 4-2). If an average score for an outcome is less than 2.0, the faculty spends a considerable amount of time determining what changes could be made in order to bring the student work to an acceptable level and other samples are evaluated to see if the sample was an isolated case. While there have been discussions about changing the threshold, it is often simpler to change the wording within the rubric when issues arise to ensure accurate evaluation.

Beyond the direct Student Outcomes assessment described above, there are additional tools used in the assessment of Student Outcomes. These tools are not as direct as the primary assessment method described previously, but we have found that they provide valuable insights that can help to inform the achievement of Student Outcomes.

- Alumni surveys – distributed via email to all alumni approximately 2.5 and 4.5 years after graduation. The full alumni survey is available upon request and will be available at the time of the visit, but some sample questions from the alumni survey include:
  - Please rate the CHBE Program's effectiveness in preparing you to apply chemical engineering fundamentals.
  - Please rate the CHBE Program's effectiveness in preparing you to be a proactive problem solver.
  - Please rate the CHBE Program's effectiveness in preparing you to pursue lifelong learning.

- Please rate the CHBE Program’s effectiveness in preparing you to be an effective communicator.
- Please rate the CHBE Program’s effectiveness in preparing you to be an effective team member.
- Please rate the CHBE Program’s effectiveness in preparing you to be a highly ethical engineering professional.
- Please rate the CHBE Program’s effectiveness in preparing you to embrace process safety.

The response threshold for the alumni survey is any response that rates the Chemical Engineering program’s effectiveness as ‘poor’ or multiple responses at ‘average’ or below.

- Employer surveys – this is not a quantitative survey but it is instead based on discussions with employers at the biannual career fair and whenever employers visit to interview students. Employers are asked to complete an employee evaluation for co-op students, and these evaluations are reviewed by the department head and DAC. The Department Head summarizes all employer comments for the DAC, which also adds their own comments as most of the members are also employers. The DAC determines whether or not a response is required.
- FE Exam results – the focus for Student Outcomes assessment is on both the overall pass rate and the success rate for the individual topics relative to the national average. The scores are reviewed by the DAC and faculty. An overall pass rate below the national average or a success rate significantly below the national average on any one topic requires a response.

Table 4-2: Response thresholds for assessing the Student Outcomes.

| Assessment Tool                        | Scale   | Threshold  |
|--|---|--|
| Student Examples<br>Assessment Rubrics | 0 – unacceptable<br>1 – marginal<br>2 – acceptable<br>3 – exceptional | Average score for any outcomes below 2.0 (acceptable) invokes an inquiry and typically a response. |
| Alumni Surveys                         | 1 – poor<br>2 – average<br>3 – good<br>4 – very good<br>5 – excellent | An average response on any questions that is less than 3.0 (good) invokes a response.              |
| Employer Surveys                       | Not Quantitative  | DAC members review comments and determine if a response is needed.                                 |
| FE exam – overall pass rate            | 0 – 100%  | Scores below national average invokes an inquiry.  |
| FE exam – individual topics            | 0 – 100%  | Scores significantly below the national average in any one area invokes an inquiry.                |

Options for responding when an inquiry is initiated due to either a score falling below the threshold as listed in Table 4-2 or a request for an inquiry from the DAC or faculty include:

- Monitoring the score over time to see if the low score repeats
- Changing course content or learning outcomes in one or more courses
- Changing curriculum requirements

We have made each of these types of responses to inquiries during the past six years had been used.

In addition to determining the type of response, the time-scale for reassessment must also be determined. Options for reassessing include:

- Waiting for the next regularly scheduled assessment (normally three years for direct Student Outcomes assessment based on student work examples)
- Scheduling a narrowly focused special reassessment
- Scheduling a reassessment of the entire outcome within the next year

The choice of reassessment option depends on the severity of the issue that invoked the inquiry.