ATTACHMENT A

Academic Department Nomination

Institutional Effectiveness Excellence Award

Department: Chemical Engineering

Nominated by: Brandon Weeks

Date of Submission: April 3, 2017 – NOTE: Dr. Darryl James ok'ed submission since 4/1 was a Saturday

(Late submissions after April 1, 2017 will not be considered).

Checklist of enclosed items in order of presentation:

- [x] Statement of support by college dean.
- [x] Brief narrative (less than 1000 words) from department chair describing continuous improvement efforts to strengthen student learning in department's degree programs.
- [x] Completed TracDat reports for all degree programs in department. Please only submit reports from the 14-15 and 15-16 academic years.
- [x] Internal documents that substantiate program improvements (i.e., revised course syllabi, revised curricula, etc.) resulting from analysis of assessment data.
- [x] Relevant documents (i.e., meeting minutes, conference attendance) that illustrate the department's commitment to academic assessment.
- [ ] Supplementary evidence (i.e., presentations, papers) that faculty members are engaged in academic assessment. **(OPTIONAL)**
- [x] **Please scan the entirety of your application packet into a single PDF file. Email this file to Darryl James (darryl.james@ttu.edu), Vice Provost for Institutional Effectiveness, by midnight on April 1, 2017. A confirmation email will be sent to you to verify receipt of your completed application. Award winners will be recognized and presented with the cash award at the Faculty Honors Convocation.**

TEXAS TECH UNIVERSITY
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March 31, 2017

Dear Provost Galyean and Committee:

I am delighted to support the Department of Chemical Engineering for the Provost's Institutional Effectiveness Excellence Award. The department has been a leader in the Whitacre College of Engineering in terms of assessing department goals and student learning outcomes and improving their programs as a result of those assessments. Dr. Sindee Simon has made significant contributions in this area both as Undergraduate Committee Chair and now as Department Chair, and she was recognized in 2012 by the Texas Tech University Office of Planning and Assessment as Fall Assessment Spotlight Champion. Below I briefly highlight the department's practices and some of the progress made as a consequence of their assessment practices.

The undergraduate program in Chemical Engineering is accredited by ABET, and the department performed at an outstanding level in the last accreditation cycle, and they are on track to perform well in the current cycle (with a report due in July). There are eleven student learning outcomes set by ABET, and the department assesses each of these in multiple ways resulting in a robust assessment matrix. Tools used include a senior comprehensive exam, capstone design project, exit interviews with every graduate, and instructor assessments of course-specific outcomes for every course. The data are reviewed and analyzed by the undergraduate committee and presented to the faculty and the department's external advisory board. Changes are made when problems are identified, with feedback from the advisory board and students and with approval from the faculty. Every three years, the department has an off-campus curriculum retreat with extensive discussion and review. The result is that the faculty buy into the curriculum and understand the assessment process and goals.

A number of significant changes have been implemented in the undergraduate program in Chemical Engineering over the past several years, including the development of a required process safety course by Dr. Brandon Weeks, which was one of the first of its kind in the nation to address the growing recognition that students lack the skills required to address the hazards in industry. Other important changes to the program include addition of evening tutoring to promote student success, addition of a required three-credit ethics course, change of the design sequence, and institution of mandatory one-on-one career counseling of juniors and seniors by the faculty. Some prior changes, such as moving the Materials course to the sophomore year, were also reversed after data showed that student success was compromised. Thus, the department takes seriously not only the need to assess and respond to problems, but also the need to close the loop and complete the full continuous improvement cycle.

In terms of the chemical engineering graduate program, assessment focuses on student research productivity and scholarship, as well as softer skills, such as the students' presentation skills, professionalism, and understanding of safety and ethics. Program improvements resulting from implementation of the assessment cycle have included publication of a graduate student handbook which clarifies expectations, an increase in the GPA requirement for core courses, and the requirement that Ph.D. students complete the Texas Tech Responsible Conduct of Research (RCR) training. The increased focus on safety in the graduate program has resulted in several laboratories having no violations in the 2016 EH&S survey – a first for the department.

In sum, the Department of Chemical Engineering has developed an excellent but sustainable assessment program which they use to evaluate overall department scholarship and productivity, as well as student learning outcomes in both their undergraduate and graduate programs. The department has a goal of being ranked in the top 50, and they are currently 47 in overall faculty scholarship according to Academic Analytics and 84 in the U.S. News and World Report ranking. They have made and continue to make significant changes aimed at increasing productivity, promoting student success, ensuring high quality of their graduates, and achieving national recognition. I commend their efforts and whole-heartedly support the Department of Chemical Engineering for recognition as the first Provost's Institutional Effectiveness Excellence Award.

Sincerely,

Al Sacco, Jr.
Dean, Whitacre College of Engineering

Continuous Improvement in the Department of Chemical Engineering

Introduction

The Department of Chemical Engineering is engaged in a process of assessment and continuous improvement designed to increase academic excellence, faculty productivity, and attainment of both undergraduate and graduate student outcomes. Assessment tools include data from a variety of sources, including Web of Science and Academic Analytics, a comprehensive senior exam, external judging of senior design projects, and evaluation of student learning outcomes in individual courses. The process includes reviews of data by departmental committees, the department's External Advisory Board (EAB), and the faculty as a whole, as well as student feedback on the programs. Changes are implemented upon faculty approval of committee recommendations, with recommendations being based on data, bench-marking of our peer institutions, and feedback from our constituencies. The Department has worked to create a process that is both sustainable and supported by the faculty.

Assessment Process and Tools

Metrics are collected on an annual basis and are reviewed by the department chair or the appropriate committee: the department chair reviews data associated with department and faculty productivity, whereas the undergraduate and graduate committees review data associated with undergraduate and graduate programs and student learning outcomes, respectively. When problems are identified, bench-marking is performed and recommendations are made for program improvement. Feedback on prospective changes is obtained from the four constituencies of the department, students majoring in chemical engineering, the alumni of the department and the chemical engineering industry, both represented by members of the EAB, and the faculty of the department. Off-site two-day triannual retreats of the entire faculty are used for in-depth evaluation and discussion of our programs, including faculty productivity and undergraduate and graduate curricula; the last two retreats were held in August 2016 and 2013. In addition, a strategic planning retreat of senior faculty was held in January 2016, facilitated by Prof. Ronald K. Mitchell of the Texas Tech Rawls College of Business.

Assessment tools include data from a variety of sources. With respect to department ranking and faculty scholarship and productivity, data includes Web of Science, Academic Analytics, and the Texas Tech Office of Research Services. For the undergraduate program, assessment includes a comprehensive senior exam, external judging of senior design projects, and evaluation of student learning outcomes in courses by instructors. An individual exit interview with the department chair is performed for every graduating senior, as well as for graduating M.S. and Ph.D students. Assessment of the graduate program is more heavily based on graduate student research productivity, from for example, Web of Science, but also includes data from the exit interviews, safety assessments, and other sources.

Department Productivity and Goals

The vision of the Department of Chemical Engineering is to be the undergraduate program of choice in Texas and recognized as one of the top research and graduate chemical engineering departments in the nation. Specifically, the department aims at being ranked within the top 50 by 2018. Indicators and associated metrics have been developed by the faculty, particularly at triennial faculty retreats, based on benchmarking against schools in the top 30 and our peer

institutions, with metrics updated as the department progresses towards its vision. The metrics focus on research and graduate student productivity since these are what drive the rankings. Goals include publication of 4 articles per faculty member per year (we were at 3.9 in 2016), restricted research expenditures of $ 250,000 per faculty per year (we were at $ 209 k in 2016) sustained enrollment of 100 graduate students (we were at 96), and an increase of the faculty to twenty tenured or tenure-track faculty (currently 16). The department is currently ranked 47 in overall faculty productivity by Academic Analytics but is ranked only 84th by U.S. News and World Report. The difference is attributed to perception and the need to better market our successes.

Specific actions aimed at increasing faculty scholarship and productivity include reduction of the teaching load to one course per term for research-active faculty member and departmental support of first-year graduate students for the first nine months while students take their core graduate classes. The result of the latter action is that faculty members can support larger research groups, resulting in higher productivity; in addition, this has allowed the department to admit more graduate students in the spring because the students do not have to be guaranteed a salary from research funding until May of the following year. We have also taken actions to improve perception by inviting more department chairs and deans to give seminars in our seminar series and have worked with WCOE marketing to produce more effective news flashes.

Undergraduate Program Outcomes

Specific actions taken to improve the undergraduate program in Chemical Engineering are guided by the assessment data coupled with bench-marking of peer programs. Since the 2012/13 academic year, five significant changes have been made in the undergraduate program based on analysis of our assessment data and one reversal of a previous change was made, as listed briefly in Table 1 with more detail concerning justification and data in the supporting information. The reversal in 2014 of a 2009 action shows that the department is monitoring changes and closing the loop in the assessment/improvement cycle. In addition to these data-driven actions, actions have also been undertaken in response to feedback from the students through the External Advisory Board, including implementation of a department-sponsored tutoring every evening (Sunday-Thursday) starting in 2015/16 and continuing due to positive feedback, as well as providing our classroom for ChE student study groups in the evenings.

Graduate Program Outcomes

Specific actions taken to improve the M.S. and Ph.D. graduate programs in Chemical Engineering have focused on improving graduate quality, in terms of technical content, research productivity and scholarship for Ph.D. students, and "soft" skills, including in the areas of communication, professionalism, safety, and ethics. Program improvements resulting from implementation of the assessment cycle have included publication of a graduate student handbook which clarifies expectations for both M.S. and Ph.D. students, an increase in the GPA requirement for the required core courses in both graduate programs, the requirement that Ph.D. students complete the Texas Tech Responsible Conduct of Research (RCR) training, and ethics training in the department in the fall of the students' first year. The department has also increased the number of seminars focused on safety from one mandatory EH&S seminar to three seminars, and this emphasis, along with internal routine laboratory checks has resulted in several laboratories having no violations in the 2016 EH&S survey – a first for the department.

Table 1: Actions Taken to Improve the Chemical Engineering Undergraduate Program

- Addition of a required course on process safety, removing the third ChE elective to keep curriculum hours the same; implementation date: Fall, 2013.
- Shift Fluid Mechanics ChE 3315 from Fall of junior year to spring of sophomore year and move Technical Communications ChE 2306 from spring of sophomore year to fall of junior year; Spring 2015.
- Shift CH E 3330 to the spring junior year from spring sophomore year, reversing prior move made in 2009; Spring 2014.
- Remove CHEM 3308/3108 Physical Chemistry II and Laboratory as required course.
- Replace ChE 4122 and 4555 with a two-course seven-credit design sequence
- Require ChE Electives to cover ABET Criterion 3h, i, and j.

Table 2: Actions Taken to Improve the Chemical Engineering Graduate Program

- All graduate students must pass core courses with 3.0 GPA or higher.
- Ph.D. students publish four to six first-author papers as part of their Ph.D.
- Ph.D. students give at least one oral presentation at a local, regional, or national meeting prior to their dissertation defense.
- Increase the number of seminars per year on safety from one to three.
- Review the text "On Being a Scientist: A Guide to Responsible Conduct in Research" with all first-year graduate students, as part of the fall seminar series.

Supporting Data

Undergraduate Program:

Continuous Improvement Actions **February 2013**

Action 1.

Description of Action	Add required course on process safety to the BSChE degree plan, removing the third CHE elective to keep curriculum hours the same
Reason/ Justification for Action	ABET revised the Program Criteria for Chemical Engineering programs to include hazards associated with processes. Although prior to this change, the curriculum included EH&S training, the safety training was predominately laboratory safety with some HAZOP evaluation. In-depth process safety was not taught. The 2011 survey of graduates in 2006-08 showed that only 85 % of them felt adequately prepared to address hazards associated with chemical processes. This is unacceptable for safety. This action directly addresses the Chemical Engineering-specific ABET Program Criteria, as well as the ABET Student Outcome "Understanding of professional and ethical responsibility" (ABET f).
Implementation Date	2013/14 catalogue; course offered as an elective in spring 2012
Assessment/ Metrics	Exit Survey – a new question will be added to address perceived knowledge of process hazards. Instructor self-evaluation of new course.
Data	**2011 Alumni Survey Results** (Graduates in 2006, 07, 08) In the course of your BSChE degree at Texas Tech: • did you receive a thorough grounding in the basic sciences, including chemistry and physics? 100 % Yes • did you attain the knowledge and skills needed to be able to design, analyze, and control physical and chemical processes in the chemical engineering industry? 92 % Yes • did you attain the knowledge and skills necessary to address the hazards associated with the chemical engineering industrial processes? 85 % Yes Senior Exit Survey Results: (Metric: >4.0) 2013 2014 2015 2016 Understanding of Process Safety 3.96 3.78 3.89 3.84
Interpretation of Results	The alumni survey data indicate that graduates did not have adequate exposure in the curriculum to process safety and associated hazards. Seniors graduating in 2013 and 2014 did not feel confident with respect to process safety. Although the change was implemented in the 2013/2014 catalog, only a portion of the seniors graduating in 2014-2016 took the course as an elective because students have the choice to graduate under the catalog they were admitted under. All students admitted in or after fall 2013 will be required to have this course for graduation. Students graduating in 2017 (in four years) are expected to be the first class that are required to take process safety.
Future Action	This action will continue to be monitored to determine the effectiveness of the added course.

Continuous Improvement Actions April 2014

Action 2.

Description of Action	Move Fluid Mechanics ChE 3315 from Fall of junior year to spring of sophomore year and Technical Communications ChE 2306 from spring of sophomore year to fall of junior year.
Reason/ Justification for Action	Instructors of the writing intensive ChE 3323 Transport Laboratory have reported that students are often initially ill-prepared to write technical reports. Discussions with students indicate that problem is due to (i) the 9 month lag between ChE 3323 (offered spring of the junior year) and Technical Communications ChE 2306, currently offered spring of the sophomore year, and (ii) students in their sophomore year lack technical maturity to address meaningful technical writing assignments. Separately, students have complained to the faculty and external advisory board that the workload of the fall semester of the junior year is too technically intense. By exchanging the times at which of fluid mechanics and technical writing are offered, both of these problems are addressed. This action affects Student Outcomes "Ability to communicate technical information clearly and concisely" (ABET g), as well as "Ability to implement strategies required to solve open-ended problems" (ABET e); the latter is impacted since students have more time to focus on the technical aspects of fluid mechanics, heat transfer and thermodynamics.
Implementation Date	2014/15 catalogue
Assessment/ Metrics	Q1 Writing skills and Q2 verbal skills of the Senior Exit Survey, Fluid mechanics section of the senior comprehensive exam, Instructor self-evaluation of technical communication skills in ChE 3232 transport lab.
Data	Senior Exit Survey 2011 2012 2013 2014 2015 2016 Writing 4.16 4.19 4.16 4.00 4.02 4.03 Verbal 3.76 4.00 4.17 4.00 3.80 3.82 While these metrics generally meet the minimum criteria of >4.0 except verbal skills in the last two years, they are among the lowest values in the exit survey.
Interpretation of Results	Change was implemented Spring 2015.
Future Action	Results will be assessed after the 2017 spring semester since the graduates of 2017 will be the first class that should have this change.

Continuous Improvement Actions April 2014

Action 3: Reverse move of CHE 3330 to sophomore year.

Description of Action	Move CHE 3330 to the spring sophomore year to spring junior year.
Reason/Justification for Action	CHE 3330 is broad survey course on materials that requires general chemistry as a prerequisite. Moving the course to the sophomore spring allowed the CHE elective to be taken in spring junior year. This change was to make it easier for students to complete the minors offered by CHE since many electives are only offered every two years. This Action primarily affects Student Outcomes ABET a "Ability to apply knowledge of math, engineering and science" and ABET e "Ability to formulate and solve engineering problems" by increasing the effectiveness of student engagement in material science and increasing the availability of electives.
Implementation Date	Spring 2009 for original action moving CHE 3330 to sophomore year Spring 2014 for reversal moving the course back to the junior year
Assessment and Metrics	Number of students obtaining Polymers and Bioengineering minors - see action on adding third elective. Instructor self-evaluation of course effectiveness as assessed by scores on the comprehensive exam and student course evaluations. No metrics were set.
Data	Comprehensive Exam (Materials section) Year % correct (materials) % correct (total) 2008/09 60.8 51.8 2009/10 53.2 48.0 2010/11* 51.1 56.4 2011/12 50.8 48.4 2012/13 36.0 46.1 2013/14 52.6 48.2 2014/15 40.3 50.7 2015/16 43.1 2016/17** 56.2 * First class taking as sophomores ** First class in multiple year taking class as juniors
Interpretation of Results and Future Action	The data indicate that sophomores are not learning as much as when it was taught to them as juniors. Prior to the change students scored relatively higher on the materials section than on the test as a whole. After moving CHE 3330 to the sophomore year, average class performance decreased and the relative score of the materials section was usually less than or equivalent to the exam as a whole. In 2016/17, performance improved significantly as predicted for students taking materials later.
Future Action	Reversal of move was completed in 2014.

Continuous Improvement Actions April 2015

Action 4: Remove CHEM 3308/3108 Physical Chemistry II and Laboratory as required course.

Description of Action	Remove CHEM 3308/3108 Physical Chemistry II and Laboratory as a required course; courses will stay on books as chemistry elective.
Reason/Justification for Action	CHEM 3308/3108 focuses primarily on quantum mechanics and does not serve most of our students well. It is no longer a prequisite for any of the chemical engineering courses. The course is also not required at five of the six peer institutions examined: • University of Texas, University of Houston, University of New Mexico, Colorado State University, and the University of Oklahoma do not require Physical Chemistry II. Two of these institutions (Texas and New Mexico) allow the course as a chemistry elective. • Texas A&M University requires Physical Chemistry for Engineers as a requirement. This change does not change the number of hours for the major since four hours of ChE credit will replace the four hours of chemistry removed. This Action primarily affects Outcomes "Ability to apply knowledge of math and science" (ABET a), "Ability to design systems as needed" (ABET c), and "Ability to implement strategies required to solve open-ended problems" (ABET e). Although the chemistry content of the curriculum may decrease, the available credit will be used to add a Chemical Engineering elective and an additional design experience.
Implementation Date	2016/17 academic year
Assessment/Metrics	Faculty Self Evaluation of Courses and Triannual Retreat – assess whether students have requisite knowledge in basic physical chemistry concepts
Results/Data	Initial assessment will be undertaken at the end of Spring 2017.
Further Action	Assessment will continue for next several years.

Continuous Improvement Actions April 2015

Action 5: Replace ChE 4122 and 4555 with a two-course seven-credit design sequence

Description of Action	Replace ChE 4122 (Chemical Engineering Review) and 4555 (Chemical Engineering Process Design and Simulation) with a two-course seven-credit design sequence. The first course of the sequence will be three credits, incorporating the current material in ChE 4122 and augment that with two credits of single component design; the second course will be a four-credit integrated capstone design course.
Reason/Justification for Action	Students' self-reported ability to design systems and component as needed (Q 11 on Senior Exit Survey) is inadequate; it has been below 4.0 for the last two years. In addition, the goals of ChE 4122 were somewhat diffuse, serving largely as review of all ChE coursework for design; the addition of stand-along design of components in that class will make it more meaningful and will serve to better prepare the students for an integrated design project. Bench-marking of six peer institutions also shows that five of the six have a two-course design sequence: • The University of Houston, University of New Mexico, Colorado State University, University of Oklahoma, and Texas A&M University require two three-credit design courses. • The University of Texas requires one four-credit design course. This change does not change the number of hours for the major since the additional credit in this change is taken from the CHEM 3108 which is no longer required. This Action affects Student Outcome "Ability to design systems as needed" (ABET c) by enhancing the design experience.
Implementation Date	2016/17 academic year
Assessment/Metrics	Q 10 (Ability to design systems and components as needed) on Senior Exit Interview
Results/Data	None yet
Further Action	Initial assessment will be undertaken at the end of Spring 2017. Assessment will continue for next several years.

Continuous Improvement Actions August 2016

Action 6: Require CHE Electives to cover ABET Criterion 3 h, i, and j

Description of Action	Elective courses are required address Student Outcomes "Understand the need to examine the long-term societal and global impact of technical decisions regarding chemical processes" (ABET h), "Effectively use library and online resources to find information" (ABET i), and "Understand contemporary issues and how they relate to their profession" (ABET j).
Reason/Justification for Action	Instructor self-evaluations, summarized in Table 4.1 indicate that outcomes h, i, and j have been addressed inconsistently in the curriculum. Furthermore, scores on Q16 and Q19 on the senior exit interview are among the lowest, often below 4.0. Since the purpose of electives is to broaden the students' perspective, requiring all electives address these three outcomes is appropriate. All students will be exposed to the outcomes, since at least two CHE electives are required for graduation.
Implementation Date	2016/17 academic year
Assessment/Metrics	Instructor self-evaluation and exit survey
Results/Data	Senior Exit Survey 2013/14 2014/15 2015/16 Q19 Context of Engineering (h) 4.02 3.76 3.85 Q 20 Ability to Learn on Own (i) 4.63 4.49 4.57 Q16 Contemporary Issues (j) 4.12 3.91 3.74 Instructor Self-Evaluation of Courses 2015/16 Number of electives addressing h None Number of electives addressing i None Number of electives addressing j None
Further Action	Assessment will be undertaken on a yearly basis starting in 2016/17 academic year.

Undergraduate Program Student Outcomes ABET a-k Assessment

ABET a-k	Indicator	Performance Goals and Metrics	Results 2012/13	Metric Met	Results 2013/14	Metric Met	Results 2014/15	Metric Met	Results 2015/16	Metric Met
a	• Understand principles traditionally used by chemical engineers and appreciate how and where they are used • Understand how basic science and math is applied in solving chemical engineering problems	≥ 50 % (Comprehensive Senior Examination) ≥ 4.0 on Q8 Fund. knowledge (Exit Survey) ≥ 4.0 on Q6 Math skills (Exit Survey) Outcome a addressed and met in multiple courses across the curriculum (Instructor self eval.)	46.1 4.44 4.54 Yes	No Yes Yes Yes	48.4 4.29 4.54 Yes	No Yes Yes Yes	50.6 4.05 4.31 Yes	Yes Yes Yes Yes	57.0 4.22 4.44 Yes	Yes Yes Yes Yes
b	• Be able to design and conduct experiments and analyze and interpret data • Be able to apply statistical analysis to data	≥ 4.0 on Q9 Experimental design (Exit Survey) ≥ 4.0 on Q10 Data analysis (Exit Survey) 100 % of students receive C or better on Statistics quiz in CH E 4232 Outcome b addressed and met in laboratories CH E 3232, 4232 (Instructor self evaluation)	4.29 4.43 71 Yes	Yes Yes No Yes	4.02 4.29 57 Yes	Yes Yes No Yes	3.93 4.24 70 Yes	No Yes No Yes	3.91 4.25 67 Yes	No Yes No Yes
c	• Be proficient with Chemical Engineering design software • Be able to design components and systems as needed	≥ 4.0 on Q11 Design ability (Exit Survey) 100 % or students receive C or better in CH E 4555 Capstone Design Outcome c addressed and met in multiple courses across the curriculum (Instructor self eval.) ≥ 60% on Design-Related Criteria (Capstone Design Project)	4.29 100 Yes	Yes Yes Yes	3.98 98 Yes 76.52	No No Yes Yes	3.91 98.3 Yes 75.40	No No Yes Yes	3.81 100 Yes 91.05	No Yes Yes Yes

ABET a-k	Indicator	Performance Goals and Metrics	Results 2012/13	Metric Met	Results 2013/14	Metric Met	Results 2014/15	Metric Met	Results 2015/16	Metric Met
d	• Be able to work effectively in teams	≥ 4.0 on Q12 Teamwork (Exit Survey)	4.78	Yes	4.49	Yes	4.35	Yes	4.34	Yes
		≥ 4.0 on Q14 Leadership (Exit Survey)	4.75	Yes	4.39	Yes	4.31	Yes	4.19	Yes
		Outcome d addressed and met in multiple courses across the curriculum (Instructor self eval.)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
e	• Be able to implement strategies required to solve open-ended problems • Be prepared to pass the F. E. exam	≥ 4.0 on Q13 Exit Survey (Independence)	4.56	Yes	4.71	Yes	4.47	Yes	4.66	Yes
		≥ 4.0 on Q15 Exit Survey (Self confidence *before 2013*)								
		≥ 4.0 on Q5 Exit Survey (Problem-solving skills)	4.60	Yes	4.44	Yes	4.33	Yes	4.41	Yes
		≥ 4.0 on Q4 Exit Survey (Creative thinking)	4.44	Yes	3.95	No	4.00	Yes	3.97	No
		≥ 4.0 on Q3 Exit Survey (Critical judgment)	4.48	Yes	4.37	Yes	4.07	Yes	4.09	Yes
		≥ 50 % (Comprehensive Senior Examination)	46.1	No	48.4	No	50.6	Yes	57	Yes
		Outcome e addressed and met in multiple courses across the curriculum (Instructor self eval.)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
f	• Be aware of the ethical responsibilities inherent to professional conduct	≥ 4.0 on Q15 Exit Survey (Understanding of process safety *after 2012*)	4.52	Yes	4.37	Yes	3.89	No	3.78	No
	• Have knowledge of health and safety procedures and be able to incorporate this knowledge into their problem-solving and laboratory activities	≥ 4.0 on Q17 Prof. behavior (Exit Survey)	4.75	Yes	4.66	Yes	4.36	Yes	4.56	Yes
		≥ 4.0 on Q18 Ethical behavior (Exit Survey)	4.79	Yes	4.66	Yes	4.51	Yes	4.84	Yes
		100 % of students receive C or better on EH&S quiz in CH E 3232	100	Yes	100	Yes	100	Yes	100	NA
	• Understand the importance of professional registration	100 % of students receive C or better on EH&S Quiz in CH E 4232	100	Yes	100	Yes	100	Yes	100	Yes
		Outcome f addressed and met in multiple courses across the curriculum (Instructor self eval.)≥ 60% on Understanding of Process Hazards (Capstone Design Project)	Yes	Yes	Yes	Yes	Yes 62.44	Yes Yes	Yes 91.43	Yes Yes
g	• Communicate technical information clearly and concisely	≥ 4.0 on Q1 Writing skills (Exit Survey)	4.16	Yes	4.00	Yes	4.02	Yes	4.06	Yes
		≥ 4.0 on Q2 Speaking skills (Exit Survey)	4.17	Yes	4.00	Yes	3.80	No	3.72	No
		Outcome g addressed and met in multiple courses across the curriculum (Instructor self eval.)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		≥ 60% on Poster Presentation (Capstone Design Project)			82.67	Yes	81.20	Yes		

ABET a-k	Indicator	Performance Goals and Metrics	Results 2012/13	Metric Met	Results 2013/14	Metric Met	Results 2014/15	Metric Met	Results 2015/16	Metric Met
h	• Understand the need to examine the long-term societal and global impact of technical decisions	≥ 4.0 on Q19 Context of Eng. (Exit Survey)	4.35	Yes	4.02	Yes	3.76	No	4.06	Yes
		Outcome h addressed and met in multiple courses across the curriculum (Instructor self eval.)	No	No	No	No	No	No	No	No
		≥ 60% on Design Impact (Capstone Design Project)					55.33	No	87.65	Yes
i	• Participate in student chapter activities and see the value of these organizations in life-long learning • Experience the value of synergistically integrating education with work and research experience • Understand the value of advanced degrees and be aware of the opportunities for pursuing such degrees • Effectively use the WWW and the library to find information	≥ 4.0 on Q20 Ability to learn on own (Exit Survey)	4.71	Yes	4.63	Yes	4.49	Yes	4.69	Yes
		≥ 50 % of students in AIChE Student Chapter	NA		NA		NA		85 %	Yes
		≥ 30 % of students perform research (Exit Survey)	49	Yes	31	Yes	43	Yes	46	Yes
		≥ 15 % of student do co-op (Exit Survey)	57	Yes	65	Yes	69	Yes	56	Yes
		≥ 15 % of students plan on pursuing advanced degree (Exit Survey)	14	No	19	Yes	16	Yes	46	Yes
		Outcome i addressed and met in at least two courses in the curriculum (Instructor self evaluation)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
j	• Understand contemporary issues and how they relate to their profession	≥ 4.0 on Q16 Contemp. Issues (Exit Survey)	4.32	Yes	4.12	Yes	3.91	No	3.94	No
		Outcome j addressed and met in at least two classes in the curriculum (Instructor self eval.)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
k	• Be proficient with computing tools and design software to solve Chemical Engineering problems	≥ 4.0 on Q7 Computing skills (Exit Survey)	4.27	Yes	4.10	Yes	3.89	No	3.75	No
		100 % of students receive C or better in CH E 4555 Capstone Design	100	Yes	100	Yes	98.3	No	100	Yes
		Outcome k addressed and met in multiple courses across the curriculum (Instructor self eval.)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Results of ChE Exit Interview Survey For Spring Graduates

Color	Score	Key
	1.0-1.9	Not at all, very dissatisfied
	2.0-2.9	Not well, dissatisfied
	3.0-3.9	Considerably, satisfied
	4.0-5.0	A great deal, very satisfied

No.	Question: To what degree did your education at TTU contribute to your learning and development in the following areas?	ABET a-k	2011	2012	2013	2014	2015	2016
8	Fundamental knowledge of ChE principles	a	4.24±0.53	4.58±0.55	4.44±0.52	4.29±0.60	4.05±0.64	4.21±0.61
6	Mathematical skills	a	4.58±0.59	4.44±0.76	4.54±0.66	4.54±0.64	4.31±0.63	4.35±0.79
9	Ability to design and conduct experiments	b	4.05±0.83	4.11±0.66	4.29±0.69	4.02±0.76	3.93±0.69	3.78±0.86
10	Ability to analyze and interpret data	b	4.26±0.71	4.30±0.62	4.43±0.55	4.29±0.64	4.24±0.64	4.12±0.71
11	Ability to design systems and components as needed	c	4.13±0.73	4.14±0.63	4.29±0.60	3.98±0.76	3.91±0.72	3.87±0.77
12	Ability to work well in diverse or multidisciplinary teams	d	4.42±0.78	4.58±0.64	4.78±0.45	4.49±0.68	4.35±0.69	4.29±0.81
14	Leadership abilities	d	4.11±0.95	4.41±0.68	4.75±0.47	4.39±0.77	4.31±0.72	4.21±0.66
13	Ability to work independently	e	4.47±0.64	4.58±0.64	4.56±0.61	4.71±0.51	4.47±0.63	4.57±0.55
15	Understanding of Process Safety	f			3.96±0.86	3.69±1.98	3.89±0.87	3.84±1.03
5	Problem-solving skills	e	4.61±0.54	4.39±0.63	4.60±0.55	4.44±0.67	4.33±0.63	4.32±0.76
4	Creative thinking	e	4.18±0.79	4.16±0.73	4.44±0.68	3.95±0.71	4.00±0.71	3.99±0.84
3	Critical judgment	e	4.34±0.70	4.33±0.62	4.48±0.63	4.37±0.62	4.07±0.60	4.21±0.68
17	Appreciation of professional behavior	f	4.37±0.65	4.55+0.72	4.75±0.47	4.66±0.73	4.36±0.85	4.41±0.74
18	Appreciation of ethical behavior in eng.	f	4.59±0.59	4.50±0.68	4.79±0.47	4.66±0.62	4.51±0.83	4.66±0.64
1	Writing skills	g	4.16±0.54	4.19±0.51	4.16±0.69	4.00±0.77	4.02±0.70	4.03±0.65
2	Speaking skills	g	3.76±0.81	4.00±0.75	4.17±0.67	4.00±0.75	3.80±0.77	3.82±0.73
19	Awareness of the political & societal context of engineering	h	3.69±0.87	3.77±0.92	4.35±0.71	4.02±0.91	3.76±0.93	3.85±0.95
20	Ability to learn on your own	i	4.45±0.64	4.61±0.59	4.71±0.45	4.63±0.54	4.49±0.60	4.57±0.55
16	Understanding of contemporary issues in science/tech	j	3.76±0.93	3.80±0.91	4.32±0.75	4.12±0.81	3.91±0.88	3.74±0.86
7	Computing skills	k	4.42±0.67	3.89±0.70	4.27±0.69	4.10±0.80	3.89±0.78	3.66±0.94
	Please rate your satisfaction with the following at Texas Tech University							
21	Effectiveness of instructors		3.66±0.70	3.64±0.71	3.90±0.68	3.56±0.87	3.62±0.65	3.54±0.68
22	General attitudes of instructors		3.89±0.73	4.14±0.71	4.08±0.71	4.00±0.74	3.67±0.81	3.60±0.81
23	Balance between theory and practice		3.70±1.04	3.58±1.04	3.81±0.86	3.49±0.95	3.33±0.81	3.33±0.96
24	Classroom facilities		3.92±0.87	3.94±0.88	3.29±1.19	2.66±1.09	3.20±0.98	3.49±0.98
25	Laboratory facilities		3.42±1.10	3.64±0.95	3.14±1.14	2.95±1.14	3.20±0.97	3.19±1.11
26	Study Space		3.42±0.94	3.67±1.20	3.25±1.16	2.76±1.14	2.85±1.25	2.63±1.12
27	Computing facilities		2.89±1.21	2.53±1.21	2.44±1.25	1.71±1.08	2.18±0.97	1.99±1.14
28	Academic advising		4.47±0.96	4.42±0.76	4.75±0.47	4.66±0.57	4.27±0.88	4.44±0.74
29	Career counseling		2.45±1.79	4.28±0.84	4.27±0.89	4.15±1.11	3.78±0.89	3.40±1.29
30	Overall learning environment		3.89±0.91	4.08±0.72	4.13±0.76	3.80±0.78	3.69±0.78	3.71±0.65

Educational and Student Learning Outcomes for M.S. in Chemical Engineering revised 12/11/15

Objective	Assessment Criteria	Metrics and Assessment Tools (tools are in parentheses)	Results			Criteria Met
			2014	2015	2016	
Graduates have advanced knowledge of the field and are able to effectively apply this knowledge	Mastery of ChE core concepts	All students pass required core curriculum with GPA of 3.0 or higher (course grades)	3/5 graduating MSs passed the course classes with GPA of 3.0 or higher	3/3 graduating MSs passed the core curriculum with GPA of 3.0 or higher	3/5 graduating MSs passed the core curriculum with GPA of 3.0 or higher	No
		Learning outcomes associated with concept mastery in core courses ChE 5312, 5321 and 5343 are met (instructor self-evaluations of the courses)	ChE 5312: outcomes met ChE 5321: outcomes met ChE 5343: outcomes met	ChE 5312: outcomes met ChE 5321: outcomes met ChE 5343: outcomes met	ChE 5312: outcomes met ChE 5321: outcomes met ChE 5343: outcomes met	
	Ability to use computational and modeling tools to solve ChE problems	Learning outcomes associated with computational and modeling tools in core courses ChE 5310 and 5323 are met (instructor self-evaluations of the courses)	ChE 5310: outcomes 1-3 met ChE 5323: outcomes met	ChE 5310: outcomes met ChE 5323: no information	ChE 5310: outcomes met ChE 5323: no information	Yes
Graduates have an understanding of research and use literature to creatively solve problems	Performance in thesis research	Students publish one refereed journal articles from their thesis research (web of science)	Ave. # of Pubs: 0. 6 ± 0.9 2/5 with ≥ 1 pubs (independent of author order)	Ave. # of Pubs: 1 1/3 with ≥ 1 pubs (independent of author order)	Ave. # of Pubs: 0.5 2/5 with ≥ 1 pubs (independent of author order)	No
Graduates are able to effectively communicate technical information	Student presentations	100 % of the students present their work at local, regional, or national meetings (exit interview)	2/5 presented their work	1/3 presented their work	1/5 presented their work	No
	Student awards for presentations	20 % of the graduating students receive local, regional, or national awards for poster or oral presentations (exit interview)	1/5 received an award	1/1 received an award	0/5 received an award	No
Graduates have a strong sense of professionalism and a good understanding of research ethics and safety	Safe conduct of research	Reported safety incidents (EHS)	One safety incident was reported to EH&S	No safety incidents were reported to EH&S	No safety incidents were reported to EH&S	Yes
	Understanding of research ethics	100 % participated in the TTU RCR program or took a professional ethics course (VPR)	1/5 successfully completed RCR training	3/3 successfully completed RCR training	1/5 successfully completed RCR training	No
	Membership or participation in professional and student organizations	100 % of graduating students are members of professional organizations (exit interview)	Professional membership unavailable	1/3 participated in professional organizations	3/5 participated in professional organizations	No
		50 % participate in TTU graduate student organizations (exit interview)	3/5 participated in TTU student organizations	1/3 participated in TTU student organizations	5/5 participated in TTU student organizations	No

Educational and Student Learning Outcomes for PhD in Chemical Engineering revised 3/30/17

Outcome	Assessment Criteria	Metrics and Assessment Tools (tools are in parentheses)	Results 2015	Results 2016	Criteria Met
Graduates have advanced knowledge of the field and are able to effectively apply this knowledge	Mastery of ChE core concepts	All students pass required core curriculum with GPA of 3.0 or higher (course grades) Learning outcomes associated with concept mastery in core courses ChE 5312, 5321, and 5343 are met (instructor self-evaluations of the courses)	7/8 graduating PhDs passed core courses with GPA of 3.0 or higher ChE 5312: outcomes met ChE 5321: outcomes met ChE 5343: outcomes met	6/6 graduating PhDs passed core courses with GPA of 3.0 or higher ChE 5312: outcomes met ChE 5321: outcomes met ChE 5343: outcomes met	Yes
	Ability to use computational and modeling tools to solve ChE problems	Learning outcomes associated with computational and modeling tools in core courses ChE 5310 and 5323 are met (instructor self-evaluations of the courses)	ChE 5310: outcomes met ChE 5323: outcomes met	ChE 5310: outcomes met ChE 5323: outcomes met	Yes
Graduates are able to perform state-of-the-art research and use literature to creatively solve problems	Performance in dissertation research	Students publish at least four refereed articles from their dissertation and at least three first-author publications (web of science)	Pubs: 4.7 ± 4.1 First-Author Pubs: 2.3 ± 1.2 4/10 with ≥ 3 first-author pubs 5/10 with ≥ 4 pubs	Pubs: 4.0 ± 2.4 First-Author Pubs: 2.3 ± 1.6 3/6 with ≥ 3 first-author pubs 4/6 with ≥ 4 pubs	No
	Placement of students	100 % of students are placed within six months of graduation (exit interview)	8/10 students placed within six months of graduation	6/6 students placed within six months of graduation	Yes
Graduates are able to effectively communicate technical information	Student presentations	100 % of the graduating students presented their work at national meetings (exit interview)	All students presented their work On average, 9.3 presentations per student	All students presented their work On average, 10.7 presentations per student	Yes
	Student awards for research	40 % of the graduating students received local or national awards (exit interview)	5/8 of graduating students received awards for presentations	5/6 of graduating students received awards for presentations	Yes
Graduates have a strong sense of professionalism and a good understanding of research safety and ethics	Safe conduct of research	100 % of students self report a good understanding of safety (exit interview) 50 % report filing near-miss or minor safety incidents (exit interview) 0 report major safety incidents (exit interview)	Question added in mid-2015; for those with question: 8/8 report a good understanding of safety 0/8 reported any incidents	6/6 report a good understanding of safety 2/6 reported near-miss or minor incidents 0/6 reported major incidents	Yes
	Understanding of research ethics	100 % completed TTU RCR training or took a professional ethics course (VPR)	5/8 successfully completed RCR training	3/6 successfully completed RCR training	No
	Membership in professional and student organizations	100 % are members of professional orgs (exit interview) 50 % participate in TTU graduate student orgs (exit interview)	4 students are members of professional orgs 8/8 students are members of TTU graduate student orgs	6/6 students are members of professional orgs 6/6 students are members of TTU graduate student orgs	Yes

Ch E 2410: Introduction to Chemical Process
Instructor Evaluation of Undergraduate Courses for Fall 2016

Instructor Carla Lacerda

Time/Place MW 5-7 pm, F 8, 9, 10 and 11 am

Catalogue Listing (4 credits). Prerequisites: CHEM 1305, CHEM 1307, ENGL 1301, MATH 1451, PHYS 1408 (concurrent enrollment allowed), and CHE 1121. Units and conversions, process variables, material and energy balances, process flow sheet analysis, phase equilibrium, elementary transient balances.

Grade Distribution

A	B	C	D	F	Drop	Total
27	25	27	36	9	41	165

Modifications Made to Course:
Course had one instructor for lectures, one TA for recitations and three TAs in charge of grading and office hours. Felder's "Elementary Principles of Chemical Processes" was adopted. Grades were based on 13 quizzes, 5 homework assignments, 1 HYSYS project, 2 midterm exams and 1 comprehensive final exam.

Expected Outcomes and Assessment

Criterion 3 a-k table (1-minimally, 2-to some extent, 3-largely)

a	b	c	d	e	f	g	h	i	j	k
3		3		3	1	1				2

Outcome	ABET 3 a-k	Performance Indicators	Assessment Results Passing students averaged (%):	Outcome Met?
Perform material balances on multi-unit chemical processes, reactive and non-reactive	a	Exam 1, quiz 1-4	70, min 34, max 100 on exam 1; 81, min 27, max 100 on quizzes 1-4	Yes, students were able to use math skills to material balances
Apply thermodynamic properties of pure and multi-component systems in the design of realistic units	c	Exam 2, quiz 5-7	78, min 49, max 98 on exam 2; 93, min 42, max 100 on quizzes 5-7	Yes, students successfully implemented multiphase and multicomponent rules for balances on units
Conduct steady-state energy balances on multi-unit chemical processes	e	Final exam, quiz 8-13	82, min 67, max 100 on final exam; 93, min 36, max 100 on quizzes 8-13	Yes, students executed couple material and energy balances on different processes

Solve material and energy balances using Matlab and/or HYSYS	k	Project, Exam 1 (last problem	88, min 50, max 100 on project; please see course reviews below*	To some extent*, students were able to implement Matlab and HYSYS for process calculations

Recommended Changes to Course:
*Implementation of Matlab and HYSYS is very challenging with the limited time – with only 4 credits, it is extremely difficult to cover Matlab content in addition to the basic content of this course. Matlab content was essentially dropped after exam 1, due to student resistance and need to speed up the pace of the course. A suggestion would be to implement this in a separa course.

Class size is not conducive to learning – classroom was small and not appropriate for 165 students. It is difficult to see the board and even with the use of technology, students get easily lost. In addition, once a question is raised, the entire class gets distracted and it becomes difficult to get back on track. It is suggested to break this group into at least two groups of 80.

Many students did not feel prepared for the quizzes, even though they covered material directly related to the lecture of the day. Some students do not have the math or chemistry background required. More stringent admission criteria, prerequisites are needed.

TAs for the course need to be available for recitation sessions.

Statistics Component: None

Health and Safety Component: Minimum commentary on safety of each unit introduced for mass and energy balances.

Ethics Component: Class discussions regarding groupwork and cheating.

MatLab Use: Minimal.

HYSIS Use: Exclusively on project assignment.

Visio Use: None

Syllabus and Course Schedule Attached.

Ch E 3322: Chemical Engineering Thermodynamics II (All Sections)
Instructor Evaluation of Course for Fall 2016

Instructor Ronald Hedden

Time/Place

Lecture:	TR	9:30 - 10:50	MCOM 359
Discussion:	W (Sec. 003)	8:00 - 8:50	EE 217
	W (Sec. 001)	10:00- 10:50	IE 103
	W (Sec. 002)	11:00- 11:50	EE 101

Catalogue Listing Solution thermodynamics, phase and chemical equilibria, analysis

Grade Distribution

A	B	C	D	F	Total
8	23	40	20	16	107

Modifications Made to Course None.

Expected Outcomes and Assessment

Outcome	ABET a-k	Performance Indicators	Assessment Results (based on students passing the course)	Outcome Met?
Describe and predict thermodynamic properties of pure liquids and gases and their mixtures	a,e	Exam 1 100 % of students should score 67% or higher	70/71 students (98.6%) met the metric	Almost completely
Analyze the phase behavior of pure fluids and multicomponent mixtures	a,e	Exam 2, Final Exam 100 % of students should score 67% or higher	44/71 students (62%) met the metric on Exam 2; 36/71 (50.7%) met the metric on the Final Exam	Partially

Analyze and predict chemical reaction equilibria	a,e	Final Exam 100 % of students should score 67% or higher	36/71 students (50.7%) met the metric on the Final Exam	Partially
Apply modern engineering tools (Matlab, HYSYS) to achieve the outcomes above.	k	Discussion Assignments (completed in class time). 100 % of students should score 67% or higher	69/71 students (97.2%) met the metric on the Final Exam	Almost completely

Recommended Changes to Course:

Too much time was spent reviewing Ch. 6 (Maxwell's Relations, Classical Thermodynamics) and Ch. 7 (Equations of State) this year. The instructor's assessment of students' knowledge on the first day of class indicated that many students were poorly prepared in these areas. As a result, one month of class time was devoted to material that should have been covered more thoroughly in ChE 2421 (or equivalent course for transfer students). The material ordinarily covered in ChE 3322 was compressed into the last 2.5 months of the course, and many students were unable to handle the increased workload, as seen in the assessment data for Exam 2 and the Final Exam (metrics were only partially met).

Actions taken:

1) The instructor has met with the ChE 2421 instructor for spring 2017 and discussed the issue. Plans were formulated to ensure more time is spent on Ch. 6 and Ch. 7 in spring 2017. Prof. Hedden will furnish the instructor for ChE 2421 with problem sets, Excel workbooks, and exam questions to fortify coverage of Ch. 6 and Ch. 7 material in ChE 2421.

2) ChE 3322 will begin with only a light review of Ch. 7 material next year. There will be more time available to cover the core material in ChE 3322.

Statistics Component: None.

Health and Safety Component: None.

MatLab Use: Use in discussion assignments (done in class).

Hysis Use: Limited use in discussion assignments (done in class).

Visio Use: None.

Syllabus and Course Schedule Attached.

ChE 4232: Unit Operations Lab
Instructor Evaluation of Course
Fall 2016

Instructor Prof. Chijuan Hu, Dr. Haoyu Zhao

Time/Place
Lecture M, W, F 12:00 - 12:50 PM IE 205
Lab Session M, T, W, Th 2:00-5:50 PM CHE B05 & Old PE 105
Group Meeting Session M, T, W, Th 2:00-5:50PM Old PE 105

Catalogue Listing Laboratory experiments illustrating the basic principles of unit operations. Includes instruction on experimental methods, equipment scale up, and technical communication. Professional practice course. (Writing Intensive)

Grade Distribution

A	B	C	D	F	Incomplete	Total
17	33	22	1	7		80

Modifications Made to Course

- A new gas absorption experiment was added to this course.
- Microscope and hemocytometer were implemented in the bioreactor experiment for students to practice cell counting.
- Rubric was modified to include lab preparation and lab technique as part of the evaluation.

Expected Outcomes and Assessment

Outcome	ABET Objective	Assessment Method and Metrics	Assessment Results (total 20 groups or 80 students)	Outcome Met
Ability to perform experiments, write reports to analyze and interpret data.	b	Data analysis and sample calculation of lab reports were used to evaluate students' ability to analyze data. Discussion part of lab reports was used to evaluate students' ability to interpret data/results. (≥ 65% on lab reports signifies outcome met) Double quiz covering four lab experiments was used to evaluate student's	Cooling Tower: Average: 80.08% ± 11.71% Range: 53.00% - 95.00% (number ≤ 65%: 3 groups) Liquid Liquid Extraction: Average: 81.04% ± 6.48% Range: 62.00% - 92.00% (number ≤ 65%: 1 groups) Bioreactor: Average: 78.33% ± 11.59% Range: 54.00% - 99.00% (number ≤ 65%: 3 groups) Gas Absorption: Average: 79.54% ± 10.84% Range: 53.00% - 97.00 (number ≤ 65%: 2 groups)	Yes

		individual ability of data analysis and solving problems. (≥ 25% signifies outcome met)	Double Quiz: Average: 55.93% ± 18.49% Range: 25%-96% 74/80 students passed 25/100 on the double quiz. (number ≤ 25%: 6 students)	Yes
Ability to use Matlab/Excel to extrapolate data and perform data analysis and the ability of statistical analysis.	b	One statistics quiz was given to evaluate students' individual ability of statistics analysis. (≥ 60% signifies outcome met) Matlab/Excel was required to analyze data. Statistics analysis in lab report was evaluated.	Statistics quiz: Average: 67.56% ± 24.17% Range: 15%-100% (number ≤ 60%: 17 students) 20/20 groups could use either Matlab or Excel to complete data analysis. Average of 66.43 % (5.31/8) was achieved to show students' ability to perform basic statistical analysis and correctly present statistical results on graphs.	No Yes Yes
Be able to work in groups to collect experimental data and prepare lab reports.	d	Peer review is required from each student on every experiment through Comprehensive Assessment of Team-Member Effectiveness (CATME) system. (≥ 80% signifies outcome met, 4.0/5.0, grade adjusted without self-rating) Individual report was required to assist assessing individual's performance and contributions.	Cooling Tower (number ≤ 80%: 10), Liquid Liquid Extraction (number ≤ 80%: 11), Bioreactor (number ≤ 80%: 11), Gas Absorption (number ≤ 80%: 9) received higher than 80% on CATME peer evaluation across five assessed categories. 10 % students' final course grades were adjusted based on the peer review and the instructors' observation.	Yes
Understand and apply Health Environment and Safety principles in this course.	f	Two safety exams: (a) On-line exam administered by TTU Environment Health and Safety. Safety certificates are collected and placed in the Unit	(a) 80/80 students submitted safety certificates. (b) 80/80 students passed the in-class exam (1 retake to pass). During the scheduled lab session, no safety violation	Yes

		Operations lab. (b) In-class safety exam. One retake was allowed. Minimum 80% was required to pass. Students have to pass both exams to continue this course. (≥ 80% signifies outcome met)	was observed. Students all wore PPE and performed experiment safely.	
Be able to clearly communicate ideas and findings with clarity by writing reports.	g	Four lab reports were required to evaluate student's written communication skills. (≥ 65% signifies outcome met)	Average of B, Range of 50% -100%, was achieved for each experiment report. (number ≤ 65%: 4 groups)	Yes
Be able to explain the global, social and/or economic impact of a unit operation.	h	One paragraph in discussion section was required to provide example of the global, social and/or economic impact. (≥ 75% (3/4) signifies outcome met)	Each group get ≥ 75% (3/4) at least on one of the reports indicated student's ability to describe the impact of the experiments they learnt.	Yes
Effectively use internet and library resources to assist writing lab report.	i	All the lab reports were required to provide reference sources. Two references were required for the introduction paragraph. Format of references followed *American Chemical Society style guide*.	All the groups were able to find crucial data such as physical properties. 20/20 of the groups were able to provide two references for introduction. All the groups provided reference sources in the lab reports.	Yes

Recommended Changes to Course:

1. Time required for each trial in gas absorption experiment are to be shortened and fresh water mode will be added in the procedure to compare with the recirculating mode.
2. Number of questions in double quiz must be reduced to ensure enough time to complete.
3. Syllabus will be modified to indicate that adjustment on grade based on performance only can be decreased not increased.

Statistics Component: One lecture on statistics and in-class statistics quiz were given. Students were expected to perform statistical analysis in the lab reports.

Health and Safety Component: Students are required to pass both the EH&S on-line lab safety test

and in-class safety test (a minimum 80% to pass). Safe practice is reinforced during lab session. Proper attire and following experiment procedure is mandatory.

MatLab Use: Matlab and/or Excel was used to analyze data.

Aspen Use: None required in this course.

Visio Use: Visio was required to provide experimental diagram.

Syllabus and Course Schedule Attached.

The syllabus was attached.

Ch E 4322: Chemical Engineering Review
Instructor Evaluation of Course for Fall 2016

Instructor Sheima J. Khatib

Time/Place

Lectures T, R	9:30 - 10:50 AM	Livermore 101
Discussion Section 001: W	10:00 - 10:50 AM	Livermore 101
Discussion Section 002: R	11:00 - 11:50 AM	Livermore 101

Catalogue Listing Review of chemical engineering and science courses. Preparation for Chemical Engineering FE exam. Design and computer simulation of process units.

Grade Distribution

A	B	C	D	F	NG	Total
73	4	4	0	0	1	82

Modifications Made to Course

- The course was modified from a 1-credit to a 3-credit course this year, therefore, two new outcomes were incorporated, namely:
  1) "Analyze and design processes consisting of unit operations studied throughout the Chemical Engineering courses, including heat exchange, distillation, absorption, stripping, extraction, reactors, by hand", (ABET skill c).
  2) "Analyze and design processes consisting of unit operations using a process simulator and/or MATLAB", (ABET skill k).

- The students were assessed based on their performance in one mock exam, similar to the FE exam, four quizzes and four Hysys projects. Since not all students performed the quizzes, the results obtained are not representative of the result of the outcome for the whole class, therefore quiz results will not be reflected in the Assessment section.
- New teaching strategies were added, involving group work and class work where students were assessed based on their participation, not on the results obtained. This was done with the goal to encourage student participation, peer instruction and consistent studying.

Criterion 3 a-k addressed by the course

a	b	c	d	e	f	g	h	i	j	k
		2		3						3

Blank - not addressed; 1 - small extent; 2 - moderate extent; 3 - great extent

Expected Outcomes and Assessment:

Outcome	ABET Objective	Assessment Method and Metrics*	Assessment Results (exams only)	Outcome Met
The ability to pass the Chemical Engineering FE Exam	e	Comprehensive exam of similar structure and content	Average: 60.0 % Score range: 37.9 – 84.6 # students scoring ≥ 46%: 74/81 # students scoring 49-40 %: 4/81 # students scoring < 40 %: 3/81	Yes, to a certain extent
Analyze and design processes consisting of unit operations using a process simulator (Aspen HYSYS)	k	Project 2 Project 3 Project 4	Average: 94.0 % # students scoring ≥ 60%: 81/81 Average: 92.0 % # students scoring ≥ 60%: 81/81 Average: 92.0 % # students scoring ≥ 60%: 81/81	Yes
Analyze and design processes consisting of unit operations studied throughout the Chemical Engineering courses, to meet certain needs defined by the problem statement	c	Project 1	Average: 94.0 % # students scoring ≥ 60%: 81/81	Yes

Recommended Changes to Course:

Outcome 3, corresponding to ABET c, was not assessed enough in this course since only one project required the students to design a process to obtain specific needs. The instructor will insert additional sections in the rest of the projects to meet this ABET outcome based on a more solid assessment.

Statistics Component: None

Health and Safety Component: None

MatLab Use: None

Aspen Use: Yes

Visio Use: None

Syllabus and Course Schedule Attached.

ChE 4353: Process Control
Instructor Evaluation of Undergraduate Courses for Fall 2016

Instructor
Parham Mobed
Time/Place

4353-001 *Class*: 11:00-12:20 TuTh
Discussion: F: 9:00-9:50
4353-002 *Class*: 11:00-12:20 TuTh
Discussion: F: 10:00-10:50

Catalogue Listing
Senior standing; CHE 3315, CHE 3341, CHE 3323; MATH 3350 or MATH 3354. Study of the principles of process dynamics and control and their applications to feedback control

Grade Distribution

A	B	C	D	F	I	Total
23	31	22	5	2	1	84

Modifications Made to Course:

Expected Outcomes and Assessment

Outcome	ABET A-K	Performance Indicators	Assessment Results	Outcome Met?
Label schematics and explain the operating principles of control system hardware	e	ABET objective "e" was assessed by 12 exam problems on the mid-term Exam 1, and a quiz.	The average percentage of points scored on the exam was 74% of the point possible with a 11% standard deviation. 92% of the students obtained 50% or more of the possible points.	yes
Qualitatively and quantitatively predict the dynamic behavior od ideal chemical processes in the time and Laplace domains	a	ABET objective "a" was assessed by 16 exam problems on mid-term Exam 2, 14 problems on mid-term Exam 3, 4 quizzes, an individual Project 1 and Final Exam.	The average percentage of points scored on the exam was 72% of the point possible with a 19% standard deviation. 85% of the students obtained 50% or more of the possible points	yes
Analyze and identify		ABET objective "c" was assessed by mid-term	The average percentage of points	yes

proportional (P), proportional-integral (PI), and proportional-integral-derivative (PID) control schemes for chemical processes		Exam 4 with a comprehensive design and analysis problem, and the Final Exam.	scored on the exam was 90% of the point possible with a 10% standard deviation. 95% of the students obtained 50% or more of the possible points	
Troubleshoot and design proportional (P), proportional-integral (PI), and proportional-integral-derivative (PID) control schemes for chemical processes	k	ABET objective "k" was assessed by an individual project over the engineering software Simulink and the Final Exam.	The average percentage of points scored on the exam was 88% of the point possible with a 7% standard deviation. 95% of the students obtained 50% or more of the possible points	

Recommended Changes to Course:
The use of Aspen DMC in the course would help the students in learning the course material with the current state-of-the-art software in control industries
Statistics Component:
None
Health and Safety Component:
None
Ethics Component:
None
MatLab Use:
Extensive use of MATLAB including the MATLAB/Simulink in the design of PID controllers and analysis of sensor noises. The design problem introduces the students to cascade control which is an advanced topic in process control.
HYSIS Use:
None
Visio Use:
None

ChE 5310: Advanced Techniques in Chemical Engineering
Instructor Evaluation of Graduate Courses for Fall 2016

Instructor Jeremy Marston

Time/Place TR 11am (CHE 101)

Catalogue Listing Application of ordinary and partial differential equations for solution of mass, momentum and/or energy transfer and transport problems. Primary emphasis is on the mathematical analysis of unsteady state systems and chemical-reaction systems: models, solutions, and model validation.

Grade Distribution

A	B	C	D	F	Total
12	13	1	0	0	26

Modifications Made to Course:

Both content and assessment was modified from the previous years. The course covered more material pertaining to PDEs (and less on ODEs) than in previous years. Assessment also included a computational project to solve a nonlinear ODE system.

Expected Outcomes and Assessment

Outcome	Performance Indicators	Assessment Results	Outcome Met?
Ability to formulate and solve mathematical models from descriptions of physical problems	Score of >60% achieved by all students in final exam	All students scored at least 64% in the final exam.	YES, metric exceeded
Ability to solve common types of differential equations pertaining to phenomenon in Chemical Engineering	Scores of >60% on both mid-term exams by all students	21/26 (81%) students achieved >60% in both mid-terms 1 and 2	NO
Ability to use advanced mathematical techniques to determine stability of solutions to differential equations	All Students scoring >60% on bi-weekly homeworks	All students scored >60% on all bi-weekly homeworks	YES

Ability to use technical programming language to solve mathematical problems	All students handing in a MatLab script that correctly solved an ODE system	25/26 students turned in a MatLab script.	No

Recommended Changes to Course:

Most students thought the section on PDEs should be expanded and that the material on perturbation theory/asymptotics could be cut. In addition First order PDEs should be covered with emphasis on characteristic curves. Also, Fourier and Laplace transform methods should be covered.

Statistics Component: None

Health and Safety Component: None

Ethics Component: None

MatLab Use: Moderate – used in the group project

Syllabus and Course Schedule Attached.

Ch E 5321: Advanced Chemical Engineering Thermodynamics
Instructor Evaluation of Graduate Course for Fall 2016

Instructor Chau-Chyun Chen

Time/Place 4:30 pm - 5:50 pm, Monday & Wednesday, ChE 101

Catalogue Listing In-depth study of fundamental laws of thermodynamics, property relations for pure material and mixtures, and phase and chemical equilibrium principles

Grade Distribution

A	B	C	D	F	Total
12	12	0	0	0	24

Modifications Made to the Course: 1) expand solid-fluid equilibrium discussions, 2) expand electrolyte thermodynamics discussions, 3) drop chemical equilibrium discussions due to overlapping with reaction engineering graduate course

Expected Outcomes and Assessment

Outcome	Performance Indicators	Assessment Results	Outcome Met?
1. An understanding of the molecular basis for equations of state and mixing rules and of the driving forces for phase and chemical equilibria	Score 50% or higher in Midterm I Exam	22/24 scored 50% or higher in Midterm I	To a large extent
2. An understanding of phase diagrams and phase equilibrium problems including the high-pressure region	Score 50% or higher in Midterm II Exam	24/24 scored 50% or higher in Midterm II	Yes
3. An ability to carry out thermodynamic calculations for vapor-liquid, liquid-liquid, and solid-fluid equilibria problems	Score 50% or higher in Final Exam	23/24 scored 50% or higher in Final Exam	Yes
4. An ability to solve for the phase equilibria problems involving complex fluids such as polymers, electrolytes, gases, and solids	Score 50% or higher in Final Exam	23/24 scored 50% or higher in Final Exam	Yes
5. An ability to use commercial simulators to solve phase equilibrium problems	Score 75% or higher in Project II	All students scored 75% or higher in Project II	Yes

Recommended Changes to Course: 1) introduce fundamentals of statistical thermodynamics, 2) connect molecular thermodynamics with molecular simulation

Syllabus and Course Schedule Attached.

Ch E 5343: Advanced Chemical Kinetics
Instructor Evaluation of Graduate Courses for Fall 2016

Instructor Theodore F. Wiesner

Time/Place Tuesdays and Thursdays, 9:30-10:50 AM, Room-CHE 101.

Catalogue Listing

Analysis and design of chemical reactor operations with multiple reactions, semibatch operations and other complex reactor configurations. Determination of kinetic parameters from operating data. Economic-based optimization, characterization, and modeling of non-ideal reactors.

Grade Distribution

A	B	C	Withraw Passing	Total
22	5			27

Modifications Made to Course:

I dropped the requirement of a term paper since the last time I taught the course in the Fall of 2013.

Expected Outcomes and Assessment

	Outcome	Performance Indicators (Students must earn ≥60% to pass.)	Assessment Results (for the 27 students completing the course)	Outcome Met?
1	Simulate in a chemical process simulator the steady-state behavior of the following ideal reactors: conversion, equilibrium, CSTR, and plug flow	Students were required to simulate the ideal reactor types in HYSYS and submit the simulator file.	26/27 students passed	Yes, to a great extent.
2	Calculate the state of a chemically reacting system under minimum Gibbs free energy	Homework on gas-phase equilibrium	27/27 students passed	Yes, to a great extent.
		Homework on multireaction and multiphase equlibria	26/27 students passed	
		Simulation of a Gibbs Reactor	26/27 students passed	
		Exam 1-Chemical Reaction Equilibrium	27/27 students passed	
3	Analyze and design homogeneous and heterogeneous reactions and reactors, from pore to bulk	Homework on reaction kinetic fundamentals	25/27 students passed	Yes, to a great extent.
		Homework on advanced reaction kinetics	26/27 students passed	
		Homework on heterogeneous reaction kinetics	26/27 students passed	
		Exam II-homogeneous and heterogeneous reaction kinetics	25/27 students passed	

	Outcome	Performance Indicators (Students must earn ≥60% to pass.)	Assessment Results (for the 27 students completing the course)	Outcome Met?
4	Estimate kinetic parameters from laboratory reactor data	Homework on simple determination of kinetic parameters	24/27 students passed	Yes, to a great extent.
		Homework on differential and integral methods of analysis	21/27 students passed	
		Exam on kinetic determination of parameters	22/27 students passed	
5	Describe qualitatively and quantitatively the kinetics of step growth and free radical polymerization.	Homework on polymerization kinetics	26/27 students passed	Yes, to a great extent.
		Homework on polymerization reaction engineering	26/27 students passed	
		Exam on polymerization kinetics	25/27 students passed	

Recommended Changes to Course:

The disciplines of chemical kinetics and chemical reactor design are very broad. I have found it difficult to select from these fields topics to teach in CHE 5343. At the same time, not many of the research projects going on in the department seem to involve kinetics and reactor design.

If I teach this course again, I believe I will focus upon chemometrics. This advanced topic is the basis for some of my research, and is intimately related to chemical kinetics.

Syllabus and Course Schedule Attached.

Faculty Retreat Minutes
August 25, 2016

Members present: Chang, Chen, Fernandes, Gill, Hedden, Hu, Khare, Khatib, Lacerda, Li, Marston, Nuraje, Simon, Vaughn, Weeks, Wiesner

Opening Comments (Simon)
- Retreat is required every 3 years for ABET accreditation.
- Welcome to new faculty – Dr. Chang and Dr. Fernandes

Undergraduate Program/ABET Requirements (Vaughn)
- ABET- Accreditation Board for Engineering and Technology
- 2016/2017 is our next evaluation year
- The evaluation process consist of submitting a self-study report by July than having a site visit Fall 2017
  - The department chair and faculty will be interviewed during the visit
  - When selecting faculty to interview, the evaluator will consider length of service, rank, laboratory responsibilities and courses with questions
  - Students will be interviewed as well

How Our Evaluator Will Judge Us
- The evaluator will review student transcripts to make sure they completed all required courses, as well as having the proper prerequisites for each required course
- In fall and spring terms, faculty need to document materials used to meet ABET criterion 3 a-k, including homework, quizzes, exams, projects, and any other work
  - Each assignment should represent the range of student performance- one representing high quality, medium and low quality
  - Copies will be kept electronically
  - Assignments should include the course number and ABET a-k objective
  - In the end, we will make web-based ABET a-k notebooks and individual course notebooks

The Self-Study Report
- The self- study report documents address questions to a series of ABET criteria
  - Criterion 1- Students The report should show continuous improvement
  - Criterion 2- Program Education Objectives
  - Criterion 3- Student Outcomes
  - Criterion 4- Continuous Improvement
  - Criterion 5- Curriculum
  - Criterion- 6- Faculty
  - Criterion 7- Facilities
  - Criterion 8- Program Criteria

Student Feedback - EAB
- Concerned about study abroad availability options
- 1/3 of exam should change each year
- ***Action item****- first week (2-3 sessions) of PhD tutoring should cover MatLab*

Instructor Self Evaluations
- Self evaluations are important for continuous improvement at the course level and for documenting that we meet ABET a-k
- Each student outcome should have a quantifiable assessment, preferably more than one
- Each student outcome should be tied to one ABET outcome a-k; the only exception to this is that a and e can be tied together if you cannot differentiate

- Practice continuing improvement for course; be sure to write recommendations for improvement and then to follow them the next time teaching the course

Instructor Record Keeping
- Need copies of all assignments and examples of graded work for all assignments that meet ABET objectives; three examples - one excellent, one average, and one poor
- Write the ABET objective the assignment covers

ABET a-k
a- ability to apply knowledge of math, engineering and science
b- ability to design and conduct experiments and analyze data
c- ability to design system, component to meet needs
d- ability to function on a multi-disciplinary team
e- ability to identify, formulate and solve engineering problems
f- understanding of professional and ethical responsibility
- Add quizzes or other means of evaluating for courses that cover this outcome

g- ability to communication effectively
- Need to incorporate individual presentations in the curriculum

h- broad education necessary to understand the impact of engineering solutions in global and societal context
- Not covered well in the program

i- recognition of need and ability to engage in lifelong learning change performance indicator from AIChE chapter to Professional Societies
- Not covered well in the program

j- knowledge of contemporary issues
- Not covered well in the program

k- ability to use techniques, skills and tools in engineering practice

Action Item: Add coverage of h, i, and j outcomes to all electives courses
Passed: 13-1

Results of ChE Exit Interview Survey
- Access to computing facilities needs to be improved
- Student study space needs to be improved

ChE Undergraduate Course Content
- ChE 1121:
  - Make changes in the syllabus
- Aspen/Hysys- Learn in 1305 Expected- No
- ABET outcomes- remove g from ABET outcomes
- ChE 1305
  - Use different assignments for each ABET outcome
  - Class covers too much outcomes
- ChE 2410
  - Objective e was assessed by 2 quizzes- state which quizzes were evaluated
  - Perhaps should not have multiple ABET outcomes per assignment
- ChE 2421
  - Hysys- Have TA do Hysys problems
- ChE 3232
  - Ethics- add Healthy and Safety to class syllabus under Expected Tools and Soft Tools
  - Remove a and e ABET outcomes
- ChE 3315
  - Aspen should be expected
- ChE 3322

    - An ability to predict the phase behavior of multicomponent mixtures- need to state the problems from the mid term
- ChE 3330
    - Adding j ABET outcome- contemporary issues to the syllabus
    - Remove g ABET outcome
- ChE 4232
    - Add h ABET outcome by adding section in laboratory report
- ChE 4353
    - Add h to Process Safety

Department Mission

- Discussed mission, particularly whether we should be program of choice in *Texas*; consensus was to leave as is:
    - The Department of Chemical Engineering will be the undergraduate Chemical Engineering department of choice in *Texas* and will be recognized as one of the top research and graduate Chemical Engineering departments in the nation

Program Educational Objectives

- Current objectives presented and discussed by faculty. Suggestions for changes were invited, but no changes were proposed. Consensus was to leave as is:
    - The Program Educational Objectives define future roles for which we are preparing our graduates. The program educational objectives for the graduates of the Bachelor of Science in Chemical Engineering at Texas Tech University are:

- Graduates will be successful in chemical engineering-related careers and other diverse career paths.
- Graduates will continue professional development and will pursue continuing education opportunities relevant to their careers.
- Some graduates will pursue advanced degrees.

Graduate Program Review (Khare)

PhD Program

- General Admission - No advisor; Recruited by faculty assuming acceptable quality
- Advisor selection
    - Faculty give seminar, students meet with faculty
    - Students rate faculty 1-5
- Courses
    - 5 core courses (completed in first two years), 4 electives
    - Students that do not have a BS in Chemical Engineering take three additional courses
- Qualifying exam- before 3rd year, need 3.0 GPA in core courses, committee consists of advisor, two additional faculty members from ChE and a faculty member from another department
- Notify Graduate School student after passes qualifying exam, student must file paperwork
- Dissertation Defense- Notify Graduate School about defending
    - Abstract for defense must be posted around building (by student)

MS Program

- Need to decrease admits to MS program and focus on students going for a PhD
- Students can receive MS along the way, after passing their qualifying exam

Problems with Graduate Program

- Couse content Digital Computation vs Advanced Techniques- too much overlap
- *Action Item- Graduate committee give course content to help faculty teaching grad courses*
- Students driving to conferences - what is our liability?

- Students access to printer after office is closed - if afterhours or color printing is needed, PIs should buy a supplementary printer for their student labs/offices
- A graduate student from another department can obtain a MS in ChE if fulfills the requirements
- RCR training - required; can meet this by taking ENGR 5392
- TAs need to know how to do the problems before get the solutions from the faculty
- Faculty need to supervise and mentor TAs, particularly if they are leading the discussions
- Three semesters of TA: first year (two semesters) - just grade, second year - teach discussions
- Need to figure out the best way to use the discussions

Advisor Switch Issue
- Students switching advisors causes loss of productivity for research groups, and this is particularly problematic for young faculty
- Students switch when they do not feel successful and valued; faculty need to make them feel successful
- Senior faculty should generally not take students switching from assistant professors
- If a switch is deemed appropriate, students should first see the graduate advisor and/or the department chair and they should discuss the situation with their current advisor; they should not find a new advisor first

Education and Student Outcome for PhD
- Graduates have advanced knowledge of field and are able to effectively apply this knowledge
  - *Placement of students with in one year*
- Remove placement of students under the Assessment Criteria column
- Add s*afety* to Understanding of Research ethics
- Check on the 9.3 average presentations per student under the Results 2015 column

Education and Student Outcome for MS
- Remove Mastery of ChE core-concepts under Assessment Criteria column
- No other changes

Changes to Courses Offered
- Change the courses being offered per semester for graduate students
- Reaction Engineering requires prerequisites - perhaps should move Dig Comp to fall and Reactions to spring
- ***Action item*** *- Graduate committee needs to look at sequence of courses and the content of Digital Computations*

Data/notebook for retreat

ChE Departmental Retreat

Thursday, August 25

9:00 - 9:10 am	Welcome and Orientation
9:10 - 10:00 am	Introduction to ABET
	Philosophy
	Terminology
	Objectives a-j
	What the department will prepare for the visit
	What faculty will need to provide
10:00 - 11:30 am	Summary of State of the Self-Study Draft and Data
10:30 am - noon	Review of Undergraduate Curriculum by Course
12:00 - 12:30 pm	Lunch
12:30 - 1:30 pm	Review of Mission, stakeholders, PEOs
1:30 - 1:50 pm	Wrap up - Undergraduate Program
1:50 - 2:00 pm	Break
2:00 - 3:00 pm	Graduate Program - PhD
	PEOs and Data
	Graduate Admissions Process
	Advisor Selection Process
	Courses and Content
	Qualifying Exam
	Dissertation Defense
3:00 - 3:45 pm	Graduate Program - MS
	PEOs and Data
	Advisor Selection Process
	Courses
	MS Thesis Defense or Comprehensive Exam
3:45 - 3:55 pm	Break
3:55 - 4:55 pm	Miscellaneous Graduate Topics
4:55 - 5:00 pm	Wrap up and Adjourn

ABET a-k

Demonstration that graduates have

a) ability to apply knowledge of math, engineering and science

b) ability to design and conduct experiments and to analyze and interpret data

c) ability to design system, component or process to meet needs

d) ability to function on a multi-disciplinary team

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

f) understanding of professional and ethical responsibility

g) ability to communicate effectively

h) broad education necessary to understand the impact of engineering solutions in a global and societal context

i) recognition of the need and ability to engage in life-long learning

j) knowledge of contemporary issues

k) ability to use techniques, skills, and tools in engineering practice

Course		Matlab	Aspen HYSYS	Visio	Statistics	Ethics	Health, Enviroment, Safety
ChE 1121	Seminar		HYSYS tutorial			film: Gilbane Gold	
ChE 1305	Analysis	Matlab	HYSYS		Introduction		
ChE 2306	Exposition			Visio		film: Incident at Morales	
ChE 2410	Chem Proc	MatLab	HYSYS				
ChE 2421	Thermo I	MatLab	HYSYS				
ChE 3232	Trans Lab	Matlab		Visio	regression, hypothesis testing, uncertainty analysis, data analysis		HE&S quiz
ChE 3315	Fluid Mech	MatLab	HYSYS				
ChE 3322	Thermo II	MatLab	HYSYS				
ChE 3326	Heat Trans	MatLab	HYSYS				
ChE 3330	Materials						
ChE 3341	Mass Trans	MatLab	HYSYS				
ChE 3323	Rections	MatLab	HYSYS				
ChE 4232	Unit Op				probability, data analysis, experimental design		HE&S quiz
ChE 4322	Review		HYSYS				
ChE 4353	Proc Cont	MatLab	HYSYS				
ChE 4356	Proc Safety					Ethics	Safety
ChE 4455	Design	Matlab	HYSYS	Visio		Ethics	design report

Record Keeping for the ABET Evaluation

From the Accreditation Policy and Procedure Manual: *II.G.6.b.(2) Materials – Evaluators will review samples of displayed course materials including course syllabi, textbooks, example assignments and exams, and examples of student work, typically ranging from excellent through poor.*

In partial fulfillment of the above requirements, the department will keep two sets of course material notebooks.

One will be a set of notebooks for each course in which copies of student work that was used for assessment of each Student Learning Outcome. For each assessment tool (homework, quiz, exam, project, presentation rubric, report, etc), three examples of student work will be kept: one copy each of work that represents excellent, average and poor examples (marked as such). These should be categorized by ABET a-k, then by the Student Learning Outcome, then by Assessment. For each assessment, there should also be information for was required to satisfy the Student Learning Outcome.

Note this means that if you hand back student work, copies must be made before the work is returned to the student.

The second set of notebooks will use the same student work products, but it will be arranged by ABET a-k. One notebook per outcome. This set of notebooks will contain the Assessments from the courses we use to demonstrate that each of the a-k is satisfied in our program. (two or three courses per outcome)

ABET student outcomes (needs revision)

course number	a	b	c	d	e	f	g	h	i	j	k	
1121							*	*		*	*	UG seminar
1305					*						*	Engineering analysis
2306							*					Tech communication
2410	*		*		*						*	Process principles
2421	*				*							Thermo I
3232		*		*		*	*		*			Transport lab
3315					*					*		Fluid mech
3322					*						*	Thermo II
3323	*	*										Reactor Design
3326	*				*							Heat transfer
3330						*						Materials
3341		*								*		Mass Transfer
4122												Review
4232		*		*		*	*		*			Unit op lab
4353	*		*								*	Process control
4356												Safety
4555			*	*							*	Design

Shaded box indicates that the outcome should be covered in the course.

* inidicates primary coverage

These represent minimum requirements.

Coverage of additional topics is at the descretion of the instructor.

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 multidisciplinary 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.

ABET

General information for our upcoming accreditation

ABET Terminology

- Program Educational Objectives: broad statements that describe what graduates are expected to attain within a few years of graduation. Program educational objectives are based on the needs of the program's constituencies.
- Student Outcomes: describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that students acquire in their progress through the program
- Assessment: one or more processes that identify, collect, and prepare data used to evaluate the attainment of student outcomes. Effective assessment uses relevant direct, indirect, quantitative, and qualitative measures as appropriate to the objective or outcome being measured. Appropriate sampling methods may be used as part of an assessment process.
- Evaluation: one or more processes for interpreting the data and evidence accumulated through assessment practices. Evaluation determines the extent to which student outcomes are being attained. Evaluation results in decisions and actions regarding program improvement.

What ABET is and what they do

- ABET is the Accreditation Board for Engineering and Technology
- They are responsible for accreditation of engineering and applied science programs. They accredit worldwide, but most of the programs are in the US
- They are an independent organization whose members are technical societies like AIChE, ASME, MRS, BSME, etc and who is governed by an elected board with input from an industrial advisory board
- ABET accredits individual programs, rather than colleges or universities
- Accreditation provides prestige and legitamancy and makes it easier for our graduates to be professionally licensed

How our evaluator will judge us: pre-site visit

- Review our self-study document
- Analyze our students transcripts. The evaluator will:
  - Make sure the courses counted toward the degree are consistent with the published requirements of the program.
  - Check to be sure prerequisites are taken before each course requiring them and the course sequence on the transcript does not vary unreasonably from the recommended sequence.
  - Ensure the number of transfer credits and the number of course substitutions are reasonable.

Accreditation

- Our last program review year was 2010. Programs that pass accreditation without concerns, weaknesses or deficiencies are reviewed every 7 years.
- 2016/2017 is our next evaluation cycle
- Programs that pass accreditation, but have a concern, weakness or deficiency or concern are evaluated more frequently
- The evaluation process consist of submitting a self-study report by next July then having a site-visit fall 2017. The content of the self-study report will be discussed later in this presentation

How our evaluator will judge us: at the visit

- Examine Assessment and Evaluation Materials: course syllabi, textbooks, example assignments and exams, and examples of student work, typically ranging from excellent through poor.
- Examine Course Materials. The evaluator will want to know that
  - The course is up-to-date and appropriate for the objectives of the program.
  - The course prerequisites are adequate.
  - The learning activities are appropriate for the course outcomes.
  - The graded work adequately assesses the course learning outcomes.
- Interview the Program Head

The self-study report: Criteria 4-Continuous Improvement

Processes for regularly assessing and evaluating the extent to which the student outcomes are being attained.

- Student Outcomes (shown below)
  - A listing and description of the assessment processes used to gather the data upon which the evaluation of each student outcome is based
  - The frequency with which these assessment processes are carried out
  - The expected level of attainment for each of the student outcomes
  - Summaries of the results of the evaluation process and an analysis illustrating the extent to which each of the student outcomes is being attained
  - How the results are documented and maintained
- Continuous Improvement
  - Describe how the results of evaluation processes for the student outcomes and any other available information have been systematically used as input in the continuous improvement of the program
  - Describe the results of any changes (whether or not effective) in those cases where re-assessment of the results has been completed
  - Indicate any significant future program improvement plans based upon recent evaluations
  - Provide a brief rationale for each of these planned changes

What we **don't** want

- **Findings of Concern**: A Concern indicates that a program currently satisfies a criterion, policy, or procedure. However, the potential exists for the situation to change such that the criterion, policy, or procedure may not be satisfied.

  Findings of Weakness: A Weakness indicates that a program lacks the strength of compliance with a criterion, policy, or procedure to ensure that the quality of the program will not be compromised. Therefore, remedial action is required to strengthen compliance with the criterion, policy, or procedure prior to the next review.
- **Findings of Deficiency**: A Deficiency indicates a criterion, policy, or procedure is not satisfied. Therefore, the program is not in compliance with the criterion, policy, or procedure.

The self-study report: Criteria 5-Curriculum

- The faculty must ensure that the program curriculum devotes adequate attention and time to each component, consistent with the outcomes and objectives of the program and institution.
- Students must be prepared for engineering practice through a curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints.

Common issues leading teams to cite shortcomings against Criterion 5.

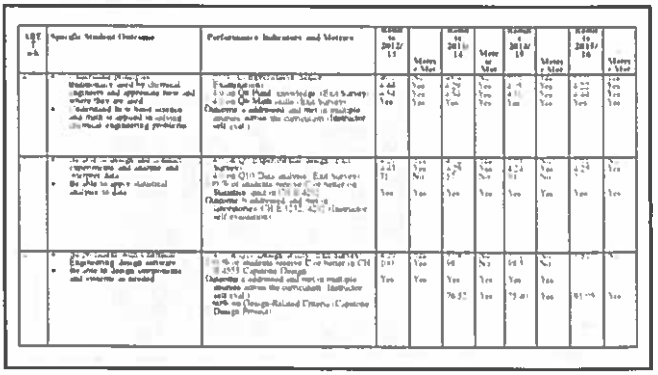
- The major design experience does not reflect enough design to be considered a major design experience or is primarily research (as opposed to design) in content
- The major design experience does not incorporate appropriate engineering standards and/or multiple realistic constraints
- The curriculum does not adequately support one or more of the student outcomes

How well are we addressing the criteria?

- Table 4.2
- Exit Interview Summary
- EAB Student Feedback

The self-study report: Program Criteria for Chemical Engineering programs

The curriculum must provide a thorough grounding in the basic sciences including chemistry, physics, and/or biology, with some content at an advanced level, as appropriate to the objectives of the program. The curriculum must include the engineering application of these basic sciences to the design, analysis, and control of chemical, physical, and/or biological processes, including the hazards associated with these processes.



Student Feedback: EAB

Undergraduate student feedback
- Overall perception that department does not care about them
  - Student perception that in-class evaluations are not addressed
    - Instructors can communicate that survey comments will be read and considered
  - Faculty not available to students
    - Need more contact with students, maybe outside of class
    - Can use TAs in discussions to foster more interaction with individual students
  - No contact with department chair
    - Conduct sophomore career info sessions
    - Meet with juniors and seniors in their classes for quick updates in department
    - Ask faculty and staff to notify her of student accomplishments they hear about, so she can acknowledge them with note of congratulations
- Tutoring
  - Students feel that department has made a good effort at providing tutoring
    - They suggest having more evenings of tutoring available
    - They suggest inviting good students to tutor

Instructor Self-evaluations are important

- Do your self-assessment properly
  - Each student learning outcome must have a separate, quantifiable assessment
  - Each student learning outcome should have multiple assessments
- Practice continuing improvement on your course
  - Use recommend changes to course to address weaknesses
  - Look at the self evaluation from the last time the course was taught before teaching it again
  - Incorporate the recommended changes from the previous offering
  - If the students meet all objectives, raise the bar

Student Feedback: EAB

Graduate student feedback
Overall they did not have many complaints
Appreciate the Best TA Award
Would like more mentoring in their writing of grants and papers
  Basic writing courses are available, but they need help with more advanced writing tasks
MS students are having difficulty finding jobs
  Job resources at the university are geared toward undergraduates
  Companies will sometimes interview MS students but do not offer more money
  Companies rarely interview international MS students
  Department needs to be up front with admitted MS students about the difficulty of finding employment with their degree
  MS in CHE is not very valuable in the job market – why do we offer the degree?
    Good MS students can feed into the PhD program
    Financial incentives

Instructor Recordkeeping

- For all student work (exams, quizzes, homework, projects, reports, rubrics, etc) that you use to assess your class:
  - A copy of the assignment
  - 2 copies each of excellent, average and poor work
  - Categorize by objective and by ABET a-k
- Copy of your Syllabus
- Copy of your textbook

Instructor Self-evaluations are important

- Used in assessment of Criteria 3 a-k and 4 continuing improvement
- Help us find weaknesses and help us find ways to overcome them
- They should not be treated as an Instructor exam
- It will help your Self-evaluation if you ensure when writing your syllabus that you cover the proper a-k and incorporate the proper tools
- It will help your Self-evaluation if , when writing your syllabus, you spend time thinking carefully about your Student Learning Objectives and your Assessments
  - There should not be too many student learning outcomes 3 or 4 is ideal
  - Do not try to cover all of a-k in your course, most courses should cover 2 or 3 well.
  - Keep assessments simple

Course Review

ChE 1121: Chemical Engineering Seminar

Catalogue Prerequisites: For Chemical Engineering majors only

Catalogue Listing

Readings and discussion of the chemical engineering profession; history, ethics, career paths, and research opportunities.

Recommended Changes to Course (from 2015)

1. Need better IT support

Modifications Made to Course

- New course

Expected Tools and Soft Skills:

Tool / Skill	Implementation in Course	Expected?
Statistics	none	No
Health and Safety	none	No
Matlab	none	No
Ethics	One class was devoted to ethics with the film 'Incident at Morales' and small group assignments on specific cases.	Yes
Aspen/Hysys	None	Yes
Visio	As described to reproduce a PDF. The goal is only familiarization with the software and typical symbols that will be encountered.	No

Actual Outcomes and Assessments

ABET a-k	Number of Assessments
a	1
g	1(?)
j	1(?)
k	1

Outcome	ABET a-k	Assessment Method and Metrics*
Describe what a chemical engineer does and the various career paths available.	g, j	Written assignment on chemical engineering careers and needs.
Ability to apply fundamental equations for chemical engineering including: mass balance, fluids, heat transfer and reaction engineering	a	Specific questions on the final exam on heat transfer, mass transfer, materials balance.
Understanding and ability to construct a process flow diagram.	k	A specific assignment in the course was to reproduce a PFD using Visio.

* Grade of 70 % or higher indicates outcome is met.

Discussion points:

- Each Outcome should have a separate assessment
- How to handle as a prerequisite for transfer students.
- One of the few courses that addresses j. A problem since it is an early-in-the curriculum class.
- Recommendations should focus on methods that the instructor can implement to improve number of students meeting outcomes

ChE 1305: Engineering Analysis I

Catalogue Prerequisites: ChE 1121 or departmental approval.

Catalogue Prerequisite or Corequisite: MATH 1451

Catalogue Listing

Synthesis and analysis of typical engineering problems emphasizing the use of computing tools, spreadsheet and compiler programming.

Recommended Changes to Course (from 2015)

1. I had not taught a freshman course in a long time. In retrospect, I see that I went over the heads of the students many times. Next term I will use simpler examples.
2. Instead of ordering a large, custom-built textbook, I will specify 3 individual softcover texts. This is to reduce the cost to students and eliminate the falling apart of the large custom text.
3. I will change the progression of topics to a more logical sequence. This is to address the poor performance of the students on the MathCAD part of the course.
4. Will have to adjust my teaching style to be less demanding and more supportive of the efforts by inexperienced millennials.

Modifications Made to Course

1. I used simpler examples and assignments than in Spring 2015 that were more appropriate for 2nd term freshmen.
2. I specified 3 individual texts, one each for the Excel, MathCAD, and MATLAB portions of the course instead of a large, custom-built text of poor binding quality.
3. The MATLAB portions of the text were taught from Jim Riggs' text *Programming with MATLAB for Engineers* instead of *Introduction to MATLAB* by Delores Etter.
4. I changed the progression of topics from *Handwritten-Excel-MATLAB-MathCAD-HYSYS* to the more logical sequence *Handwritten-Excel-MathCAD-MATLAB-HYSYS*. The latter sequence progresses in terms of steeper learning curves for the software. This was to address the poor performance of the students on the MathCAD part of the course.
5. I instituted a series of random, in-class pop quizzes to incentivize class attendance and discourage cheating.
6. I changed the weekly laboratory assignments from group assignments to individual assignments to allow for more precise outcomes assessment.
7. I assigned only one group project, a complicated MATLAB project. The project was set up using the CATME Peer Evaluation tool. The use of the tool was very successful. CATME significantly reduced to workload required to set up teams and conduct peer assessments. A very pleasant surprise was all the spontaneous comments by the students on how they liked their groups.

Expected Tools and Soft Skills:

Tool / Skill	Implementation in Course	Expected?
Statistics	Training in linear regression in Excel	Yes
Health and Safety	none	No
Matlab	Four weeks training in MATLAB with 4 individual projects. Assessed with an exam, 3 projects, 1 group project, and 2 pop quizzes specific to MATLAB use.	Yes
Ethics	Standard university requirements for ethical behavior were stated in the syllabus and reviewed in class.	no
Aspen	Students submitted an individual project in which they completed a tutorial in HYSYS. They then were required to answer 4 exam questions using their HYSYS file on Exam 4. One pop quiz also dealt with HYSYS.	Yes
Visio	none	No

Actual Outcomes and Assessments

ABET a-k	Number of Assessments
a	11
b	2
d	1
e	3
g	3
k	8

Outcome	ABET a-k	Assessment Method and Metrics*
Communicate engineering analyses in a professional format	g	Weekly individual project requiring submission of a handwritten engineering calculation Weekly individual project requiring submission of a typewritten engineering calculation Pop Quiz 1
Apply knowledge of analytical and numerical mathematics to solve problems involving - linear and nonlinear systems of equations -nseries - numerical differentiation and integration	a	Projects 3, 4, 6, 8, 9,10,12, 13 Pop Quiz 2, 5
Identify, formulate, and solve elementary engineering problems	e	4 multiple choice exams Pop Quiz 3 Project 5
Read and write programming flowcharts using the top-down programming paradigm	k	Project 7 Pop Quiz 4
Apply linear regression to data (Excel)	b	Exam 2 (Q10, 11, 12) Linear regression homework
Construct, debug, and execute a procedural computer program (MATLAB)	k	Pop Quiz 6 Project 11 Group Project
Teamwork and project planning skills, goal setting, dealing with project uncertainty, effective interpersonal communication skills	d	CATME
Set up a steady state simulation of a chemical process (HYSYS)	k	Project 14 Pop Quiz 7 Exam 2 (Q27, 28, 29, 30)

Comment:

- Self-valuations should include metrics for achieving outcomes
- Soft skill (ethics) should address professional practice. Standard lecture on academic misconduct is not sufficient

Ch E 2306: Exposition of Technical Information

Catalogue Prerequisites: 2.5 TTU GPA; C or better in ENGL 1302

Catalogue Prerequisite or Corequisite: None

Catalogue Listing Organization and presentation of experimental data, and research interpretation and conclusions. Computer-aided preparation of engineering reports. Fulfills Core Communication (Oral) requirement. (Writing Intensive)

Recommended Changes to Course (from 2014)

One-on-one mock interviews were conducted to tailor the interview to each student's specific interests and career goals instead of having a group interviews during the lab

Modifications Made to Course

The order of the lectures is changed to cover the job search related aspects (resume preparation, mock interviews and career search strategies) earlier in the semester to enable students to use the learning towards their internship search.

The final exam was eliminated and the points divided between the final project and final presentation.

Expected Tools and Soft Skills:

Tool / Skill	Implementation in Course	Expected?
Statistics	No	No
Health and Safety	Moderate – discussed while discussing the ethics video	No
Matlab	No	No
Ethics	Yes	Yes
Aspen	None	No
Visio	Yes – used for the engineering drawing component of the class	Yes

Actual Outcomes and Assessments

ABET a-k	Number of Assessments
d	1
f	2
g	3
j	3

Outcome	ABET A-K	Performance Indicators
Ability to function in a team to plan, manage and organize the work	d	Project management presentations of the final project (>70%)
An understanding of the ethical issues involved in writing and presenting information and performing as an engineer in the industry	f	1. Absence of plagiarism in writing assignments and oral presentations 2. Lab 8 (>70%)
Ability to communicate effectively in written form	g	Final Project Report (> 70%)
An ability to generate clear and effective oral presentations, to gauge an audience, and to appropriately select a presentation method and style based on the audience.	g	1. Final Project presentation (>70%) 2. Labs 2,3 and 4 (>70%)
Knowledge of some of the contemporary issues and problems faced by engineers	j	1. Participation points for in-class discussion of "The anatomy of a disaster" video (>50%) 2. In-class discussion on teaming and leadership (>50%) 3. Mock Interview (>70%)

ChE 2410: Introduction to Chemical Process

Catalogue Prerequisites: CHEM 1305, 1307, ENGL 1301, MATH 1451, and ChE 1121

Catalogue Prerequisite or Corequisite: PHYS 1408

Catalogue Listing

Units and conversions, process variables, material and energy balances, process flow sheet analysis, phase equilibrium, elementary transient balances.

Recommended Changes to Course (from 2015)

1. New textbook
2. Work some problems in brief. Some students complain about too much detail for some problems.
3. Grade MATLAB HW more rigorously and use as performance indicator.
4. Have HYSYS available for student installation early in semester.
5. Increase focus on physical behavior (phase and equilibrium.

Expected Tools and Soft Skills:

Tool / Skill	Implementation in Course	Expected?
Statistics	none	No
Health and Safety	Several parts lecture that covered hazards	Yes
Matlab	Numerous homework problems	Yes
Ethics	none	No
Simulator	Extensive use with numerous problems and a major design project involving multi-unit multicomponent liquid and gas flow. This was an actual industrial problem.	Yes
Visio	none	Yes

Actual Outcomes and Assessments

ABET a-k	Number of Assessments
a	2
e	3
k	1

Outcome	ABET a-k	Assessment Method and Metrics*
Analyze and perform steady-state mass balances on single and multi-unit chemical processes, both with and without chemical reactions	a e	Assessed by questions on mid-semester exams and questions on the final exam. Questions from the exams addressed a and e. Nine quizzes were also given that addressed these. Objective "a" was assessed by 2 quizzes and 6 exam problems administered on exams 1, 3, and the final. Objective "e" was assessed by 2 quizzes and 10 exam problems.
Be able to estimate or compute the thermodynamic property behavior of pure and multi-component systems using simple models.	e	Assessed by 9 problems on exam 1 and the final and 2 quiz problems.
Analyze and perform steady-state energy balances on single and multi-unit chemical processes, both with and without chemical reactions	a e	Objective "a" was assessed by 5 exam problems and 1 quiz. Objective "e" was assessed by 2 quizzes and 8 exam problems.
Perform mass and energy balance calculations using process simulator software (HYSYS)	k	Small-group design project: Determine process requirements for a system to dehydrate, compress and burn a multicomponent gas mixture. The system required multiple units, recycle and combustion equipment. Assessment was based on demonstrating an understanding design trade-off proper equipment and physical properties. Students turned in a design report, consisting of a project summary, material and energy balance sheets and their HYSYS program. Group member received the group grade.

Students scoring 50% or more were considered to have achieved the outcome.

Comment:

- Perhaps should not have multiple outcomes per assessment.
- Assessment strategy with individually graded exam questions was difficult and time consuming

ChE 2421: Chemical Engineering Thermodynamics I

Catalogue Prerequisites: ChE 2410

Catalogue Prerequisite or Corequisite: MATH 2450

Catalogue Listing

Properties of pure substances, ideal gas behavior, heat effects in industrial reactions, first and second law analyses, energy conversion and power cycles.

Recommended Changes to Course (from 2015)

None

Modifications Made to Course

- This instructor taught this course for the first time. The pedagogy remained nearly the same as that taught by the previous instructor and other section instructor.
- In discussion section (Friday), this instructor asked 2 TA's to lead the discussion with Instructor alternatively, which focused on the homework problems, questions from students, and additionally assigned problems.

Expected Tools and Soft Skills:

Tool / Skill	Implementation in Course	Expected?
Statistics	None	No
Health and Safety	None	No
Matlab	Optional use in HW practice problems	Yes
Ethics	None	No
HYSYS	None	Yes
Visio	None	No

Actual Outcomes and Assessments

ABET a-k	Number of Assessments
a	2
e	1
k	1

Outcome	ABET a-k	Performance Indicators
Ability to apply the first and second laws to open and closed processes involving ideal gases	a	Exam 1.
Ability to calculate the properties of a non-ideal gas using equations of state and generalized correlations	a	Exam 2
Ability to use the steam tables and thermodynamic charts to solve problems	k	Quizzes 3 and 4
Ability to analyze energy conversion, refrigeration, and power cycles	e	Exam 3

Students achieving 60% on assessment were considered to have met the outcome

Comments:

- Optional use of tool is insufficient. The requirement can be avoided by any students.

ChE 3232: Chemical Engineering Transport Laboratory

Catalogue Prerequisites: ChE 2306, ChE 3315, and ChE 3326

Catalogue Prerequisite or Corequisite: ChE 3341

Catalogue Listing

Experiments in mass, momentum, and heat transport; statistical analysis of data. (Writing Intensive)

Recommended Changes to Course (from 2015)

1. Students do not demonstrate much experience with technical writing. Although resources and examples of technical writing are provided as reference for students to look, only a few students read it. In the future, examples of technical report or literature paper will be provided and discussed in class.
2. After moving to a new lab space, either double-pipe or shell-tube heat exchanger experiment will be set up and implemented in this course.
3. Although classroom was reserved and TA was present to help students on group report during discussion session, very few groups use the time efficiently. In the future, students will have the freedom to set up their own group meeting time and indicate group members' attendance on peer review. TA will help answer questions during office hours.

Modifications Made to Course

- Three instructors co-taught this course to manage the large number of enrolled students.
- CHE 3232 Safety Manual was updated.
- An online peer and self-evaluation system - CATME (Comprehensive Assessment of Team-Member Effectiveness) was implemented in this course to develop team work skills and assess students' performance.
- Diffusion experiment was moved from CHE 4232 Unit Ops Lab to this course. The diffusion experiment was re-designed to be more intellectually stimulating, and several problems with the apparatus were addressed to ensure that the experiment provides the correct values for diffusion coefficients.

Expected Tools and Soft Skills:

Tool / Skill	Implementation in Course	Expected?
Statistics	One lecture on statistics was given. Students were expected to perform statistical analysis in the lab report, such as average, standard deviation, error propagation and uncertainty analysis. Statistics were tested in the final exam.	Yes
Health and Safety	Students were required to pass both the EH&S on-line lab safety and Chemical Hygiene Plan (CHP) test and in-class safety test (a minimum 80% to pass). Safe practice was reinforced during lab session. Proper attire and following experiment procedure was mandatory.	Yes
Matlab	MATLAB and/or Excel solver was used to extrapolate data.	Yes
Ethics	none	No
Aspen	none	No
Visio	Visio diagram is required in 2 lab reports except for free and force convection.	Yes

Actual Outcomes and Assessments

ABET a-k	Number of Assessments
a	3
b	2
d	2
e	2
f	3
g	2
i	3
k	3

Outcome	ABET a-k	Assessment Method and Metrics*
Apply the theoretical principles of fluid mechanics, heat transfer, and mass transfer to solve laboratory scale questions.	a	Final exams covering 4 lab experiments were used to evaluate students' individual level of knowledge and ability of solving lab-related problems.
Ability to perform experiments, analyze and interpret data.	b	Experimental section was required to describe how the experiment was conducted. Sections of data analysis and discussion were used to evaluate students' ability to analyze and interpret data.
Be able to work in groups to collect experiment data and prepare lab reports.	d	Peer review is required from each student on every experiment. Individual report was required to assist assessing individual's performance and contributions.
Ability to apply both critical thinking and engineering knowledge to solve problems in practical situation.	e	Discussion/conclusion section of the report. Analysis of engineering diagram/plot to solve practical problems and find possible solutions.
Understand and apply Health Environment and Safety principles in this course.	f	2 safety exams: (a) On-line exam administered by TTU Environment Health and Safety. Safety certificates are collected and placed in the Unit Operations lab. (b) In-class safety exam. One retake was allowed. Minimum 80% was required to pass. Students have to pass both exams to continue this course.
Be able to clearly communicate in writing with clarity and fluency.	g	Lab reports were required to assess students' writing skills.
Effectively use Internet and library resources to assist writing lab report.	i	Part of the lab report questions required students to answer questions through self-learning process. All the lab reports and presentations were required to provide reference sources. Format of references followed *American Chemical Society style guide.*
Ability to use MATLAB, Excel to extrapolate data and perform statistics analysis.	k	¾ experiments required students to use MATLAB/Excel to extrapolate data. ¾ experiments required students to take minimum 3 measurements at each condition and use Excel to perform statistical analysis.

Comments:

- Need guidelines for what scores on the performance indicators indicate fulfilling the Outcome
- Covers more outcomes than needed. Should change outcomes that address a, e and k to b since these assessments are focused on analyzing data.

ChE 3315: Fluid Mechanics

Catalogue Prerequisites: ChE 2410

Catalogue Prerequisite or Corequisite: MATH 3350

Catalogue Listing

Principles of momentum transport. Application to laminar and turbulent flow, metering, porous media, and settling.

Recommended Changes to Course (from 2015)

1. Discussion section formats will be changed for the next year to go over more instructor-led and TA-led problem solving.
2. With regards to material covered, there was still probably too much material toward the final weeks which was too difficult for the majority of students.
3. Most students found the new section on pumps useful, therefore it is proposed to expand this section again and place more emphasis on integrating this material with pipe flows, as it will be useful for Transport Lab in their Fall semester.

Modifications Made to Course

1. The assessment was modified from the previous semester to allow for more heavy weighting on mid-term exams, whilst the final exam was kept at 40% of the overall grade.
2. The second group project was also removed. More material on turbomachinery and pumps was added, as well as flow in packed beds, whilst materials on non-Newtonian pipe flows was removed.
3. Discussion sessions were instructor-led based on feedback from previous years.

Expected Tools and Soft Skills:

Tool / Skill	Implementation in Course	Expected?
Statistics	none	No
Health and Safety	none	No
Matlab	Moderate – used in the group project	Yes
Ethics	none	No
Aspen	None	No
Visio	none	No

Actual Outcomes and Assessments

ABET a-k	Number of Assessments
a	?
e	1
j	1
k	1

Outcome	ABET A-K	Performance Indicators
Ability to apply mathematical and physical principles to solve problems in fluid mechanics	a	Overall course
Ability to identify, formulate and solve engineering problems	e	Mid-term exams
Knowledge of contemporary issues in fluid dynamics	j	Weekly challenge assignments
Use of technical programming software to solve pipe network flow problems	k	Solved problems

Comments:

- Course grade shouldn't used as performance indicator
- Aspen/Hysys should be required

ChE 3322: Chemical Engineering Thermodynamics II

Catalogue Prerequisites: ChE 2421, CHEM 3305

Catalogue Listing

Solution thermodynamics, phase and chemical equilibria, analysis of processes.

Recommended Changes to Course (from 2015)

Give a project on the topic of reaction equilibria

Modifications Made to Course

Increased the emphasis on solving numerical problems on the topic of multicomponent vapor-liquid equilibria.

Expected Tools and Soft Skills:

Tool / Skill	Implementation in Course	Expected?
Statistics	none	No
Health and Safety	none	No
Matlab	Both projects required the use of MATLAB	Yes
Ethics	none	No
Aspen	Both projects required the use of Aspen HYSYS or Aspen Plus	Yes
Visio	none	No

Actual Outcomes and Assessments

ABET a-k	Number of Assessments
a	3 (?)
e	3 (?)
k	1

Outcome	ABET a-k	Assessment Method and Metrics*
An ability to describe and predict thermodynamic properties of liquids and gasses	a, e	Midterm Exam I.
An ability to use MATLAB and process design software for predicting the phase behavior of multicomponent mixtures	k	Projects 1 and 2
An ability to predict the phase behavior of multicomponent mixtures	a, e	Midterms 1-3
An ability to describe reaction equilibria	a, e	Question 14 of final exam.

Comments:

- Prerequisites, is chem 3305 (organic chemistry) needed? Is correquisite adequate (helps transfers) Should Math 3350 be a prerequisite?
- Each outcome must have an independent assessment.
- Whether an outcome is met should be based on all students passing the course

ChE 3323: Chemical Reaction Engineering

Catalogue Prerequisites: ChE 3322 and ChE 3326

Catalogue Listing

An introduction to the kinetics of chemical conversion processes and the design of chemical reactors.

Recommended Changes to Course (from 2015)

None

Modifications Made to Course

1. Course had one instructor and 3 TAs (one led discussion sessions, two were graders).
2. Fogler was adopted.
3. Grades were based on 12 computer-intensive homework sets, 2 midterm exams and 1 comprehensive final exam.

Expected Tools and Soft Skills:

Tool / Skill	Implementation in Course	Expected?
Statistics	none	No
Health and Safety	none	No
Matlab	Extensive – All homework problems	Yes
Ethics		No
Aspen	none	No
Visio	none	No

Actual Outcomes and Assessments

ABET a-k	Number of Assessments
a	1
b	1
c	1
e	1

Outcome	ABET a-k	Assessment Method and Metrics*
Ability to apply math and engineering skills to solve reactor design problems	a	Exam 1
Ability to analyze and interpret kinetic rate data	b	Exam 2
Ability to design batch and flow reactors	c	Final exam
Ability to solve reactor design engineering problems	e	Homework 1-12

* Grade of 70 % or higher indicates outcome is met.

Comments:

- Should require Aspen/Hyssys
- Ethics and class behavior: to fulfill ABET Ethics should be assessed and extend beyond discussion of class behavior.

ChE 3326: Heat Transfer

Catalogue Prerequisites: ChE 2421 and MATH 3350

Catalogue Listing

Principles of energy transport. Application to heat conduction, convection, and radiation. Design and performance of heat exchangers and furnaces.

Recommended Changes to Course (from 2015)

Dedicate less time to 'heat conduction', and instead focus more on heat exchanger design. This can be done by following the text-book less rigorously in chapters 1-5 (i.e. by skipping some less important topics).

Modifications Made to Course

None

Expected Tools and Soft Skills:

Tool / Skill	Implementation in Course	Expected?
Statistics	none	No
Health and Safety	none	No
Matlab	Yes	Yes
Ethics	none	No
Aspen	none	No
Visio	none	No

Actual Outcomes and Assessments

ABET a-k	Number of Assessments
a	1
e	3
k	3

Outcome	ABET a-k	Assessment Method and Metrics*
Ability to apply knowledge of math, engineering and science	a	Exam 1 Exam 2
Ability to identify, formulate, and solve engineering problems	e	Final Exam
Ability to use techniques, skills, and tools in engineering practice	k	Score on MATLAB project

Students scoring higher than 50% on an assessment were considered to have met the outcome

Comments:

- Should require Aspen/Hysys use

ChE 3330: Engineering Materials Science

Catalogue Prerequisites: ChE 2421, CHEM 1308, and MATH 1452

Catalogue Listing

Engineering properties of metals, ceramics, and polymers; molecular, crystal, and microstructure configurations; selection of materials for applications.

Recommended Changes to Course (from 2015)

1. Homework count as "0 point" (if submitted) or "-2 points" (if not submitted). Some students suggested adding "+2 points" for submitted and good performance.
2. If positive points on homework added, final exam can reduce to 40%.
3. In-class discussion on materials and ethics can be further included. Can be 5 points count to this part and decrease points for quizzes to 5 points.

Modifications Made to Course

The syllabus for this course in Spring 2016 is prepared based on the syllabus from the same instructor in Spring 2015. List of questions for each chapter were provided for students to better understanding course materials and preparing exams. The homework problems and exams changed. Three pop-up quizzes were added and achieve good attendance. 1-page report on "materials selection" used as quiz 4. Presentation on "materials selection" was added. Student cannot pass the course if scoring less than 50% in the final exam.

Expected Tools and Soft Skills:

Tool / Skill	Implementation in Course	Expected?
Statistics	none	No
Health and Safety	none	No
Matlab	Students use MATLAB (or Excel) on selected HW.	Yes
Ethics	none	No
Aspen	none	No
Visio	none	No

Actual Outcomes and Assessments

ABET a-k	Number of Assessments
a	2
g	1

Outcome	ABET a-k	Performance Indicators
The course is designed to give undergraduate student a fundamental grasp of the molecular, physical and engineering properties of materials in general. The course emphasizes commonalities among the different material classes, viz., metals, ceramics and polymers. Composite materials are also expected to be understood as a mixture of, e.g., polymer and ceramic fiber. Material degradation including corrosion, fatigue and fracture should be understood.	a	Homeworks that covered each major topics Two mid-term exams and one final exam Four Quizzes
Be able to apply knowledge of math, engineering and science in materials related problems	a	Exams and quizzes included problems requiring knowledge of engineering math and the ability to apply it to specific material-related problems. Students needed to pass the final exam with 50% score
Develop skills to aid in ability to communicate effectively	g	Case study on unique materials (such as artificial bones, medical implants).

Comments:

- Is the chemistry elective sufficient?
- Is Matlab use assessed? Optional usage without assessment does not fulfil Mathematical Tool use expectations.
- Each outcome must have independent assessments
- Can this course be used for h, i, j (impact of engineering, lifelong learning, contemporary issues) rather than/in addition to g?

ChE 3341: Mass Transfer Operations

Catalogue Prerequisites: CHE 3322- Chemical Engineering Thermodynamics II

Catalogue Prerequisite or Corequisite:

Catalogue Listing
Theory and practice of mass transfer. Particular emphasis on the operations of distillation, absorption, and extraction.

Recommended Changes to Course:

1) Incorporate a Hysys project as part of the graded assignments.
2) Decrease the weight of Mock Exam and Quiz grades from 25% to 15% of the overall average grade.
3) Organize more seminars from engineers that work in industry to share their experience with the students, to improve Outcome 1.
4) To improve Outcome 2, include more homework and class problems.

Modifications Made to Course

- The textbook was changed from Benitez (2009) to Wankat (2007).
- More short quizzes and mock exams were incorporated in the course. The number of midterm exams was reduced from two (last year) to one (this year).
- A Matlab project was assigned as part of the course work.
- Homework assignments similar in nature to last year's were assigned however they were not graded and solutions were posted for students to evaluate themselves.
- The students were assessed based on their performance in exams, quizzes and a project. The midterm exam grade contributed to 25 % of the overall average; the quizzes and mock exam contributed 25%,the Matlab project counted 5% and the Final Exam, which was comprehensive, counted as 45% of the overall average grade.
- The exams consisted of sets of long problems, similar to the ones done in class and in homework assignments. All exams contained one part, which consisted of short concept questions where students would have to employ their writing skills to explain their understanding of concepts.

Expected Tools and Soft Skills

Tool / Skill	Implementation in Course	Expected?
Statistics	None	No
Health and Safety	None	No
Matlab	Project	Yes
Ethics	None	No
HYSYS	None	Yes
Visio	None	No

ChE 3341

Actual Outcomes and Assessments

ABET a-k	Number of Assessments
a,e	4
c	1
h, j	3

Expected Outcomes and Assessment:

Outcome	ABET a-k	Performance Indicators*	Assessment Results (only passing students)	Outcome Met
Appreciate the role of mass transfer and separation processes in chemical engineering.	h, j	Quiz 1 Quiz 4 Extra Credit Assignment	Quiz 1 Quiz 4 Extra Credit	Yes, to a large extent
Describe mathematically and verbally the transport phenomena of molecular diffusion and convective mass transfer.	a, e	Midterm Exam Quiz 2 Quiz 3 Quiz 5	Midterm Exam Quiz 2 Quiz 3 Quiz 5	Yes, to a large extent
Analyze and design the following unit operations: Absorption and Stripping; Distillation; Extraction	c	Final Exam	Final Exam	Yes

**Outcome met by a score ≥ 65%*

Comments:

- There should be separate assessments for each outcome
- Outcomes h, j? Were they assessed independently
- Extra credit assignment should not be used for to assess an outcome, since all students who pass the course may not attempt it? It should just replace the appropriate required assessment?

ChE 4121: Chemical Engineering Review

Catalogue Prerequisites: IE 2324, senior standing in chemical engineering

Catalogue Listing
Preparation for the chemical engineering portion of the FE exam and the chemical engineering and the chemical engineering capstone design project.

Recommended Changes to Course (from 2015)
First time the course was taught

Modifications Made to Course
None

Expected Tools and Soft Skills:

Tool / Skill	Implementation in Course	Expected?
Statistics	none	No
Health and Safety	none	No
Matlab	none	No
Ethics	none	No
Aspen	none	No
Visio	none	No

Actual Outcomes and Assessments

ABET a-k	Number of Assessments
a	2
e	3

Outcome	ABET a-k	Assessment Method and Metrics
Ability to pass the Chemical Engineering FE exam	e	Comprehensive exam of similar structure and content
Ability to identify chemical engineering problems and apply knowledge learnt in previous courses to solve them	a	Quizzes and homework.

Students who score 50% or greater are considered to have achieved the outcome.

Comments:

- Since there are sections on engineering ethics, and statistics on the FE exam, do we want to extend our coverage of this course to these topics.
- Next year should include Aspen/Hysys

ChE 4232: Unit Operations Laboratory

Catalogue Prerequisites: ChE 3232 and senior standing in chemical engineering

Catalogue Listing

Laboratory experiments illustrating the basic principles of unit operations. Includes instruction on experimental methods, equipment scale up, and technical communication. (Writing Intensive)

Recommended Changes to Course (from 2015)

1. A new gas absorber was purchased to replace the broken one in the lab. Thus, gas absorber experiment will be added back to this course.
2. A brand new fluidized beds equipment will be added to this course. Right now, ion exchange resin bed was used to observe fluidized bed and the results were not accurate. The new instrument will improve that.

Modifications Made to Course

- Microscope was implemented in the bioreactor experiment for students to observe cell morphology.
- The pump of ion-exchange experiment was broken and in the process of repair.

Expected Tools and Soft Skills:

Tool / Skill	Implementation in Course	Expected?
Statistics	One lecture on statistics and in-class statistics quiz was given. Students were expected to perform statistical analysis in all the lab reports except for cooling tower.	Yes
Health and Safety	Students are required to pass both the EH&S on-line lab safety test and in-class safety test (a minimum 80% to pass). Safe practiced is reinforced during lab session. Proper attire and following experiment procedure is mandatory.	Yes
Matlab	MATLAB and/or Excel was used to extrapolate data.	Yes
Ethics	none	No
Aspen	none	No
Visio	Visio diagram is required in 4 lab reports except for diffusion lab.	Yes

Actual Outcomes and Assessments

ABET a-k	Number of Assessments
a	2
b	2
d	3
e	3
f	3
g	2
i	3
k	3

Outcome	ABET Objective	Assessment Method and Metrics
Apply the theoretical principles of separation, mass transfer and heat transfer to solve laboratory scale questions.	a	Double quiz covering four lab experiments were used to evaluate students' individual level of knowledge and ability of solving lab-related problems.
Ability to perform experiments, write reports to analyze and interpret data.	b	Data analysis and sample calculation of lab reports were used to evaluate students' ability to analyze data. Discussion part of lab reports was used to evaluate students' ability to interpret data/results.
Be able to work in groups to collect experimental data and prepare lab reports.	d	Peer review is required from each student on every experiment. Individual interview with student was employed to assist assessing individual's performance and contributions.
Ability to apply critical thinking and engineering knowledge to solve problems in practical situation.	e	Summary/discussion section of the report. Instructor and TA's observation through lab session.
Understand and apply Health Environment and Safety principles in this course.	f	Two safety exams: (a) On-line exam administered by TTU Environment Health and Safety. Safety certificates are collected and placed in the Unit Operations lab. (b) In-class safety exam. One retake was allowed. Minimum 80% was required to pass. Students have to pass both exams to continue this course.
Be able to clearly communicate ideas with clarity.	g	Four lab reports were required to evaluate student's written communication skills.
Effectively use internet and library resources to assist writing lab report.	i	All the lab reports were required to provide reference sources. Two references were required for the introduction paragraph. Format of references followed *American Chemical Society style guide*.
Ability to use Matlab/Excel to extrapolate data and perform data analysis and the ability of statistical analysis.	k	One statistics quiz was given to evaluate students' individual ability of statistics analysis. Matlab/Excel was required to analyze data. Statistics analysis in lab report was evaluated. Two questions related to statistics analysis were assessed in double quiz.

Comments:

- Need guidelines for what scores on the performance indicators indicate fulfilling the Outcome
- Covers more outcomes than needed. Should change outcomes that address a, e and k to b since these assessments are focused on analyzing data.

ChE 4353: Process Control

Catalogue Prerequisites: ChE 3315, ChE 3341, ChE 3323; MATH 3350 or MATH 3354

Catalogue Listing

Study of the principles of process dynamics and control and their applications to feedback control.

Recommended Changes to Course (from 2015)

1. Outcome 1 (Describe the context and importance of process control in chemical engineering) was not achieved. In reviewing the course, I found that I did not have a performance metric for it. This will be corrected the next time I teach the course.
2. Outcome 2 (Troubleshoot P, PI, and PID control schemes for chemical processes) was not achieved. I ran out of time during the semester. This will be corrected the next time I teach the course through greater lecturing efficiency.
3. There was a disconnect between the homework problems and the exam problems. This arose because I changed the textbook to that published by former TTU faculty Jim Riggs and Naz Karim. From student comments, it appears this was a source of confusion for the students. This problem should disappear next term as the course examples have now been harmonized with the text.
4. Students comments indicated that they learned more from projects than from multiple choice tests. This comment also appeared after the fall 2013 semester. Perhaps it would be good to make more of the course project-oriented next term.

Modifications Made to Course

Approximately half the class was earning below a C after 2 exams. In response, I conducted a mid course survey for the purpose of formative assessment (survey attached). In response to the mid-course survey, I modified the balance of the course in the following ways.

1) The students said the pace was too fast. In response, I eliminated some controller troubleshooting and dynamic HYSYS simulation from the course.

2) I reduced the number of questions on the exams.

3) Lectured during discussion periods rather than have a TA cover homework problems.

Expected Tools and Soft Skills:

Tool / Skill	Implementation in Course	Expected?
Statistics	none	No
Health and Safety	none	No
Matlab	Extensive use of the Simulink part of MATLAB. Four assignments were given.	Yes
Ethics	none	No
Aspen	None. Deleted from course because students said material was being covered too fast.	No
Visio	**None**	**No**

Actual Outcomes and Assessments

ABET a-k	Number of Assessments
a	3
b	1
c	3
e	3
f	1
k	3

Outcome	ABET A-K	Performance Indicators
Label schematics and explain the operating principles of control system hardware	k	multiple choice exams quizzes
Qualitatively and quantitatively predict the dynamic behavior of ideal chemical processes in the time and Laplace domains	a	multiple choice exams quizzes
Analyze (P), proportional-integral (PI), and proportional-integral-derivative (PID) control schemes for chemical processes.	e	multiple choice exams quizzes
Troubleshoot and design proportional (P), proportional-integral (PI), and proportional-integral-derivative (PID) control schemes for chemical processes.	c	multiple choice exams quizzes

ChE 4555: Chemical Process Design and Simulation

Catalogue Prerequisites: Senior standing in Chemical Engineering

Catalogue Listing

Design of chemical processes and equipment using computer simulation, flow sheeting, optimization, and process synthesis techniques (Writing Intensive)

Recommended Changes to Course (from 2015)

1. Spend much more time on technical design of major components: heat exchangers, separation columns, reactors
2. Combine first two preliminary projects
3. Assess equipment optimization with homework or exam question.
4. Should provide Outcome and objective for working in groups
5. The objective concerning design heuristics is poorly stated and difficult to assess. It should be omitted, as it is just a component of the overall general design process.

Modifications Made to Course

1. Much more time on technical design of major components: heat exchangers, separation columns, reactors.
2. The first two preliminary projects were combined with an emphasis on process optimization and improvement.
3. Group scores were assessed by CATME project. Groups that appeared to have serious group conflicts were reassigned after the first project.
4. Design heuristics objective from last semester was merged with the overall general design process.

Expected Tools and Soft Skills:

Tool / Skill	Implementation in Course	Expected?
Statistics	none	No
Health and Safety	Required assignment for HAZOP analysis. major requirement for each student to complete a safety analysis of some unit of final designed project.	Yes
Matlab	Matlab was optional and used by some groups on calculations that were difficult or unmanageable in Aspen. Generally not used	Yes
Ethics	None (forgot)	Yes
Aspen	Usage was required in projects	Yes
Visio	Vision or similar CAD software was required for the flowcharts of the capstone and projects	Yes

Actual Outcomes and Assessment

ABET a-k	Number of Assessments
c	1
d	2
f	2
g	2
k	5

Outcome	ABET a-k	Assessment Method and Metrics*
Efficiently design equipment and processes by hand and by simulation	c	Individual homework assignments
Estimate equipment, capital, and operating costs of chemical processes	k	Exam (individual) Intermediate Design Report - Economic evaluation Sections graded separately using rubric. (group) Capstone Design Report - Economic evaluation Sections graded separately using rubric. (group)
Optimize equipment and processes	k	Intermediate Design Report – Optimization section Capstone Design Report – Optimization section
Conduct risk assessment of chemical processes and use good practice in incorporating safety into facility design	f	Individual AIChE SACHE Certificate for HAZOP analysis. Individual safety analysis for the Capstone Design Project (individual)
Design a chemical process that is in compliance with Federal and state environmental regulations	c	Capstone Design Report - group
Work effectively in multidisciplinary groups	d	Group interactions/work divisions assessed by the instructor in required weekly group meetings CATME self-assessment of group members
Communicate technical information effectively	g	Poster presentation (group) Capstone Design Project oral presentation (group)

* Grade of 70 % or higher indicates outcome is met.

Comments: Should have covered h and/or j.

Ch E 5310: Advanced Chemical Engineering Techniques
Instructor Evaluation of Graduate Courses for Fall 2015

Instructor Siva A. Vanapalli

Time/Place 8:00 – 9:50 am, ChE 101

Catalogue Listing Application of ordinary and partial differential equations for solution of mass, momentum, and/or energy transfer and transport problems. Primary emphasis is on mathematical analysis of unsteady state systems and chemical-reaction systems: models, solutions and model validation.

Grade Distribution

A	B	C	D	F	Total
11	12	6	0	0	29

Modifications Made to Course: Included lectures on laplace transforms, singular perturbation analysis and matched asymptotic expansions.

Expected Outcomes and Assessment

Outcome	Performance Indicators	Assessment Results	Outcome Met?
1. An ability to formulate mathematical models from the description of a physical problem	The metric used was a score of 50% or above in Final exam	In Final Exam, 29/29 scored 50% or higher.	Yes
2. An ability to solve commonly occurring differential equations in chemical engineering problems	The metric used was a score of 50% or above in Midterm 2	In Midterm 2, 25/29 scored 50% or higher.	Yes
3. An ability to use techniques of linear algebra	The metric used was a score of 50% or above in Homework 1	In homework 1, 29/29 scored 50% or higher.	Yes
4. An ability to use MATLAB software for solving mathematical problems	The metric used was a score of 75% or higher in Homework 5	In homework 5, 29/29 scored 50% or higher.	Yes

Recommended Changes to Course: None.
Syllabus and Course Schedule Attached.

ChE 5310 – Advanced Chemical Engineering Techniques, Fall 2015
101 ChE Bldg
8:00 – 9:50 MW
Tentative Syllabus

Instructor: Siva A. Vanapalli, Associate Professor, Chemical Engineering
(siva.vanapalli@ttu.edu, 834-1757, 201 ChE Bldg)
TA: Siddhartha Gupta, ChE 107, Office hours: Tuesday 5 – 7 pm

Office Hours: Tuesday 10:00 – 12:00 pm.

Texts: Selected material from the following books will be used for lectures.

Graham M. D. and Rawlings, J.B., *Modeling and Analysis Principles for Chemical and Biological Engineers*, (2013).
Deen, W. M. *Analysis of Transport Phenomena*, 2nd Ed. (2011)
Varma A. and Morbidelli, M., *Mathematical Methods in Chemical Engineering*, (1997).
Kreyszig, E., *Advanced Engineering Mathematics*, 10th Ed. (2011).

Prerequisites: Differential and integral calculus; Basic linear algebra; Transport phenomena in chemical engineering

Organization: Twice weekly lectures; approximately 6-8 homeworks
Midterm I: Monday, Oct 5
Midterm II: Wednesday, Nov 11
Final Exam: Wednesday, 7:30-10:00 am, Dec 9

Holidays: Mon Sept 7; Wed Nov 25
Last class day, Wed, Dec 2

Topics to be covered - The organization is tentative.

1. Vectors and Tensors
2. Constitutive and conservation equations of transport
3. Ordinary differential equations
4. Stability analysis
5. Partial differential equations
6. Linear algebra

Expected outcomes and assessment:
1. An ability to formulate mathematical models from the description of a physical problem
2. An ability to solve commonly occurring differential equations in chemical engineering problems
3. An ability to use techniques of linear algebra
4. An ability to use MATLAB software for solving mathematical problems

Each outcome will be separately assessed using grades on homeworks, project, and exams. Expected minimum grades to meet outcomes: Outcomes 1-3 will be assessed based on a score of 50% or more on the relevant exam(s); Outcome 4 will be assed based on a score of 75% or more on homework problems involving MATLAB.

Grading: Homeworks (10%), Midterm I (35%), Midterm II (35%) and Final Exam (20%). Grading scale: A (>85), B (70-85), C (55-69), D (40-54), F (<40).

Homeworks: Homework is important and will be given approximately bimonthly and will be expected to be completed by the following week and turned in just before the class begins. Students who do not submit homeworks or submit late will receive zero points.

For the student's professional development, I suggest that homework sets be written up semi-formally: restate the problem and discuss the solution as you progress. Use plain white or engineering paper, write on one side only, and practice being professional. Start with a sketch and label the source for all information. The goal should be to present the homework problem to a person who is not familiar with the problem and has not read the problem set, but is (at least) as technically competent as you are. A grader should not have to refer to a book to grade a properly prepared homework set.

Exams: Exams will be either closed or open book and in class.

Class rescheduling: Scheduled classes may be cancelled due to instructor travel to scientific meetings and conferences. These classes will be rescheduled.

Classroom policy: The attendance is compulsory. The doors to the classroom close at 8:05 am. If you are late, please do not enter the classroom. If you are absent for three or more classes, you will lose 5% of the total score in the course. Your absence will be regarded official, if you provide a doctor's note or an e-mail note to me from your advisor.

Following activities are not allowed in the classroom: laptop usage, texting or talking on the cellphone, and reading a newspaper.

Policy on student disability: Any student, who because of disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor's office hours. For additional information, please contact Student Disability Services in West Hall or call 806-742-2405.

Ethical conduct: Engineers must possess personal integrity both as students and as professionals. They must be honorable people to ensure safety, health, fairness, and the proper use of available resources in their undertakings. It is dishonorable for students to receive credit for work that is not the result of their own efforts.

Please see the descriptions of Cheating and Plagiarism found in the Tech University Catalog: For homework or projects plagiarism means using any work other than your own (including other texts, and students not enrolled in this class) without clear, unambiguous acknowledgment. For exams it means coping or trying to copy any other students work, any use of cell phones, mp3 players, or electronic media during exams, and any notes or open text other than explicitly allowed by the instructor.

NOTE: This syllabus is intended to give the student guidance in what may be covered during the semester and will be followed as closely as possible. However, the instructor reserves the right to modify, supplement and make changes as the course needs arise.

Ch E 5321: Advanced Chemical Engineering Thermodynamics
Instructor Evaluation of Graduate Course for Fall 2015

Instructor Chau-Chyun Chen

Time/Place 12:30 pm - 1:50 pm, Tuesday & Thursday; ChE 101

Catalogue Listing In-depth study of fundamental laws of thermodynamics, property relations for pure material and mixtures, and phase and chemical equilibrium principles

Grade Distribution

A	B	C	D	F	Total
15	11	0	0	0	26

Modifications Made to the Course: 1) Had two midterm exams instead of one, 2) Moved Project II to between midterm II and Final

Expected Outcomes and Assessment

Outcome	Performance Indicators	Assessment Results	Outcome Met?
1. An understanding of the molecular basis for equations of state and mixing rules and of the driving forces for phase and chemical reaction equilibria	Score 50% or higher in Midterm Exams	24/26 scored 50% or higher in Midterm I and 23/26 scored 50% or higher in Midterm II	To a large extent
2. An understanding of phase diagrams including the high pressure region	Score 50% or higher in Midterm Exams	24/26 scored 50% or higher in Midterm I and 23/26 scored 50% or higher in Midterm II	To a large extent
3. An ability to solve chemical reaction equilibria problems	Score 50% or higher in Midterm Exams	24/26 scored 50% or higher in Midterm I and 23/26 scored 50% or higher in Midterm II	To a large extent
4. An ability to carry out thermodynamic calculations for vapor-liquid, liquid-liquid, and solid-fluid equilibria problems	Score 50% or higher in Final Exam	24/26 scored 50% or higher in Final Exam	Yes
5. An ability to solve for the phase partitioning in phase equilibria problems involving complex fluids such as polymers, electrolytes, gases, and solids	Score 50% or higher in Final Exam	24/26 scored 50% or higher in Final Exam	Yes
6. An ability to use commercial simulators to solve phase equilibrium problems	Score 60% or higher in Project II	All students scored 60% or higher in Project II	Yes

Recommended Changes to Course: expand Solid-fluid equilibrium discussions

Syllabus and Course Schedule Attached.

CHE 5312: Fluid Transport Principles and Analysis

Spring 2016

Instructor: Dr. Rajesh Khare

Time/Place: 8.30 am–9:50 am, Monday & Wednesday/Chem. Engr. 101

Catalogue Listing: Fundamental relations governing mass, momentum, and energy transfer within fluids, with special emphasis on simultaneous transport, process applications, and numerical methods of analysis.

Grade Distribution:

A	B	C	D	F	Total
12	10	5	-	-	27

Modifications Made to Course:
Homeworks were assigned but were not graded, quizzes were given instead.

Expected Outcomes and Assessment:

Outcome	Performance Indicators	Assessment Results	Outcome Met?
An ability to analyze unidirectional, lubrication and creeping flow processes	Receive 50% or more on Midterm Exam 2	11 students who received a C or higher grade got less than 50% on Midterm Exam 2	Partially
An ability to develop a mathematical formulation based on the physics of the transport problem	Receive 50% or more on the Final Comprehensive Exam	1 student who received a C or higher grade got less than 50% on the Final Comprehensive Exam	To a large extent

Recommended Changes to Course:
A substantial review of vector and tensor analysis emphasizing physical significance of various mathematical operations should be included at the beginning of the course.

Syllabus Attached.

CHE 5312

Fluid Transport Principles and Analysis

Spring 2016

Instructor:	Dr. Rajesh Khare
Office:	Livermore 215
Phone:	806-834-0449
Email:	rajesh.khare@ttu.edu
Office hours:	Tuesday, 8.30 am to 10.30 am
TA:	Shamim Ahmmed (md.s.ahmmed@ttu.edu)
Time/Place:	Lecture: 8.00 am – 9:50 am Monday & Wednesday/Chem. Engr. 101
Required Text:	W. M. Deen, "Analysis of Transport Phenomena", Oxford University Press: Oxford, Second Edition, 2012.
Reference Text:	R. B. Bird, W. E. Stewart and E. N. Lightfoot (BSL), "Transport Phenomena", Second Edition, John Wiley & Sons: New York, 2007.

Expected Knowledge and Skills Entering the Course

- Differential and integral calculus, basic linear algebra
- General physics
- Undergraduate chemical engineering transport phenomena

Expected Outcomes and Assessment Methodology

- Knowledge of vector and tensor algebra, flow kinematics
- An ability to develop a mathematical formulation based on the physics of the transport problem
- An ability to analyze unidirectional, lubrication and creeping flow processes
- An ability to analyze laminar flows at high Reynolds number
- An ability to apply knowledge of conservation equations to practical problems

These outcomes will be assessed by quizzes, examinations and a project.

Topics to be Covered

- Vectors and tensors
- Introductory concepts: Stress tensor, viscosity, boundary conditions, fluid kinematics, dimensionless numbers
- Conservation equations: Mass, momentum and energy
- Solution methods for transport problems
- Low Reynolds number flows
- Laminar flows at high Reynolds number
- Heat and mass transfer in flows

Criteria for Assessment

There will be two mid-term and one comprehensive final exam for the course. In addition, there will be 5 quizzes and 1 project in the class. **Projects that are submitted late will not receive any credit.** Homeworks will be assigned but will not be collected and hence will not be graded.

Grading System

Item	Contribution	Total Points
Quizzes	5 at 30 points each	150
Project	1 at 70 points	70
Mid-term exams	2 at 240 points each	480
Final (Comprehensive) exam	300 points	300
Total		**1000**

At the end of the semester, points will be tallied and converted to a percentage. Based on this percentage, the following scale will be used to assign grades:

	Guaranteed Grade
Above 80	A
Between 65 and 80	B
Between 50 and 65	C
Between 40 and 50	D
Below 40	F

Class Rescheduling due to Instructor Travel
Occasionally, scheduled classes will be cancelled due to instructor travel to scientific conferences and meetings. These classes will be rescheduled at times convenient to all concerned.

Ethical Conduct
Students will be expected to adhere to the ethical standards of the engineering profession. Cheating is prohibited, and the representation of the work of another person as your own will be grounds for receiving a failing grade in the course.

Classroom Policy on Student Disability
Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor's office hours. Please note instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, you may contact the Student Disability Services office in 335 West Hall or 806-742-2405.

ChE 5321: Advanced Chemical Engineering Thermodynamics
Fall 2015

Instructor Professor Chau-Chyun Chen
Chauchyun.chen@ttu.edu
Office: PE202FB

Time/Place TR12:30 - 01:50 pm ChE 101

Text J.M. Prausnitz, R.N. Lichtenhaler, E.G. de Azevedo, "Molecular Thermodynamics of Fluid-Phase Equilibria," Prentice Hall, 2003

S.I. Sandler, "Using ASPEN PLUS® in Thermodynamics Instruction – A Step-by-Step Guide," AIChE and Wiley, 2015 (optional)

Teaching Assistant Pradeep Vyawahare
pradeep.vyawahare@ttu.edu
Office: ChE 107 (Office hour: Friday pm)

Topics To Be Covered
Thermodynamic Properties
Intermolecular Forces & Statistical Thermodynamics
Phase Equilibria
Chemical Reaction Equilibria
Properties of Complex Fluids
Aspen Properties

Outcomes and Assessment

- An understanding of the molecular basis for equations of state and mixing rules and of the driving forces for phase and chemical reaction equilibria (assessed by questions on the midterm I exam)
- An understanding of phase diagrams including the high pressure region (assessed by questions on the midterm II exam)
- An ability to solve chemical reaction equilibria problems (assessed by a problem on the midterm II exam)
- An ability to carry out thermodynamic calculations for vapor-liquid, liquid-liquid, and solid-fluid equilibria problems (assessed by problems on the midterm II exam and the final exam)
- An ability to solve for the phase partitioning in phase equilibria problems involving complex fluids such as polymers, electrolytes, gases, and solids (assessed by problems on the final exam)
- An ability to use commercial simulators to solve phase equilibrium problems (assessed by Project II)

Grading		
	Homework	20 %
	Midterm I	10 %
	Midterm II	10 %
	Project I	10 %
	Project II	20 %
	Final Exam	30 %

Ethical Conduct You may talk to one another about homework problems and projects. However, you are expected to do the homework on your own. Projects should be done on your own or with your partner, as assigned. Copying homework solutions or projects, or parts thereof, from other students or other groups or from any other source, including the web, and submitting it as your own work constitutes unethical behavior and is grounds for dismissal from the University. Similarly, cheating on quizzes or exams is unethical and grounds for dismissal from the University. If you are caught cheating, you will fail the course.

Professor Absence The instructors will be absent for several lectures due to professional commitments.

Classroom Policy

1. Read the chapter before the class.
2. Laptop use is not allowed in class unless specified beforehand by the instructor.
3. Cellular phones MUST be in 'no-ring' mode. Use of cellular phones in class is absolutely prohibited.
4. Class absences – With the exception of absences due to official University business and religious observations, both of which the instructor must be notified of in advance, students will not be allowed to make up quizzes, tests, or other in-class work that they miss due to absence. Homework cannot be turned in late due to absence.
5. All students are expected to come to class on time. Eating, sleeping, reading newspapers, and doing homework for other classes are not allowed. Students are expected to assist in maintaining a classroom environment that is conducive to learning. Inappropriate behavior, disruptive, or unprofessional behavior will not be tolerated.

Tentative Schedule

Week of	Topics
Aug. 24(2)	Chapter 1 (Prausnitz et al.): Review; Project I (8/27 no class)
Aug. 31(2) [a]	Chapter 2 (Prausnitz et al.): Classical Thermodynamics (9/3 no class)
Sept. 7(2) [b]	Chapter 3 (Prausnitz et al.): Fugacity
Sept. 14(2)	Chapter 4 (Prausnitz et al.): Intermolecular Forces
Sept. 21(2)	1st Midterm Exam on Sept. 24, 12:30 p.m.
	Chapter 5 (Prausnitz et al.): Gas Mixtures
Sept. 28(2)	Chapter 6 (Prausnitz et al.): Liquid Mixtures - Excess Functions
Oct. 5(2)	Chapter 7 (Prausnitz et al.): Liquid Mixtures - Solution Models
Oct. 12(2)	Chemical Reaction Equilibria
Oct. 19(2)	2nd Midterm Exam on Oct. 22, 12:30 p.m.
Oct. 26(2)	Using Aspen Properties with Excel (Sandler); Project II
Nov. 2(2)	Chapter 8 (Prausnitz et al.): Polymers
Nov. 9(2) [c]	Chapter 9 (Prausnitz et al.): Electrolyte Solutions
Nov. 17	**Project II due**
Nov. 16(2)	Chapter 10 (Prausnitz et al.): Solubilities of Gases in Liquids
Nov. 23(1) [d]	Chapter 11 (Prausnitz et al.): Solubilities of Solids in Liquids
Nov. 30(2)	Chapter 12 (Prausnitz et al.): High-Pressure Phase Equilibria
Dec. 4(1) [e]	**Final Exam: 10:30 am to 1:00 pm, Friday, December 4th**

[a] Symposium of Scholars, [b] Labor Day (Sept. 7), [c] AIChE (November 9-13), [d] Thanksgiving (Nov. 25-29), [e] Final Exam (Dec. 4-9)

CHE 5323: Digital Computation for Chemical Engineers

Spring 2016

Instructor: Harvinder Singh Gill
Class hours: Tuesday and Thursday, 5:00 pm - 6:20 pm
Location: ChE 101

Topics to be covered: Methods for solving linear and nonlinear algebraic systems, eigenvalue analysis, time-dependent ODEs, stability, PDEs solved by finite differences and finite elements.

Grade Distribution:

A	B	C	D	F	Total
22	4	1	-	-	27

Modifications Made to Course:

1) After receiving a request from the students to include a project for the course, I substituted the mid term with a project. This allowed the students to research a topic, i.e., 'Stability Analysis' in greater detail, and to solve a published research article (Nemanic et al., "An analysis of chemical reactor stability and control – iv", Chemical Engineering Science, vol 11, 1959, pp. 199-206) using MATLAB.
2) The grade distribution was assessed by: HW: 30%, Project: 40%, Final:30%, instead of HW: 30%, Exams (Midterm + Final): 70%.

Expected Outcomes and Assessment:

Outcome	Performance Indicators	Assessment Results	Outcome Met?
Understand stability analysis and its application to linear systems and differential equations	Successfully complete the Project and solve the associated research paper	All students successfully solved the project. Min :85/100 Max :100/100 Mean: 97.2/100	Yes.
An ability to apply concepts of digital computation to chemical engineering systems	At least 60% grade on Final exam	All students received greater than 60% on the two exams. Min :70/100 Max :100/100 Mean: 90.3/100	Yes

Recommended Changes to Course: None

Syllabus Attached.

Digital Computation for Chemical Engineers - CHE 5323

Spring 2016

Instructor: Harvinder Singh Gill,
Class hours: Tuesday and Thursday, 5:00 pm - 6:20 pm
Location: ChE 101

Instructor office: Livermore 213
Instructor office hours: Email the instructor to set up an appointment
Email: harvinder.gill@ttu.edu

Textbooks:
Required:
Applied Numerical Analysis Using MATLAB, Author: Laurene V. Fausett ISBN: 0132397285

Additional reading (recommended)
1) Numerical Methods for Chemical Engineers with MATLAB Applications, Authors Alkis Constantinides and Navid Mostoufi, ISBN: 0130138517
2) Engineering Computation with MATLAB, Author: David Smith, ISBN: 9780132568708

Topics to be covered: Methods for solving linear and nonlinear algebraic systems, eigenvalue analysis, time-dependent ODEs, stability, PDEs solved by finite differences and finite elements.

Expected knowledge and skills entering the course

- Differential and integral calculus
- Basic linear algebra, vectors, matrices
- Some exposure to MATLAB or other programming language
- Thorough undergraduate chemical engineering course knowledge in transport phenomena, reaction engineering, and thermodynamics

Homework policy

- All computation will be done using the scientific computing program MATLAB. Do not export graphical results to other programs such as Excel, Mathematica, etc.; plot all results in MATLAB instead.
- For each homework assignment involving MATLAB code, create a Microsoft Word document containing all your results. In this document, describe how the problem was solved, and present the pertinent figures and graphs that show the results. You should include the code and output of this code in your MS Word file. Use the file name *lastname_firstname_HW1_PX.m* for the program for problem *X* of Homework 1. In the comments of the code, clearly note the name of any program that you submit, and describe how it is used to solve the problem; describe what you should provide as input, how the results are stored, what the output means, etc. Write programs such that a fellow chemical engineering graduate student could follow the purpose of the program and utilize it.
- You will turn in printouts of this document at the beginning of class on the day the homework is due. Grading is based not only on the basis of correct solutions, but also on the basis of presentation.
- In some circumstances, the instructor may assign homework that requires pencil-and-paper analysis as well.
- You are free to discuss and consult with colleagues, but everyone must submit his or her own programs and solution. You may not copy the program of another student, and each student's program must be written solely by that student.
- Homework may not be turned in late. No exceptions.

Exams
There will be a total of 3 exams (including the final exam). All exams will be take-home.

Grades
The final grade will be 30% Homework, 70% Exams
NOTE: The instructor may change the relative weights of the exams; students will be notified.
Grades of 90-100% correspond to an A; 80-89% to B; 70-79% to C; 60-69% to D; below 60% to an F. The instructor may lower these demarcations, but the demarcations will not be raised.

Ethical conduct
If a student represents the work of another person as their own in any way, this act will constitute grounds for a failing grade in the course.

Class rescheduling due to instructor travel
Scheduled classes may be cancelled due to instructor-travel resulting from other professional commitments. These classes may be rescheduled at times convenient to the students and instructor. Topics and/or dates may be changed during the semester at the instructor's discretion because of scheduling issues, developments in the discipline, or other contingencies.

Classroom policy
1. Laptop use is not allowed in class unless required by the instructor for in class work.
2. Cellular phones MUST be in 'no-ring' mode. Use of cellular phones in class is absolutely banned. You WILL be asked to leave the classroom if found texting or using a cellular phone.
3. Class absences – *refer to the current catalogue for details.* With the exception of absences due to official University business and religious observations, both of which the instructor must be notified of in advance, students will not be allowed to make up quizzes, tests, or other in-class work that they miss due to absence. Homework, which is due at the beginning of class, cannot be turned in late due to absence.
4. All students are expected to come to class alert and ready to participate. Eating, sleeping, reading newspapers, and doing homework for other classes is not allowed during class. Students are expected to assist in maintaining a classroom environment that is conducive to learning. Inappropriate behavior in the classroom shall result, minimally, in a request to leave the class. Disruptive or unprofessional behavior will not be tolerated.

Standard Texas Tech Policies that apply to the course:
1. Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor's office hours. Please note instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, you may contact the Student Disability Services office in 335 West Hall or 806-742-2405.
2. Any student absent for a religious holiday should make that intention known prior to the absence and shall make up missed exams in accordance with Texas Tech Operating Policy 34.19.
3. Students will foster a spirit of academic integrity, and they will not present work as their own that was not honestly performed by them. Copying homework or projects, or parts thereof, from other students, or other groups, or from any other source, including the web, and submitting it as your own work constitutes unethical behavior and is grounds for dismissal from the University. Similarly, cheating on quizzes or exams is unethical and grounds for dismissal from the University. For a complete description see Texas Tech Operating Policy 34.12.

NOTE: This syllabus is intended to give the student guidance in what may be covered during the semester and will be followed as closely as possible. However, the instructor reserves the right to modify, supplement and make changes as the course needs arise.

ChE 5343: Reaction Kinetics
Instructor Evaluation of Graduate Courses for Fall 2015

Instructor Carla Lacerda

Time/Place Tue-Thu 8:00 to 9:20, ChE 101

Catalogue Listing (3 credits). Analysis and design of chemical reactor operations with multiple reactions; semibatch operations and other complex reactor configurations. Determination of kinetic parameters from operating data. Economic-based optimization, characterization and modeling of non-ideal reactors.

Grade Distribution

A	B	C	D	F	Total
10	11	6	0	0	27

Modifications Made to Course:
Course had one instructor and a TA available for office hours and grading assignments. Froment was adopted, and handouts from other books were also used. Grades were based on 1 midterm exam and 1 comprehensive final exam. Homework assignments were collected but not graded.

Expected Outcomes and Assessment

Outcome	Performance Indicators	Assessment Results Passing students averaged (%):	Outcome Met?
An ability to apply knowledge of mathematics, science, and engineering	Exam 1	79, min 60, max 100	Yes, students were able to solve advanced reactor problems and include constraints beyond what is taught at the undergraduate level
An ability to design a system, component, or process to meet desired needs within realistic constraints	Final exam	79, min 59, max 100	Yes, students had a comprehensive understanding of reactor design coupled with transport

Recommended Changes to Course: The curriculum was rearranged from last year to include multiple models during the semester. Coverage of reactions with transport was more comprehensive than last year. Different textbooks were used as additional supporting material. Students were not comfortable with multiple sources, due to differing author notations. For next semester, need to implement shorter exams over smaller blocks of material.

Statistics Component: None

Health and Safety Component: None

Ethics Component: Class discussions regarding groupwork and cheating.

MatLab Use: Limited.

HYSIS Use: None

Visio Use: None

Syllabus and Course Schedule Attached.

ChE 5343: Reaction Kinetics – Fall 2015

Course information

Instructor	Dr. Carla Lacerda
Office	LIV 219
Phone	Office: 834-4089
Email	Carla.Lacerda@ttu.edu
Office Hours	Fri 1 – 3 pm
Time/Place	Lectures: Tue-Thu 8:00 - 9:20 CHE 00101
Teaching Assistant	Samira Abedi - samira.abedi@ttu.edu - OH Thu 4 - 5 pm PE 202 FC
Catalogue Listing	Analysis and design of chemical reactor operations with multiple reactions; semibatch operations and other complex reactor configurations. Determination of kinetic parameters from operating data. Economic-based optimization, characterization and modeling of non-ideal reactors.
Textbooks	Froment, Bischoff, and De Wilde - Chemical Reactor Analysis and Design Hill and Root - Introduction to Chemical Engineering Kinetics and Reactor Design Rawlings and Ekerdt - Chemical Reactor Analysis and Design Fundamentals Doraiswamy and Uner - Chemical Reaction Engineering Beyond the Fundamentals
Software	MATLAB; Aspen HYSYS

Expected Chemical Engineering Knowledge and Skills

- Calculus (differentiation, integration) and differential equations
- General physics, chemistry and introductory biochemistry
- Transport processes (fluid flow, heat and mass transfer)
- Chemical engineering thermodynamics

Expected Outcomes and Assessment

Students will have the ability to:

- Develop advanced kinetic models for biological and heterogeneous chemical reactions, and obtain kinetic parameters (Midterm)
- Use the conservation equations to model reactors with imperfect mixing, heat and mass transfer limitations (Final Exam)

Each outcome will be separately assessed using exam grades. Expected minimum grade to meet outcomes is a C on each individual exam.

Topics to Be Covered

- Basics of reaction kinetics
- Heterogeneous kinetics
- Transport processes in reactions
- Multi-phase reactions
- Design of specific reactor types

Topics and/or dates may be changed during the semester at the instructor's discretion because of scheduling issues, developments in the discipline, or other contingencies. This syllabus is intended to give the student guidance in what may be covered during the semester and will be followed as closely as possible. However, the instructor reserves the right to modify, supplement and make changes as the course needs arise.

Grading

Course outcomes will be evaluated with one midterm and one final exam. Grade points will be distributed as follows: the midterm and the final exam will each account for 50% of the grade (2 x 50 points). An extra credit project (worth 5 points in addition to the 100 possible points) might be assigned during the course of the semester at the instructor's discretion.

The final grade will be assigned as follows: A = 88-100%; B = 75-87%; C = 63-74%; D = 50-62%; F = < 50%. Students will only pass the course with a C or better.

Exams

Exam dates are indicated in the table below. All exams are closed book; an equation sheet will be provided. Any requests for regrades on exams must be in writing and must be received within two days of the exam's return; the reason for the regrade must be fully explained.

Homework

Homework assignments will be posted on Blackboard during the semester. Students are expected to work in groups and with the TA. Homework will be collected at the beginning of class on the scheduled dates below but will not be graded.

Ethical Conduct

If you are caught cheating, you will receive a zero for the work in question on the first infraction; you will fail the course for subsequent infractions. Violations of academic integrity standards will be subjected to disciplinary sanctions according to University policy:
http://www.depts.ttu.edu/studentjudicialprograms/academicinteg.php

Classroom Policy

1. Laptop or tablet use is not allowed in class. Cell phones must be silent. Use of cell phones in class is absolutely banned. You will be asked to leave if found texting or using a cellular phone.
2. All students are expected to come to class alert and ready to participate. Eating, sleeping, reading newspapers, and doing homework for other classes is not allowed during class. Inappropriate behavior in the classroom shall result in a request to leave the class. Disruptive or unprofessional behavior will not be tolerated. Repeat offenses may result in referral to the Dean's office.
3. *Attendance for all class periods is mandatory.* Students missing exams for personal reasons must obtain permission from the instructor beforehand. No excuses for missed exams will be accepted after the fact. Students will not be allowed to make up exams missed due to unjustified absence.
4. *Graduate students need to always be on time!* If you are late (over five minutes past the hour), you will not be allowed to come in and disrupt the classroom. This will be considered an absence. If multiple absences/late entrances occur during the semester, you will fail the course.
5. Graphing and programmable calculators will not be allowed during exams. Exchange of calculators is not allowed. All personal belongings will be left at the front of the classroom before exams start. Leaving the room is not allowed during exams. Exams are supposed to be left face down on student's desk once completed.

Standard Texas Tech Policies that Apply to the Course

1. Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make arrangements. Students should present appropriate verification from Student Disability Services during the instructor's office hours. Please note instructors are not allowed to provide classroom accommodations to a student until verification from Student Disability Services has been provided. You may contact the Student Disability Services office at 335 West Hall or 806-742-2405.
2. Any student absent for a religious holiday should make that intention known prior to the absence and shall make up missed exams in accordance with Texas Tech Operating Policy 34.19.
3. Students will foster a spirit of academic integrity, and they will not present work as their own that was not honestly performed by them. The attempt of students to present as their own any work that they have not performed is regarded by the faculty and administration as a serious offense and renders the offenders liable to serious consequences. For a complete description see Texas Tech Operating Policy 34.12.

Tentative Schedule

Date	Lecture topic	
Week 1		
8/25/2015	Review of stoichiometry and reaction rates	
8/27/2015	Analytical solutions for common material balances	
Week 2		
9/1/2015	Review of chemical equilibrium I	
9/3/2015	Review of chemical equilibrium II	
Week 3		
9/8/2015	Properties of the reaction rate coefficient	
9/10/2015	Enzyme kinetics	
Week 4		
9/15/2015	Microbial kinetics	
9/17/2015	Review of biokinetics	
Week 5		
9/22/2015	Kinetics of heterogeneous reactions I	HW1 due
9/24/2015	Kinetics of heterogeneous reactions II	
Week 6		
9/29/2015	Special cases of heterogeneous kinetics	
10/1/2015	Parameter estimation in reactor design	
Week 7		
10/6/2015	Study cases	
10/8/2015	**Exam 1 – in class**	
Week 8		
10/13/2015	Parameter estimation for heterogeneous models	HW2 due
10/15/2015	Reactions at the interface - spherical pellet	
Week 9		
10/20/2015	Reactions at the interface - cylindrical pellet	
10/22/2015	Gas-solid reactions and reactors	
Week 10		
10/27/2015	Gas-liquid reactions and reactors I	
10/29/2015	Gas-liquid reactions and reactors II	
Week 11		
11/3/2015	Multi-phase reactions and reactors	HW3 due
11/5/2015	Ideal reactor design with energy balance - batch	
Week 12		
11/10/2015	*Class canceled*	
11/12/2015	Ideal reactor design with energy balance - flow	
Week 13		
11/17/2015	Nonideal reactors I	
11/19/2015	Nonideal reactors II	
Week 14		
11/24/2015	Study cases	HW4 due
Week 15		
12/1/2015	Comprehensive review	
Week 16		
12/5/2015	**Final exam 7:30 – 10 am**	

TEXAS TECH UNIVERSITY
Edward E. Whitacre Jr.
College *of* Engineering

JANUARY 2016

Chemical Engineering Department Strategic Planning

Review of Initial Session and Continuation

Sindee L. Simon
P. W. Horn Professor and Whitacre Department Chair

Departmental Mission and Vision

Mission

Educate, conduct research, and disseminate ChE knowledge through internationally recognized programs for the benefit of society.

Vision

Be the undergraduate ChE department of choice in Texas and be recognized as one of the top research and graduate ChE departments in the nation.

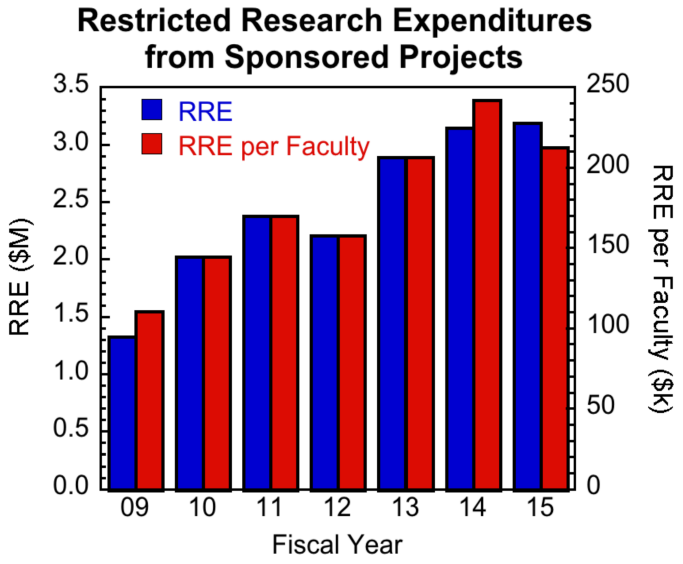
US News and World Report Ranking:

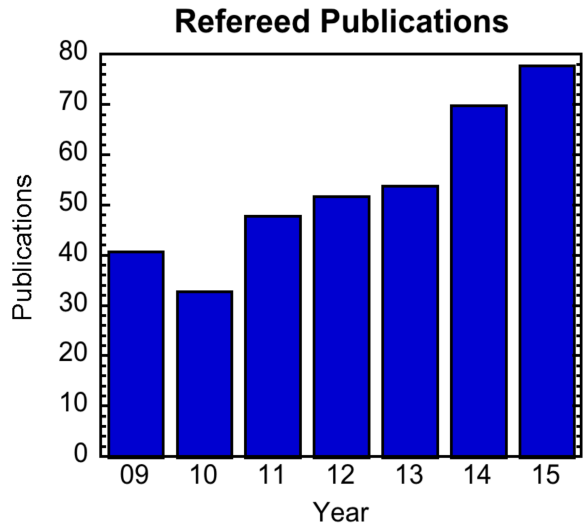
2011	68
2012	68
2013	81
2014	60
2015	68

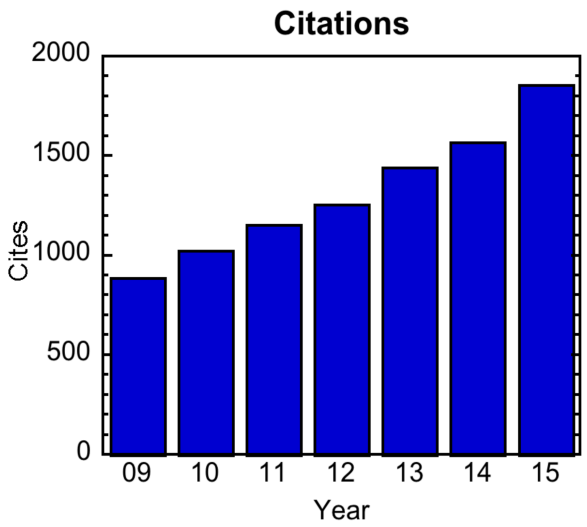
Short-Term Goal: Top 50

Long-Term Goal: Top 30

Department Research Productivity







- Our current goal for publications is 5 refereed publications per faculty member per year. We were at 5.2 in 2015.
- Our current goal for sponsored projects restricted research expenditures is $ 5 M per year or $ 250 k per faculty member. We are currently at $ 210 k per year.

Benchmarking the Numbers Against Peers

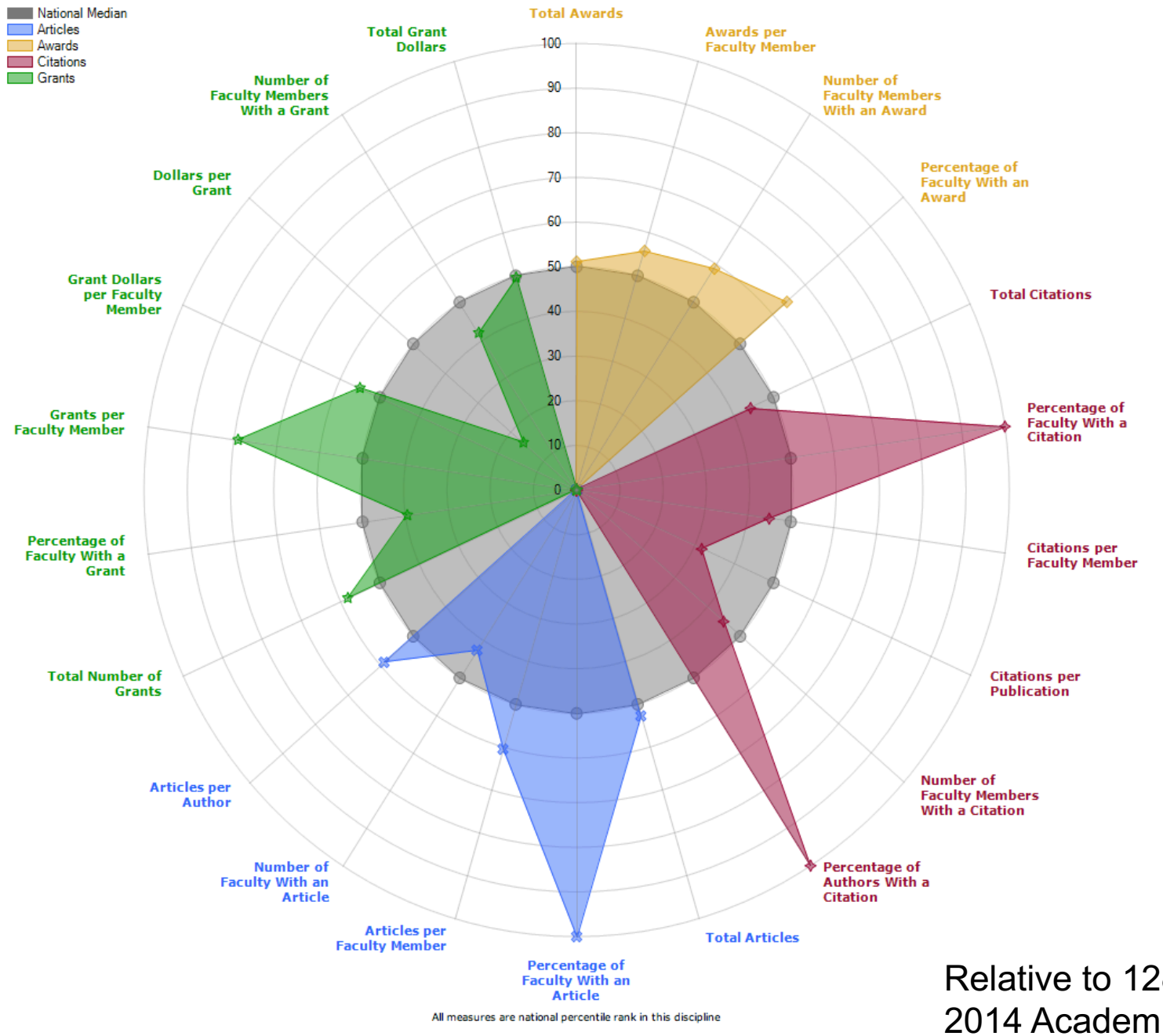
Institution	2015 Rank US News	2010 NRC Rank	Number of Faculty (Assist, Assoc, Full)	Named Chairs	Grad. Stud.	UG Stud.	Research Areas
Texas	**6**	**1-5**	26 (4, 4, 19)	22	192	704	Mater, Bio, Energy, Envir, Proc Eng, Modeling
Texas A&M	**31**	**26-51**	30 (7,4,26)	15	179	713	Mater, Bio, Envir, Proc/Rxn Eng, Modeling
Houston	**39**	**41-65**	25 (8,2,15)	8	137		Mater, Bio, Proc/Rxn Eng, Petr
Arizona	**50**	**50-78**	18 (1,1,16)	6	45	200	Adv Mater, Bio, Env
Auburn	**50**	**70-95**	15 (3,3,9)	9	92	461	Adv Mater, Bio, Energy, Systems Eng
Oklahoma	**57**	**45-74**	16 (4,2,10)	7	55	546	Mater, Bio, Energy, Envir
Kansas	**57**	**67-94**	22 (5,5,12)	5	33	434	Mater, Bio, Energy, Modeling
Colorado State	**57**	**55-86**	13 (5,4,4)	2	19	248	Poly, Bio, Envir, Modeling
Kansas State	**74**	**71-95**	11 (2,1,8)	2	34	306	Adv Mater, Bio, Energy, Envir, Rxn Eng
Texas Tech	**68**	**61-95**	**16 (6, 5, 5)**	**5**	**91**	**512 (248)**	**Mater, Bio, Energy, Modeling**

2015 data from web

Benchmarking Productivity Against Peers

Institution	2015 Rank US News	2010 NRC Rank	No. of Faculty (2014)	Pubs per Faculty (2011-14)	Total Pubs (2011-14)	Cites per Faculty (2010-14)	Total Cites (2010-14)	Funding per Faculty (2010-14) k$	Total Funding (2010-14) M$	Awards per Faculty	Total Awards
Texas	**6**	**1-5**	27	35.44	957	720	19,443	496.8	13.41	3.93	106
Texas A&M	**31**	**26-51**	35	23.31	816	303	10,588	176.5	6.18	0.46	16
Houston	**39**	**41-65**	20	16.90	338	226	4,516	327.9	6.56	0.95	19
Arizona	**50**	**50-78**	18	12.67	228	119	2,147	119.5	2.15	0.33	6
Auburn	**50**	**70-95**	13	9.62	125	217	2,823	336.0	4.37	0.77	10
Oklahoma	**57**	**45-74**	16	14.13	226	244	3,901	277.7	4.44	0.50	8
Kansas	**57**	**67-94**	21	11.52	242	179	3,769	300.8	6.32	0.33	7
Colorado State	**57**	**55-86**	12	8.42	101	121	1,456	251.9	3.02	0.33	4
Kansas State	**74**	**71-95**	11	8.82	97	72	788	372.3	4.09	0.45	5
Texas Tech	**68**	**61-95**	**13**	**15.15**	**197**	**173**	**2,242**	**245.8**	**3.19**	**0.62**	**8**

Department Strengths and Weaknesses



Relative to 128 ChE Depts
2014 Academic Analytics

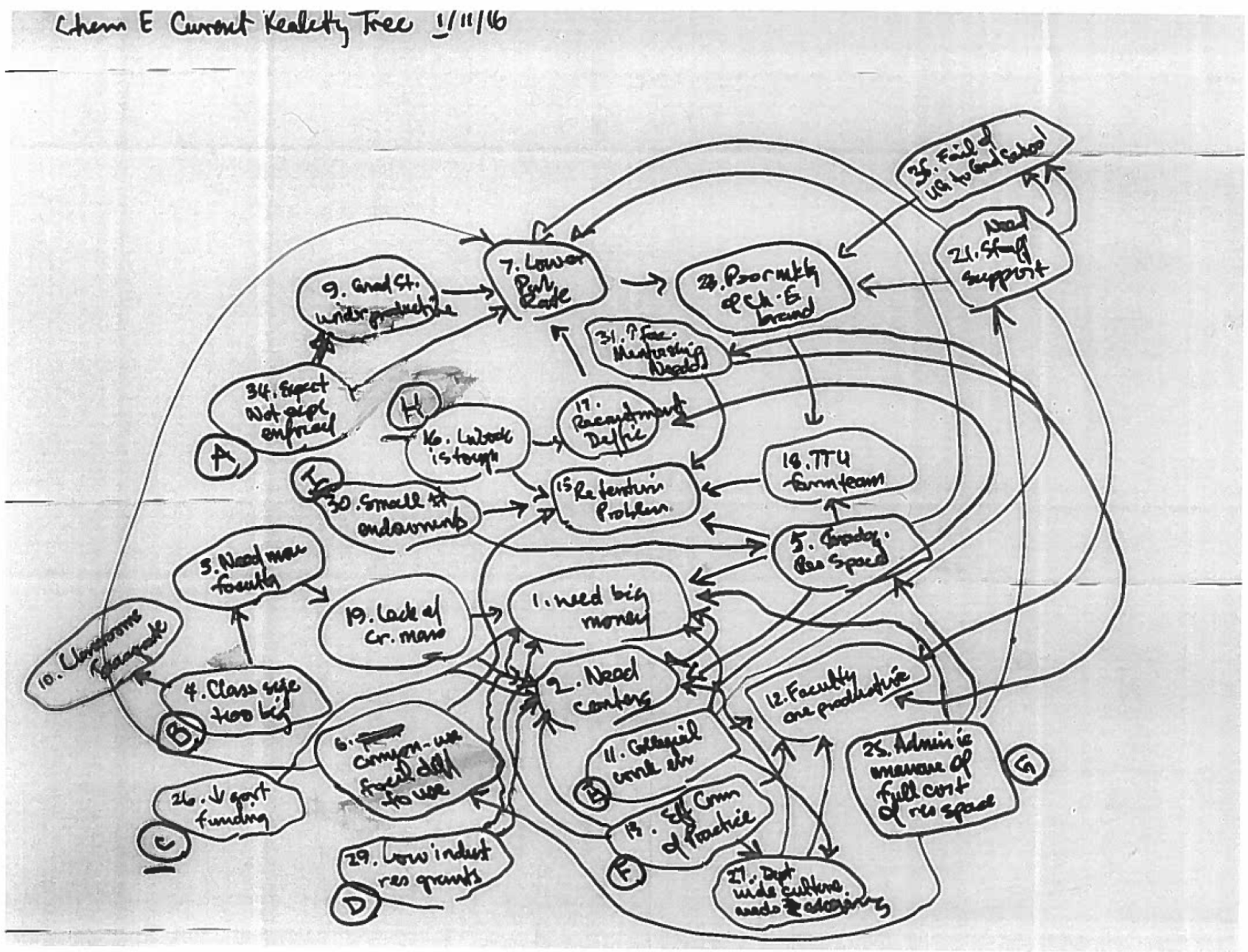
Benchmarking Against Schools Ranked 30 & 50

Institution Ranked	Pubs per Faculty (2011-14)	Total Pubs (2011-14)	Cites per Faculty (2010-14)	Total Cites (2010-14)	Funding per Faculty (2010-14) k$	Total Funding (2010-14) M$	Awards per Faculty	Total Awards
1	44 Stanford	1352 CalTech	1558 Stanford	41,832 CalTech	1,241.7 CalTech	54.6 CalTech	6.02 CalTech	265 CalTech
30	19 Northeastern	427 USC	339 CMU	7,945 UC-Davis	393.3 Utah	7.02 CMU	1.07 Columbia	24 Northeastern
50	16 Lehigh	294 Columbia, Akron	244 Oklahoma	4,516 Houston	274.6 UMass-Amherst	4.94 Florida	0.75 MichTech, NJIT	12 MichTech, NJIT, Vanderbilt
Texas Tech (Ranking)	**15.15 (52)**	**197 (62)**	**173 (72)**	**2,242 (73)**	**245.8 (59)**	**3.19 (66)**	**0.62 (58)**	**8 (64)**

Ranking of Strengths and Weaknesses

Description	Rank	Percentile	Z-Scores	Totals
Percentage of Authors With a Citation	1	100.0%	0.4	100%
Percentage of Faculty With an Article	1	100.0%	0.7	100%
Percentage of Faculty With a Citation	1	100.0%	0.7	100%
Grants per Faculty Member	28	79.1%	0.8	2.38
Percentage of Faculty With an Award	47	64.3%	0.4	46%
Articles per Faculty Member	52	60.5%	0.1	15
Articles per Author	54	58.9%	0	15
Number of Faculty Members With an Award	54	58.9%	-0.2	6
Total Number of Grants	55	58.1%	0	31
Awards per Faculty Member	58	55.8%	-0.3	0.62
Grant Dollars per Faculty Member	59	55.0%	-0.1	$245,768
Total Articles	62	52.7%	-0.3	197
Total Awards	64	51.2%	-0.3	8
Total Grant Dollars	66	49.6%	-0.4	$3,194,979
Number of Faculty Members With a Citation	72	45.0%	-0.3	13
Citations per Faculty Member	72	45.0%	-0.4	172
Total Citations	73	44.2%	-0.5	2,242
Number of Faculty With an Article	75	42.6%	-0.3	13
Number of Faculty Members With a Grant	76	41.9%	-0.5	7
Percentage of Faculty With a Grant	79	39.5%	-0.2	54%
Number of Faculty	84	35.7%	-0.5	13
Citations per Publication	89	31.8%	-0.7	10
Dollars per Grant	109	16.3%	-0.8	$103,064

Reality Tree Developed with Don Mitchell



Driving Factors and Ideas for Initiatives

- Expectations for Ph.D. students are not well articulated or enforced
  - Develop departmental colloquia that students take until they reach candidacy
  - Develop expectations form that students sign
  - Have students give departmental seminars
  - Improve handbook
- Undergraduate enrollments and class sizes are too large
  - Set stricter GPA requirements or set enrollment caps
  - Hire another professor of practice or full-time instructor
  - Teach multiple sections if faculty size allows
- The collegial work environment needs to be preserved
  - Have faculty lunches where one person describes their research
  - Designate a faculty / staff lunch area for people that eat lunch in
  - Encourage flow of information
- Effective communities of practice need to be expanded
- The administration is unaware of the full cost of research
  - Talk to reagents
- The department has a small number of endowments
- Faculty members have low funding from industrial sources
- Government funding is decreasing
- Lubbock makes recruiting and retaining faculty difficult

Assessment: Account Information Four Column

TEXAS TECH UNIVERSITY
Office of the Provost
Office of Planning & Assessment

Degree Program - ENG - Chemical Engineering (BSCHE)

CIP Code: 14.0701.00
Disciplinary Accrediting Body: ABET
Next Program Review: 17-18
Degree Program Coordinator: Sindee Simon
Degree Program Coordinator Email: Sindee.Simon@ttu.edu
Degree Program Coordinator Phone: 8067423553
Degree Program Coordinator Mail Stop: 3121
Program Purpose Statement: The educational objectives of the department are threefold: 1) graduates will be successful in chemical engineering-related careers and other diverse career paths; 2) graduates will continue professional development and will pursue continuing education opportunities relevant to their careers; and 3) some graduates will pursue advanced degrees. In addition, the departmental vision is to be the undergraduate chemical engineering department of choice in Texas and to be recognized as one of the top research and graduate chemical engineering departments in the nation.
Assessment Coordinator: Sindee Simon

Student Learning Outcomes	*Assessment Methods*	*Results*	*Actions for Improvement*
ABET Criteria 3a - An ability to apply knowledge of mathematics, science, and engineering **Outcome Status:** Active **Outcome Type:** Student Learning **Start Date:** 09/01/2006	**Survey - Student -** Exit Interviews of Graduating Seniors **Criterion:** Value of 4.0 or higher on Questions 6 (Math skills) and 8 (Fundamental knowledge) **Schedule:** Yearly **Related Documents:** Exit Survey Results 2009	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met 4.21 on Q8 (Fundamental Knowledge of ChE Principles) and 4.35 on Q6 (Mathematical Skills). Criterion met. (05/23/2016) **Assessment Cycle:** No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met 4.05 on Q8 (Fundamental knowledge); 4.31 on Q6 (Math skills) (06/05/2015) **Related Documents:** Exit Survey Data Table 21 2015.doc **Assessment Cycle:** No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met 4.29 on Q8 (Fundamental Knowledge); 4.54 on Q6 (Math Skills)	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		(09/18/2014) **Related Documents:** Table 4-2 Page 1 abc	
	Standardized Test - Comprehensive Senior Examination **Criterion:** >= 50% on the Comprehensive Senior Exam **Schedule:** Yearly	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met 57% average on Senior Exam. (06/15/2016)	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met 50.6% on Senior Exam for Fall 2014 (05/05/2015) **Related Documents:** Table 4-2 Page 1 Rev.docx	
		Assessment Cycle: Action To Be Defined (Prior to 2015-2016) **Result Type:** Criterion Not Met 48.4% on Senior Exam for Fall 2013 (09/18/2014) **Related Documents:** Table 4-2 Page 1 abc	
		Assessment Cycle: Action To Be Defined (Prior to 2015-2016) **Result Type:** Criterion Not Met 46.1% on Senior Exam for Fall 2012 (09/18/2013) **Related Documents:** Table 4-2 Page 1 abc 2013 Recent Continuous Improvement Chem Eng.docx	**Action for Improvement:** Move ChE 3330 Engineering Materials Science to the spring junior year from sophomore year. This change reverses a change made in 2009. Student scores on the Materials section of the Comprehensive Exam decreased significantly for students taking Materials as sophomores from 53 % in 2009 and 61 % in 2008 to scores ranging from 36 to 52 % in the following years. The data indicate that students are not getting as much out of the class when they take it as sophomores. (09/01/2013)
			Action for Improvement: Change the way ChE 4122 is taught to improve learning and student

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
			responsibility. The current course is taught by multiple professors reviewing different areas of chemical engineering. In Fall 2013, we will move to one faculty member taking full responsibility for the course. (09/01/2013) **Follow-Up: Evidence of Improvement:** Having one instructor take full responsibility of the course resulted in improved student performance. The average on the comprehensive exam increased from 46.1 % to 48.4 % in 2013 to 50.7 % in 2014. (06/05/2015)
	Instructor Course Evaluation - Instructor self-evaluation of course **Criterion:** Student learning outcome "a" met in course as evaluated by one or more performance indicators using HWs, quizzes, exams, and/or projects. **Schedule:** Yearly	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met For 2015/16, student learning outcome "a" met in ChE 1305, 2410, 3232, 3323, 4122, 4315, 4363, 4366, and 4391. ChE 1305: Projects and pop quizzes were used to assess with a target of at least 70% on each project or pop quiz. Project 3: 90/97 students were successful; Project 4: 80/97; Project 6: 90/97; Project 8: 89/97; Project 9: 85/97; Project 10: 70/97; Project 12: 88/97; Project 13: 84/97; Pop Quiz 2: 68/97; and Pop Quiz 5: 66/97. Outcome met. ChE 2410: Analyze and perform steady-state mass balances on single and multi-unit chemical processes, both with and without chemical reactions For 2015/16, this objective was evaluated by 2 quizzes and 6 exam problems on Exams 1, 3, and the Final Exam with students required to score at least 50%. Mean: 62%, std deviation: 22%. 85% of the students (80/94) scored at least 50%. Outcome met. Understand and perform steady-state energy balances on	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		single and multi-unit chemical processes, both with and without chemical reactions For 2015/16, 5 exam problems and 1 quiz were evaluated with students required to score at least 50%. Of the students passing the course, mean: 78%, std deviation: 21%. 90% (85/94) scored at least 50%. Outcome met. All outcomes met. ChE 3232: For 2015/16, final exams covering 4 lab experiments were used to assess. 94/98 students (1 did not take final) passed 50% on the final. Mean: 66.4 with a range of 50 - 91. Outcome met. ChE 3323: For 2015/16, Exam 1 was used to assess the outcome. Mean: 78, min: 50, max: 100. Outcome met. ChE 4122: For 2015/16, quizzes and HWs were evaluated. HW mean: 98%, 68/69 students scored at least 50%. Quizzes mean: 60%, 53/69 students scored at least 50%. Outcome met. ChE 4315: For 2015/16, at least 60% was required by all students on mid-term exams. Scores of > 78% was achieved. Outcome met. ChE 4363: For 2015/16, homeworks were given that covered major topics. In addition, 2 mid-term exams and a final exam was given. Mean for HW 1: 3.2/4. Mean for HW 3: 3.3/4. Mean for mid-term 1: 14.1/20. Mean for mid-term 2: 13.4/20. Mean for Q3 of mid-term 1: 2.7/4. Mean for HW 2: 3.1/4. Outcome met. ChE 4366: For 2015/16, scores of at least 60% were required on quizzes and HW 1. In quizzes, 20/27 students scored at least 60%. In HW 1, all 27 students scored at least 60%. Outcome met. ChE 4391: For 2015/16, Quiz 1, Midterm Exam, HW 1, HW3, and the Final Exam were evaluated. All 12 students scored	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement

at least 60% on the midterm exam. Midterm exam mean: 78.3; min 64. All 12 students scored at least 60% on Quiz 1. Quiz 1 mean: 75.4, min 60. All 12 students scored at least 60% on HW 1. 8/12 students scored at least 60% on the Final Exam. Final Exam mean: 71, min 50. 11/12 students (91%) scored at least 60% on HW3. Outcome met. (06/29/2016)

Related Documents:

20152016 ABET.xlsx

Assessment Cycle: No Action Needed (Prior to 2015-2016)
Result Type: Criterion Met

Student learning outcome "a" met in ChE 1305, 2410, 2421 (both sections), 3232, 3315, 3322, 3323, 3326, 3330, 3341, 4232, 4356, and 4363.

ChE 1305: For 2014/15, for Excel, 90/100 students scored > 70% on a Excel exam. For MATLAB, 96/100 students scored > 70% on a MATLAB exam.

ChE 2410: For 2014/15, the objective was assessed by 5 exam problems. Students who obtained 50% of the possible points met the objective. The range was 26% - 100%; mean was 68% with a standard deviation of 18%. 75% (66/88) of the students obtained 50% or more of the possible points.

ChE 2421 (001): For 2014/15, Quizzes 1-4, Exam 1, Exam 2, and the Final Exam were assessed with the requirement of at least 60% of the students scoring at least 60%. 26/33 (78%) students scored at least 60/100 on Exam 1. 32/33 (96%) students scored at least 60% on Quizzes 1-4. 21/33 (63%) students scored at least 60/100 on the Final Exam. 26/33 (78%) students scored at least 60/100 on Exam 1. 10/33 (30%) students scored at least 60/100 on Exam 2. 21/33 (63%) students scored at least 60/100 on the Final Exam. 29/33 (87%) students scored at least 60% on Quizzes 1-4.

ChE 2421 (002): For 2014/15, Quizzes 1-7, Exam 1, and the

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		Final Exam were assessed with at least 60% of the students scoring above 60% on each. 45/49 (92%) students scored at least 60 (out of 100) on Exam 1. 48/49 (98%) students scored at least 60% on average on Quizzes 1-4. 33/41 (80%) students scored at least 60/100 on the Final Exam. 41/49 (84%) students scored at least 60% on average for Quizzes 5-7. Outcome met. ChE 3232: For 2014/15, Final Exams covering 3 lab experiments were used to evaluate students' individual levels of knowledge and abilities of solving lab problems. 42/59 students passed 50% of the Final Exam with 50% of the students showing adequate knowledge to solve engineering problems. Mean: 59.5; Range: 25.0 - 90.0. ChE 3315: For 2014/15, the metric of the assessment was at least 60% overall grade by at least 80% of the students. Fall - 82/90 students achieved > 50% on the Final Exam and > 60% overall for the course. Spring - 51/91 students achieved > 50% on the Final Exam and > 60% overall for the course. ChE 3322: For 2014/15, the metrics were to receive at least 55% on Midterm I and at least 55% cumulatively on the 3 exams. For Midterm I, 10 students who passed the course scored less than 55% on Midterm I. On the 3 exams, 18 students who passed the course scored less than 55% cumulatively on the 3 exams. ChE 3323: For 2014/15, Exam 1 was used to assess. Mean was 85 with a min of 54 and a max of 100. ChE 3326: For 2014/15, Exams 1 and 2 were used to assess and a successful performance was > 50% score on Exam 1 and Exam 2 with a max of 150 points on each exam. On Exam 1, 52/55 students who passed the course met this. The mean was 105 and the range was 52-140. On Exam 2, 44/55 passing students met this. Mean was 99 and the range was 28-145.	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		ChE 3330: For 2014/15, homeworks covering major topics, 2 midterm exams (20 points each), 4 quizzes (2.5 points each), a final exam (50 points) were given with a bonus point for submitting report on material selection. 73 students achieved at least a C with the minimum score needed was 50 points. Exam 1 mean: 16.1/20; Exam 2 mean: 14.1/20; Final Exam mean: 29.4/50; Mean score for the 4 quizzes: 7.1/10. Mean for passing the course: 68.1%. 73 students demonstrated the ability to apply knowledge of math, engineering, and science in materials related problems (6 students scored less than 50%). ChE 3341: For 2014/15 - Molecular diffusion question on Exam 3: mean 66%; 40/76 students scored at least 65% Interphase mass transfer question on Exam 3: mean 78%; 50/76 students scored at least 65% Stripping question on Exam 3: mean 78%; 60/77 students scored at least 65% Exam 2: mean 79%; 66/84 students scored at least 65% Extraction question on Exam 3: mean 67%; 45/77 students scored at least 65% ChE 4232: For 2014/15, a double quiz covering 5 lab questions was used to assess. The mean was 67 +/- 21 with a range of 20-98. 43/53 students passed 50% of the final exam with 81% of the students showing adequate knowledge to solve engineering problems. ChE 4356: For 2014/15, students had to score either at least 60% on the exam or complete all of the safety certifications in HWs 1-3. 21 of the students scored better than 60% on Exam 1. All students completed the safety modules and received certification. ChE 4363: For 2014/15, HWs and exams were used to assess. Mean score for HW1: 3.4/4; mean score for HW3: 3.5/4; mean score for Midterm 1: 13.4/20; mean score for Midterm 2: 15.4/20; mean score of Q3 of Midterm 1: 2.5/4; mean score for HW2 Q1-3: 3.0/4; mean score for HW2 Q4-	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement

7: 3.0/4; mean score for Midterm 1 Q5: 2.0/3; mean score for Q2 of the Final Exam: 3.2/5. (06/10/2015)

Related Documents:

Table 5-2 2015 REV.docx

Table 4-2 Page 1 abc 2015.docx

Assessment Cycle: No Action Needed (Prior to 2015-2016)
Result Type: Criterion Met

Student learning outcome "a" met in ChE 2410, 2421,3315, 3323, 3326, and 4353 in 2013/14.

ChE 2410: "Understanding and performing steady-state mass balances on mult-unit chemical processes, both with and without chemical reactions" - in 2013/14, this objective was assessed by Exam 1, Problems 1-3; Exam 2, Problems 1-2; Exam Problem 1; Extra Credit Exam Problem 1; and, Final Exam Problems 2, 4, and 8. 86% of the students (75/87) obtained 50% or more of the possible points – outcome met.

ChE 2410: "Understand and perform steady-state energy balances on mult-unit chemical processes, both with and without chemical reactions" - for 2013/14, was assessed on Exam 3, Problems 4 and 6; Extra Credit Exam Problem 5; Final Exam Problem 3; and, Quiz 7. 93% of the students (81/87) obtained 50% or more of the possible points - outcome met.

ChE 2421: "Ability to apply the first and second laws to open and closed processes involving ideal gases" - For 2013/14, this was assessed via Quizzes 1-4 and Exam 1. 33/41 (80%) students scored 60/100 or higher on Exam 1. 37/41 (90%) students scored 60% or higher on average on Quizzes 1-3. Outcome met.

"Ability to calculate the properties of a non-ideal gas using equations of state and generalized correlations" - for 2013/14, the metric was assessed on Quizzes 5-7, Exam 2, and the Final Exam. 23/41 (56%) of the students scored 60% or higher on Exam 2. 33/41 (80%) of the students

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		scored 60% or higher on the Final Exam. 37/41 (90%) students scored 60% or higher on average on Quizzes 5-7. Outcome met. "Manipulate thermodynamic quantities using Maxwell's relations" - for 2013/14, the metric was assessed on the Final Exam. 33/41 students (80%) scored 60% or higher - outcome met. "Ability to use the steam tables and thermodynamic charts to solve problems" - for 2013/14, this metric was assessed on Quizzes 1-4, Exams 1 and 2, and the Final Exam. 33/41 (80%) of the students scored 60% or higher on Exam 1, 23/41 (56%) scored 60% or higher on Exam 2, 33/41 (80%) students scored 60% or higher on the Final Exam, and 37/41 (90%) of the students scored 60% or higher on average on Quizzes 1-3: outcome met. ChE 3315: For 2013/14, 67/80 students scored 50% or higher on the final: outcome met. ChE 3326: For 2013/14, the metric used was > 50% of total score on Exams 1 and 2 (200 points each). On Exam 1, 39/72 of students who passed the course received 50% or higher score. On Exam 2, 72/72 (100%) of the passing students received 50% or higher score: outcome met. ChE 4353: For 2013, students had to achieve > 70% on 2 multiple choice exams. On Exam 1: 35 out of 42 met the criteria. On Exam 2: 41 out of 42 met the criteria. Outcome met. (09/18/2014) **Related Documents:** Table 5-2.docx	
ABET Criteria 3b - An ability to design and conduct experiments, as well as to analyze and interpret data **Outcome Status:** Active	**Survey - Student -** Exit Interviews of Graduating Seniors **Criterion:** Value of 4.0 or higher on Questions 9 (Experimental Design)	**Assessment Cycle:** 2015 - 2016 **Result Type:** Inconclusive 3.78 on Q9 (Ability to Design and Conduct Experiments); 4.12 on Q10 (Ability to Analyze and Interpret Data).	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
Outcome Type: Student Learning **Start Date:** 09/01/2006	and 10 (Data Analysis) **Schedule:** Yearly **Related Documents:** Exit Survey Results 2009	(05/23/2016) **Assessment Cycle:** Action To Be Defined (Prior to 2015-2016) **Result Type:** Inconclusive 3.93 on Q9 (Experimental Design); 4.24 on Q10 (Data Analysis) (06/05/2015) **Related Documents:** Exit Survey Data Table 21 2015.doc **Assessment Cycle:** No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met 4.02 on Q9 (Experimental Design); 4.29 on Q10 (Data Analysis) (09/18/2014) **Related Documents:** Table 4-2 Page 1 abc **Assessment Cycle:** No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met 4.02 on Question 9 (Experimental Design) 4.29 on Question 10 (Data Analysis) (09/18/2014) **Related Documents:** Exit Survey Results 2009	
	Instructor Course Evaluation - Statistics quiz in ChE 4232 **Criterion:** 100% of students receive C or better on statistics quiz in ChE 4232 **Schedule:** Yearly	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Not Met For 2015/16, in ChE 4232, the mean was 67.19 +/- 18.64 with a range of 20-100 on the statistics quiz. Criterion not met. (06/22/2016) **Assessment Cycle:** Action To Be Defined (Prior to 2015-2016) **Result Type:** Criterion Not Met 70% received C or better on statistics quiz. (06/15/2015) **Related Documents:** Table 4-2 defg 2015.docx **Assessment Cycle:** Action To Be Defined (Prior to 2015-2016) **Result Type:** Criterion Not Met 57% received C or better (09/18/2014) **Related Documents:** Table 4-2 Page 1 abc	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
	Instructor Course Evaluation - Instructor self-evaluation of course **Criterion:** Student learning outcome "b" met in course as evaluated by one or more performance indicators using HWs, quizzes, exams, and/or projects. **Schedule:** Yearly	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met For 2015/16, student learning outcome "b" met in ChE 1305, 4232, 4315, 4363, and 4366. ChE 1305: For 2015/16, students were required to answer 2 of 3 questions on Exam 2 (Q10, 11, and 12) correctly and score at least 70% on linear regression HW. All students answered all 3 questions correctly and 49/97 scored at least 70% on the assessed HW. Outcome met. ChE 3323: For 2015/16, Exam 2 was used to assess. Mean: 80, min: 52, max: 104. Outcome met. ChE 4232: For 2015/16, data analysis and sample calculation of lab reports were used to evaluate students' ability to analyze data, a discussion part of lab reports was used to evaluate students' ability to interpret data and results, and a double quiz covering 4 lab experiments was used to evaluate each student's ability of data analysis and solving problems. Cooling tower - mean: 80.37 +/- 9.68, range: 65.0 - 95.0. Liquid Liquid extraction - mean: 77.85 +/- 8.72, range: 62.0 - 82.0. Bioreactor - mean: 80.92 +/- 8.31, range: 73.0 - 95.0. Diffusion - mean: 82.0 +/- 9.53, range: 64.0 - 95.0. Double quiz - mean: 56.96 +/- 21.05; range: 17 - 100. 31/49 students passed the double quiz with at least 50. Outcome met. ChE 4315: For 2015/16, scores > 60% by each student team on final report were required. All groups scored > 90% on final project reports. Outcome met. ChE 4363: For 2015/16, Q4 - 7 on HW 2 was evaluated. Mean score for HW 2: 3.1/4. Outcome met. ChE 4366: For 2015/16, at least 60% was required in a journal article critique project, a design project, and a lab group project. All 27 students scored at least 60% on ALL projects. Outcome met. (02/24/2016) **Related Documents:**	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		20152016 ABET.xlsx 20152016 ABET.xlsx 20152016 ABET.xlsx 20152016 ABET.xlsx **Assessment Cycle:** No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met Student learning outcome "b" met in ChE 1305, 3232, 3323, 4232, and 4363. ChE 1305: For 2014/15, for Excel, 90/100 students scored > 70% on a Excel exam. For MATLAB, 96/100 students scored > 70% on a MATLAB exam. ChE 3232: For 2014/15, an experimental section was required to describe how the experiment was conducted. Sections of data analysis and sample calculation were used to evaluate students' ability to analyze and interpret data. Discussion part was used to evaluate their ability to interpret data/results. First report: mean was 74.8 with a range of 55.0-95.0. Second report: mean was 72.7 with a range of 60.0 to 92.0. Third report: mean was 75.1 with a range of 60.0-88.0. ChE 3323: For 2014/15, Exam 2 was used to assess. Mean was 77 with a min of 51 and a max of 99. ChE 4232: For 2014/15, data analysis and sample calculation of lab reports were used to evaluate students' ability to analyze data. The discussion part of lab reports was used to evaluate their ability to interpret data/results. Cooling tower - mean: 78.71 +/- 5.80; range: 69.75-88.05; Liquid Liquid extraction - mean: 77.61 +/- 5.37; range: 63.00-87.00; Bioreactor - mean: 76.27 +/- 4.57; range: 66.25-90.00; Ion exchange - mean: 78.00 +/- 4.50; range: 66.50-87.00; Diffusion - mean: 78.87 +/- 4.44; range: 70.00-87.00 ChE 4363: For 2014/15, mean score for HW2: 3.0/4. Outcome met. (06/10/2015)	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement

Related Documents:
Table 5-2 2015 REV.docx
Table 4-2 Page 1 abc 2015.docx

Assessment Cycle: No Action Needed (Prior to 2015-2016)
Result Type: Criterion Met
Student learning outcome "b" met in ChE 3232, 3322, 3323, 4344, 4232

ChE 3232: For 2013/14, to measure "Ability to perform experiments, write reports, and perform oral presentation to analyze and explain data", data analysis and sample calculation of lab reports were used to evaluate students' ability to analyze data. Also, discussion part of lab reports was used to evaluate their ability to interpret data/results. Less than 30% of the first reports provided clear structure, good writing skills and proper data analysis with statistical analysis. For that, the mean was 73.2 with a range of 65 to 82. 80% of the last reports provided acceptable technical writing and proper data analysis/interpretation.
Mean: 80.9
Range: 72.0 to 94.0
60% of the groups were able to consistently achieve grade A or B for their presentations. Average grade was based on the grades from both instructor and TAs. - outcome met

ChE 3322: For 2013/14, the metric was met including discussion of obtaining activity coefficient model parameters from experimental data.

ChE 3323: For 2013/14, Exam 2 was used to determine the outcome. The passing students averaged 76 with a min of 50 and a max of 100 - outcome met

ChE 4232:

For 2013/14, use of statistical analysis was acceptable in about 90% of lab reports overall, a major improvement over 2010 and 2011 class performances. 21 of 37 students passed statistics quiz (60% or higher grade), which does not

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		meet the target of 100% of students passing - outcome met ChE 4344: For 2013/14, the metric was assessed by an average grade of C or better on laboratory reports and quizzes. All students met this (11/11) - outcome met (09/18/2014) **Related Documents:** Table 5-2.docx	
ABET Criteria 3c - 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. **Outcome Status:** Active **Outcome Type:** Student Learning **Start Date:** 09/01/2006	**Survey - Student -** Exit Interviews of Graduating Seniors **Criterion:** Value of 4.0 or higher on Question 11 (Design ability) **Schedule:** Yearly **Related Documents:** Exit Survey Results 2009	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Not Met 3.87 on Q11 (Ability to Analyze and Interpret Data). Criterion not met. (05/23/2016)	**Action for Improvement:** Change design sequence to two formal classes, ChE 4322 Chemical Engineering Review and ChE 4455 Chemical Process Design and Simulation (from a one-credit 4122 and five-credit 4555). This will allow design of individual units to be taught in ChE 4322 as part of the review course and will allow the capstone design class to focus on process and multi-unit design. (06/13/2016)
		Assessment Cycle: Action To Be Defined (Prior to 2015-2016) **Result Type:** Criterion Not Met 3.91 on Q11 (Design ability) (06/05/2015) **Related Documents:** Exit Survey Data Table 21 2015.doc	
		Assessment Cycle: Action To Be Defined (Prior to 2015-2016) **Result Type:** Criterion Not Met 3.98 on Q11 (Design Ability) (09/18/2014) **Related Documents:** Table 4-2 Page 1 abc	
		Assessment Cycle: Action To Be Defined (Prior to 2015-2016) **Result Type:** Criterion Not Met	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		3.98 on Question 11 (Design Ability) (09/18/2014) **Related Documents:** Exit Survey Results 2009	
	Instructor Course Evaluation - Instructor self-evaluation of course **Criterion:** Student learning outcome "c" met in course as evaluated by one or more performance indicators using HWs, quizzes, exams, and/or projects. **Schedule:** Yearly	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met For 2015/16: ChE 3323: The final was used to assess. Mean: 70, min: 62, max: 97. Outcome met. ChE 4555: Efficiently design equipment and processes by hand and by simulation - An assignment was assessed with students having to earn at least 70% on 2 or more individual design assignments. 63/68 students scored 70% or higher. Mean: 82 +/- 21. Range: 30-100. Criteria met. Design a chemical process that is in compliance with Federal and state environmental regulations - The Capstone report, poster presentation, and oral project presentation were used to assess with students needing to score at least 75% of the points. Criteria met. Outcome met. (06/27/2016)	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met Student learning outcome "c" met in ChE 2421 (both sections), 3323, 3341, 4340, 4353, and 4555. ChE 2421 (001): For 2014/15, Quizzes 5-10 and Exams 2 and 3 were assessed with 60% of students making at least 60%. 10/33 (30%) students scored at least 60/100 on Exam 2. 29/33 (87%) students scored 60/100 on Exam 3. 31/33 (93%) students scored at least 60% on average on Quizzes 5-10. ChE 2421 (002): For 2014/15, Problem 2 of Exam 2 was assessed with a metric of at least 60% of the students scoring at least 60%. 32/49 (66%) students scored at least	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		60/100 on this problem. Outcome met. ChE 3323: For 2014/15, the Final Exam was used to assess. The mean was 77 with a min of 63 and a max of 100. ChE 3341: For 2014/15 - Molecular diffusion question on Exam 3: mean 66%; 40/76 students scored at least 65% Interphase mass transfer question on Exam 3: mean 78%; 50/76 students scored at least 65% Stripping question on Exam 3: mean 78%; 60/77 students scored at least 65% Exam 2: mean 79%; 66/84 students scored at least 65% Extraction question on Exam 3: mean 67%; 45/77 students scored at least 65% ChE 4340: For 2014/15, the metric was 80% of students correctly identifying at least 60% of processes on pertinent question on the final exam/final exam section "A". 20/21 students scored above the metric. ChE 4353: For 2014/15, the students were required to obtain > 70% on the group project including peer evaluations. 57/59 students met this metric. ChE 4555: For 2014/15, the oral Capstone presentation was assessed. Students were required to earn 60% of the possible sum of the report, poster, and presentation points. Also, students were required to obtain open-ended and undefined process and costing information from the literature, Internet, and company sources. All reports showed adequate independent work to obtain information and techniques. All of the reports were adequate. Report scores ranged from 58%-96% with a mean of 78%. An independent committee of faculty and an industrial representative judged the poster. The presentation scores ranged from 67%-93% with a mean of 78%. (06/10/2015) **Related Documents:** Table 5-2 2015 REV.docx	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement

Table 4-2 Page 1 abc 2015.docx

Assessment Cycle: No Action Needed (Prior to 2015-2016)
Result Type: Criterion Met
Student learning outcome "c" met in ChE 3323, 4344, 4353, 4356, 4372, 4555

ChE 3323: For 2013/14, the final exam was used to measure success of the outcome. The mean was 77 with a min of 65 and a max of 92. Outcome met.

ChE 4344: For 2013/14, the assessment metric was a C or better on quizzes. All students (11/11) met this (100%). Outcome met.

ChE 4353: For 2013/14, the assessment metric was a requirement to design a control loop in a chemical process as part of a group project. The scores, adjusted by peer evaluation, must be greater than 70%. All students (42/42) met the criteria. Outcome met.

ChE 4356: For 2013/14, the SACHE safety certificate series needed to be completed by the students to meet the outcome. All of the students completed the entire series. Outcome met.

ChE 4372: For 2013/14, to assess this outcome, a team project with an oral presentation was scheduled. A grade of 70% or better was required. All students passed the team project. Outcome met.

ChE 4555: For 2013/14, The Capstone report and a poster presentation was used to measure the outcome. The Capstone reports receiving a min of 75% of the total points (656 of 875) were considered adequate. All students submitted satisfactory reports. Report scores ranged from 670 to 870 points with a std dev of 17. All students participated in developing the report: as indicated by satisfactory group evaluations (min 70%, 14/20. Group presentations ranged from 14 to 20 of 20 with a mean of

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		19.3 and a std deviation of 2.3). Outcome met. (09/18/2014) **Related Documents:** Table 5-2.docx	
	Course Level Assessment - Grade in ChE 4555 Capstone Design **Criterion:** 100% of students receive C or better in ChE 4555 Capstone Design **Schedule:** Yearly	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met For 2015/16: all 68 students scored at least a C in ChE 4555. Criterion met. (06/27/2016)	
		Assessment Cycle: Action To Be Defined (Prior to 2015-2016) **Result Type:** Criterion Not Met 98.3% received C or better in 2014/15. (06/15/2015) **Related Documents:** Table 4-2 Page 1 abc 2015.docx	
		Assessment Cycle: Action To Be Defined (Prior to 2015-2016) **Result Type:** Criterion Not Met 98% received C or better in 2013/14 (09/18/2014) **Related Documents:** Table 4-2 Page 1 abc	
		Assessment Cycle: Action Complete (Prior to 2015-2016) **Result Type:** Criterion Met 100% of students received C or better in 2012/13 (09/18/2013) **Related Documents:** Table 4-2 Page 1 abc 2013 Recent Continuous Improvement Chem Eng.docx	**Action for Improvement:** Use results from external judging of senior poster presentations of capstone projects to evaluate student learning outcomes with respect to design (06/05/2015)
	Capstone Assignment/Project - External judging of capstone design posters **Criterion:** 100 % of teams receive above 60 % on design-related criteria **Schedule:** Yearly	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met Average score is 91.05; low score is 74.07. Outcome met. (06/13/2016)	
		Assessment Cycle: Action To Be Defined (Prior to 2015-2016) **Result Type:** Criterion Not Met Average score on design-related criteria: 75.40; Low score: 49.00; One out of 15 groups scored < 60 %. (06/05/2015) **Related Documents:** Capstone Project Eval 2015 (2).doc	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		Assessment Cycle: Action To Be Defined (Prior to 2015-2016) **Result Type:** Criterion Not Met Average score on design-related criteria: 76.52; Low score: 56.67; One out of ten groups scored < 60 %. (09/20/2014) **Related Documents:** Capstone Project Eval 2015 (2).doc	
	Capstone Assignment/Project - External judging of capstone design project posters **Criterion:** Technical component score of > 60 % **Schedule:** annual	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met Average score is 91.05; low score is 74.07. Outcome met. (06/27/2016)	
ABET Criteria 3d - An ability to function on multi-disciplinary teams **Outcome Status:** Active **Outcome Type:** Student Learning **Start Date:** 09/01/2006	**Survey - Student -** Exit Interviews of Graduating Seniors **Criterion:** Value of 4.0 or higher on Questions 12 (Teamwork) and 14 (Leadership) **Schedule:** Yearly **Related Documents:** Exit Survey Results 2009	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met 4.29 on Q12 (Ability to Work Well in Diverse or Multidisciplinary Teams); 4.21 on Q14 (Leadership Abilities). Criteria met. (05/23/2016)	**Action for Improvement:** Begin using CATME software to give students feedback on their teamwork skills. Trial CATME use was performed in Spring 2016 in ChE 3232 and 4555. Extend to other classes in 2016/17. (06/13/2016)
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met 4.35 on Q12 (Teamwork); 4.31 on Q14 (Leadership) (06/05/2015) **Related Documents:** Exit Survey Data Table 21 2015.doc	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met 4.49 on Q12 (Teamwork); 4.39 on Q14 (Leadership) (09/18/2014) **Related Documents:** Table 4-2 defg.docx	
	Instructor Course Evaluation - Instructor self-evaluation of course **Criterion:** Student learning outcome "d" met in course as evaluated by	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met For 2015/16, student learning outcome "d" met in ChE 1305, 3232, 4232, 4366, and 4555.	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
	one or more performance indicators using HWs, quizzes, exams, and/or projects. **Schedule:** Yearly	ChE 1305: For 2015/16, CATME adjustment factor >= 0.7 was required to meet outcome. All students satisfied this. Outcome met. ChE 3232: For 2015/16, peer review was required from every student on every experiment to assess. Fluid Friction: 56/99 students received higher than 80% Free and Forced Convection: 60/99 received higher than 80% Pump Performance: 59/99 received higher than 80% Diffusion: 52/99 received higher than 80% Outcome met. ChE 4232: For 2015/16, a peer review was required from each student on each experiment. An individual interview was implemented to assist assessing individual's performance and contributions. 48/49 students received satisfactory peer reviews. Outcome met. ChE 4366: For 2015/16, at least 60% was required in a journal article critique project, a design project, and a lab group project. All 27 students scored at least 60% on ALL projects. Outcome met. ChE 4555: For 2015/16, group work divisions were assessed by the instructor in required weekly group meetings. Groups were self-assessed by CATME assessment performed on the web. 66/69 group members received group assessments with a mean of 3.5 or higher in the final CATME assessment. Mean score was 4.2 +/- 0.7. Range: 2.2 - 5. Outcome met. (06/29/2016) **Related Documents:** 20152016 ABET.xlsx	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met Student learning outcome "d" met in ChE 3232, 3330, 4232, 4353, 4356, and 4555.	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement

ChE 3232: For 2014/15, a peer review was required from each student on every experiment. An individual report was required to assist assessing individual's performance and contributions. 53/59 students received satisfactory in peer reviews.

ChE 3330: For 2014/15, "Material Selection", which the student groups (3-4 students in each group) find specific material around Texas Tech and determine why that material was selected based on the knowledge provided in the course. A 1-page report was submitted for the instructor to evaluate (1 bonus point for submitting the report). 45/79 students submitted reports. Major properties of the selected material were summarized in the report. Outcome met.

ChE 4232: For 2014/15, peer review was required from every student on every experiment. An individual interview with student was used to assist assessing students' performances and contributions. 50/53 students were satisfactory in peer reviews.

ChE 4353: For 2014/15, students had to score > 70% on peer evaluations to meet the metric. 57/59 students met this.

ChE 4356: For 2014/15, all students had to pass Exam 2 which included the development of a "short course" for a chemical industry setting. Also, student video projects addressing OSHA and EPA rules were assessed. All students passed the exam and all team projects exhibited understanding the importance of government regulation to safety.

ChE 4555: For 2014/15, all students were required to complete online training and obtain their AIChE SACHE certificate. All students did this. Outcome met. (06/10/2015)

Related Documents:

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement

Table 5-2 2015 REV.docx
Table 4-2 defg 2015.docx

Assessment Cycle: No Action Needed (Prior to 2015-2016)
Result Type: Criterion Met
Student learning outcome "d" met in ChE 3232, 3330, 4353, 4356, 4363, 4364, 4555

ChE 3232: For 2013/14, to measure the outcome, peer review is required from each student on every experiment. Individual interview with student was employed to assist assessing individual's performance and contributions. 61/68 students received satisfactory in peer review. 7 students received consistently bad peer review. 17% students' grades were adjusted on the peer review and the instructor's observation. Outcome met.

ChE 3330: For 2013/14, the ethics presentation was graded. The description of the project is attached as is the grading system. Instructor and peer grades were combined. Overall, the instructor and peer evaluations were very satisfactory. The students functioned well and the students seemed to enjoy the project. All students participated actively and were fully engaged based on student evaluations and on the instructor observations of individual participation. Outcome met.

ChE 4353: For 2013/14, the metric was requiring students to achieve > 70% on anonymous peer evaluations. All students achieved 75% or greater on their peer evaluations. Outcome met.

ChE 4356: For 2013/14, the metric was measured by a field trip attendance at Borger chemical plants. 85% participation in the field trip to Borger. 3 students were unable to go on the main trip; however, they arranged trips to OXY in Denver City. Outcome met.

ChE 4363: For 2013/14, a group project was used as a metric. The mean of the passing students was 86 with a

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		min of 60 and a max of 100. The students worked well in groups, typically with a group leader responsible for the math. Outcome met. ChE 4364: For 2013/14, the metrics were a group project written report (to design a drug delivery system for specific application (different for each group)) with >= 60% signifies outcome met and a group project oral presentation (a written report of the group project (>= 60% signifies outcome met)). All students passing course passed group project written report: Ave. 90 +/- 0; low 90. All students passing course passed group project oral presentation: Ave. 90 +/- 0; min 90. Outcome met. ChE 4555: For 2013/14, the metric was obtaining a AIChE SACHE certificate. All students completed online training and received the certificate. Outcome met. (09/18/2014) **Related Documents:** Table 5-2.docx	
ABET Criteria 3e - An ability to identify, formulate, and solve engineering problems **Outcome Status:** Active **Outcome Type:** Student Learning **Start Date:** 09/01/2006	**Survey - Student -** Exit Interviews of Graduating Seniors **Criterion:** Value of 4.0 or higher on Questions 3 (Critical Judgement), 4 (Creative Thinking), 5 (Problem-Solving Skills), and 13 (Independence); prior to 2012 also Question 15 (Self Confidence) **Schedule:** Yearly **Related Documents:** Exit Survey Results 2009	**Assessment Cycle:** 2015 - 2016 **Result Type:** Inconclusive 4.21 on Q3 (Critical Judgment); 3.99 on Q4 (Creative Thinking); 4.32 on Q5 (Problem-Solving Skills); 4.57 on Q13 (Ability to Work Independently), (05/23/2016) **Assessment Cycle:** No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met 4.07 on Q3 (Critical Judgement); 4.00 on Q4 (Creative Thinking); 4.33 on Q5 (Problem-Solving Skills); 4.47 on Q13 (Independence) (06/05/2015) **Related Documents:** Exit Survey Data Table 21 2015.doc **Assessment Cycle:** Action To Be Defined (Prior to 2015-2016) **Result Type:** Inconclusive 4.71 on Q13 (Independence); 4.44 on Q5 (Problem-solving Skills); 3.95 on Q4 (Creative Thinking) - DID NOT MEET; 4.37 on Q3 (Critical Judgment) (09/18/2014)	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		Related Documents: Table 4-2 defg.docx	
	Instructor Course Evaluation - Instructor self-evaluation of course **Criterion:** Student learning outcome "e" met in course as evaluated by one or more performance indicators using HWs, quizzes, exams, and/or projects. **Schedule:** Yearly	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met For 2015/16, student learning outcome "e" met in ChE 1305, 2410, 3232, 3323, 4122, 4232, 4363, and 4366. ChE 1305: For 2015/16, students were required to earn at least 70% on 4 multiple choice exams, at least 70% on Pop Quiz 3, and at least 70% on Project 5. 60/97 students satisfied the 4 multiple choice exams, 39/97 students satisfied Pop Quiz 3, and 91/97 students satisfied Project 5. Outcome met. ChE 2410: Analyze and perform steady-state mass balances on single and multi-unit chemical processes, both with and without chemical reactions For 2015/16, 2 quizzes and 10 exam problems were evaluated with students obtaining 50% of the possible points meeting this outcome. Mean: 76%; std deviation: 22%. 90% of the students (85/94) satisfied this objective. Outcome met. Be able to estimate or compute the thermodynamic property behavior of pure and multi-component systems using simple models For 2015/16, 9 problems on exam 1 and the final exam and 2 quiz problems were evaluated with students obtaining 50% of the possible points meeting this outcome. Mean: 64%, std deviation: 22%. 78% of the students (72/94) satisfied this objective. Outcome met. Understand and perform steady-state energy balances on single and multi-unit chemical processes, both with and without chemical reactions For 2015/16, 2 quizzes and 8 exam problems were evaluated with students obtaining 50% of the possible points meeting this outcome. Mean: 83%, std deviation:	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		31%. 91% of the students (86/94) satisfied this objective. Outcome met. All outcomes met. ChE 3232: For 2015/16, discussion and conclusion sections of lab reports and diagrams/plots were evaluated. Fluid Friction: 19/25 of the groups properly discussed and compared results with theories. Free and Forced Convection: 21/25 of the groups properly discussed and compared results with theories. Pump Performance: 85% of the students were able to find the required solution when the calculation wasn't necessary for the problems; the rate dropped to 51% when calculations were involved. Outcome met. ChE 3323: For 2015/16, HW1-12 were used to assess. Mean: 92, min: 50, max: 100. Outcome met. ChE 4122: For 2015/16, a comprehensive exam was evaluated. Mean: 57%. 40/69 students scored at least 50%. Outcome met. ChE 4232: For 2015/16, a summary/discussion section of a report was evaluated with instructor's and TA's observations through lab session. On the lab reports, most groups were able to properly discuss experimental results and make suggestions or modifications for improvement. Outcome met. ChE 4363: Understanding of the mechanisms, models and application of enzyme kinetics For 2015/16, at least 55% on Q5 of Midterm Exam 1 and at least 55% on Q2 of Final Exam satisfied this objective. Q5 Mean: 2.4/3; Q2 mean: 3.6/5. Outcome met. Ability to analyze, size, design and select bioreactors For 2015/16, at least 55% on HW 4 and at least 55% on Q5	

of Midterm Exam 2 and on Q3 of Final Exam satisfied this objective. HW 4 mean: 3.5/4.0; Midterm Exam 2 mean: 13.4/20.0. Outcome met.

All outcomes met.

ChE 4366: For 2015/16, at least 60% was required in a journal article critique project, a design project, and a lab group project. All 27 students scored at least 60% on ALL projects. Outcome met. (06/29/2016)

Related Documents:

20152016 ABET.xlsx

Assessment Cycle: No Action Needed (Prior to 2015-2016)
Result Type: Criterion Met

Student learning outcome "e" met in ChE 1305, 2410, 3232, 3315 (Fall), 3322, 3323, 3326, 3341, 4232, 4353, 4356, and 4363.

ChE 1305: For 2014/15, for Excel, 90/100 students scored > 70% on a Excel exam. For MATLAB, 96/100 students scored > 70% on a MATLAB exam. Also, a group project required submission of a handwritten engineering calculation and a group project required submission of a typewritten engineering calculation were required with > 70% required. On both, all submittals scored > 70%. Outcomes met.

ChE 2410: For 2014/15,
"Be able to estimate or compute the thermodynamic property behavior of pure and multi-component systems using simple models": 7 exam problems were used to assess with students required to score at least 50% on these problems to meet this outcome. Range: 18-100; mean: 69; std. dev. 22%. 66/88 (75%) students met this outcome.
"Understand and perform steady-state energy balances on mult-unit chemical processes, both with and without chemical reactions": 7 exam problems were used to assess with students required to score at least 50% on these problems to meet this outcome. Range: 27-100+; mean: 75; std. dev. 29%. 61/88 (70%) students met this outcome.

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		ChE 3232: For 2014/15, the discussion/conclusion section of a report along with instructor's evaluation of Q&A section of presentations were assessed. In lab reports, 90% of the groups were able to properly discuss and compare the experimental results with theoretical value. During oral presentations, 85% of the students were able to answer questions and show critical thinking skills to a certain extent. Outcome met. ChE 3315: For 2014/15, at least 80% of the students were required to score > 70% on midterm exams to meet the outcome. Fall - 74/90 students achieved > 70% in Midterms 1 and 2. Outcome met for Fall semester. ChE 3322: For 2014/15, the metrics were to receive at least 55% on Midterm I and at least 55% cumulatively on the 3 exams. For Midterm I, 10 students who passed the course scored less than 55% on Midterm I. On the 3 exams, 18 students who passed the course scored less than 55% cumulatively on the 3 exams. ChE 3323: For 2014/15, HW 1-12 were used to assess. Mean: 75, min: 21, and max: 100. Outcome met. ChE 3326: For 2014/15, a 500-point final exam was used to assess with a metric of > 50% of the total points. 50/55 passing students scored at least 50% on the final exam. Mean: 324; range: 200-475. Outcome met. ChE 3341: For 2014/15, Molecular diffusion question on Exam 3: mean 66%; 40/76 students scored at least 65% Interphase mass transfer question on Exam 3: mean 78%; 50/76 students scored at least 65% Stripping question on Exam 3: mean 78%; 60/77 students scored at least 65% Exam 2: mean 79%; 66/84 students scored at least 65% Extraction question on Exam 3: mean 67%; 45/77 students scored at least 65%	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement

ChE 4232: For 2014/15, a summary/discussion section of the report was used to assess along with instructor and TA's observation through lab session. On lab reports, most groups were able to properly discuss experimental results and make suggestions for modifications or improvement. Outcome met.

ChE 4353: For 2014/15, exam questions and an individual HYSYS dynamic project were used to assess. 58% of the students answered Exam 1 Q11-16 and Exam 4 Q1-3 correctly; 52% answered Exam 3 Q3-8 and Q17-25 correctly; 34% answered Exam 3 Q1-2, 9-16, and 26-31 correctly. All students earned > 85% on the project. Outcomes met.

ChE 4356: For 2014/15, students had to score either at least 60% on the exam or complete all of the safety certifications in HWs 1-3. 21 of the students scored better than 60% on Exam 1. All students completed the safety modules and received certification.

ChE 4363: For 2014/15, Midterm 1 Q5, Midterm 2 Q5, Final Exam Q2 and 3, and HW4 were used to assess with a metric for a mean score at least 55% on each item. Mean score for Midterm 1 Q5: 2.0/3; mean score for Final Exam Q2: 3.2/5; mean score for HW4: 3.6/4; and, mean score for Midterm 2: 15.4/20. Outcome met. (06/10/2015)

Related Documents:

Table 4-2 defg 2015.docx

Table 5-2 2015 REV.docx

Assessment Cycle: No Action Needed (Prior to 2015-2016)
Result Type: Criterion Met
Student learning outcome "e" met in ChE 2410, 3315, 3322, 3323, 3326, 3330, 4353, 4232, 4341

ChE 2410: For 2013/14, "Understand and perform steady-state mass balances on mult-unit chemical processes, both with and without chemical reactions" was assessed by Exam 1 problems 4-7, Exam 2 problems 3-7, Exam 3 problem 2,

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		extra credit exam problem 2, and final questions 1, 5, and 6. Students who obtained 50% of the possible points were considered to have met this objective. Of the students who passed the course, the percentage of points scored on this objective out of the possible total points ranged from 32% to 100% with a mean of 72% and a std dev of 23%. 86% of the students (75/87) obtained 50% or more of the possible points. Outcome met. "Understand and perform steady-state energy balances on mult-unit chemical processes, both with and without chemical reactions)" was assessed by Exam 3 problems 3 and 5, extra credit exam problems 3 and 4, final exam problems 7 and 9, and quizzes 8 and 9. Of the students who passed the course, the percentage of points scored on this objective out of the possible total points ranged from 27% to 100+% with a mean of 75% and a std dev of 27%. 86% of the students (76/87) obtained 50% or more of the possible points. Outcome met. ChE 3315: For 2013/14, the metric used was a score of 50% or above on Midterms I and II. On midterm I, 56/80 students scored >= 50%; on midterm II, 62/80 students scored >= 50%. Outcome met. ChE 3322: For 2013/14, all homeworks, quizzes, and exams were used to assess the objective. Outcome met. ChE 3323: For 2013/14, HW 1-9 were used to assess the objective. Mean was 79 with a min of 55 and a max of 100. Students understood how to approach homework problems to design reactors. Outcome met. ChE 3326: For 2013/14, the metric was the final exam with success being > 50% of total score on the Final Exam out of 400. 68/72 passing students received 50% or higher score on the Final Exam. Max obtainable score = 400, mean was 285, range was 145-390. Outcome met. ChE 3330: For 2013/14, HWs and Exams included problems	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		requiring knowledge of engineering math and the ability to apply it to specific materials-related problems. Students needed to pass the final exam with > 56% score. 10 students demonstrated this ability (out of 10). Outcome met. ChE 4232: For 2013/14, the instructor's observation of problem-solving skills in lab situations; experimental and Results/Discussion sections of lab reports. At the end of the course, all students were judged to be adequately prepared to take practical approaches to solving of physical problems during experiments, based upon instructor's observations and lab report calculations. Outcome met. ChE 4341: For 2013/14, the following metrics were used: Mid-term Exam 1 - Q5 on comparison of step-growth polymerization and radical chain polymerization (>= 50% signifies outcome met). Mean: 2.5/3 HW 2 - Q2 and 3 on the kinetic expressions for step-growth polymerization (>= 50% signifies outcome met). 9/13 students solved Q2; 9/13 students solved Q3 (one student did not submit HW). Mean for HW 2: 3.3/4 HW 3 - Q2 and 3 on the kinetic expressions for chain polymerization (>= 50% signifies outcome met). 8/12 students solved Q2; 8/12 students solved Q3 (two students did not submit HW). Mean for HW3: 3.1/4 Mid-term Exam 1 - Q4 on use these expressions to solve problems, both numerically and analytically for step polymerization (>= 50% signifies outcome met). Mean for Q4 of Mid-term I: 2.2/3 Mid-term Exam 1: Q6 and 7 on use these expressions to solve problems, both numerically and analytically on chain polymerization (>= 50% signifies outcome met). Mean for Q6 and 7 of Mid-term I: 2.4/3.	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		Mean for Mid-term I: 15.9/20 Also, the following are measured: Mid-term I - Q1 on functionality (>= 50% signifies outcome met). Mean for Q1 of Mid-Term I: 1.7/3 Final - Problem 1 on monomer structure and functionality (>= 50% signifies outcome met). Mean for Problem 1 of Final: 2.5/3. All met. ChE 4353: For 2013/14, students must achieve > 70% on 2 multiple choice exams. 35/42 students met the criterion for the first exam; 41/42 students met the criterion on the second exam. Outcome met. (09/18/2014) **Related Documents:** Table 5-2.docx	
	Standardized Test - Comprehensive Senior Examination **Criterion:** Average grade of 50% or better **Schedule:** Yearly	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met 57% average (40/69 students). Criteria met. (06/15/2016)	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met 50.6% on Senior Exam for Fall 2014 (05/05/2015) **Related Documents:** Table 4-2 Page 1 Rev.docx	
		Assessment Cycle: Action To Be Defined (Prior to 2015-2016) **Result Type:** Criterion Not Met 48.4% on Senior Exam for Fall 2013 (09/18/2014) **Related Documents:** Table 4-2 defg.docx	
ABET Criteria 3f - An understanding of professional and ethical responsibility **Outcome Status:** Active **Outcome Type:** Student Learning	**Survey - Student -** Exit Interviews of Graduating Seniors **Criterion:** Value of 4.0 or higher on Questions 15 (Process Safety, after 2012), 17 (Professional Behavior)	**Assessment Cycle:** 2015 - 2016 **Result Type:** Inconclusive 3.84 on Q15 (Understanding of Process Safety); 4.41 on Q17 (Appreciation of Professional Behavior); and 4.66 on Q18 (Appreciation of Ethical Behavior in Engineering).	**Action for Improvement:** Add a requirement that students take ENGR 2392 Engineering Ethics and Its Impact on Society, effective in Fall 2016 catalogue. (06/13/2016)

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
Start Date: 09/01/2006	and 18 (Ethical Behavior) **Schedule:** Yearly **Related Documents:** Exit Survey Results 2009	(05/23/2016) **Assessment Cycle:** Action To Be Defined (Prior to 2015-2016) **Result Type:** Inconclusive 3.89 on Q15 (Understanding of Process Safety); 4.36 on Q17 (Professional Behavior); 4.51 on Q18 (Ethical Behavior) (06/05/2015) **Related Documents:** Exit Survey Data Table 21 2015.doc **Assessment Cycle:** No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met 4.37 on Q15 (Understanding of Process Safety); 4.66 on Q17 (Professional Behavior); 4.66 on Q18 (Ethical Behavior) (09/18/2014) **Related Documents:** Table 4-2 defg.docx **Assessment Cycle:** No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met 4.55 on Q17 (Professional Behavior); 4.50 on Q18 (Ethical Behavior) (09/18/2012) **Related Documents:** Table 4-2 defg.docx	**Action for Improvement:** Add question on exit interview concerning knowledge of process safety. Add required process safety course to the curriculum - this is in response to a new ABET requirement that "The curriculum must provide a thorough grounding in the basic sciences including chemistry, physics, and/or biology, with some content at an advanced level, as appropriate to the objectives of the program. The curriculum must include the engineering application of these basic sciences to the design, analysis, and control of chemical, physical, and/or biological processes, including the hazards associated with these processes." (01/01/2012)

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
			Follow-Up: Evidence of Improvement: Score was 3.89 in 2015 Senior Exit Interview concerning Understanding of Process Safety. Score should be above 4.00; however, all seniors are not yet required to take the course. Continue monitoring. (06/05/2015) **Follow-Up: Evidence of Improvement:** Score was 3.69 on 2014 Senior Exit Interview on Understanding of Process Safety. Score should be above 4.00; however, all seniors are not yet required to take the course. Continue monitoring. (09/01/2014) **Follow-Up: Evidence of Improvement:** Score was 3.96 in 2013 Senior Exit Interview on Understanding of Process Safety. Score should be above 4.00; however, all seniors are not yet required to take the course. Continue monitoring. (09/01/2013) **Follow-Up: Evidence of Improvement:** A process safety course was added to the curriculum and taught for the first time in Spring 2012. A question was added to the senior exit interview concerning student's perceived proficiency in process safety. (01/01/2012)
	Instructor Course Evaluation - Instructor self-evaluation of course **Criterion:** Student learning outcome	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met For 2015/16, student learning outcome "f" met in ChE 3232,	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
	"f" met in course as evaluated by one or more performance indicators using HWs, quizzes, exams, and/or projects. **Schedule:** Yearly	4232, 4366, and 4555. ChE 3232: For 2015/16, 2 safety exams were evaluated: an online exam administered by TTU EH&S with safety certificates collected and placed in Unit Ops lab; and, an in-class exam with one allowed retake and a required 80% to pass. All students were required to pass BOTH exams to continue the course. All 99 students passed both exams; 10 students exercised the retake on the in-class exam. No safety violations were observed. All students wore PPE and performed experiments safely. Outcome met. ChE 4232: For 2015/16, 2 safety exams were evaluated: an online exam administered by TTU EH&S with safety certificates collected and placed in Unit Ops lab; and, an in-class exam with one allowed retake and a required 80% to pass. All students were required to pass BOTH exams to continue the course. All 49 students passed both exams; 10 students exercised the retake on the in-class exam. No safety violations were observed. All students wore PPE and performed experiments safely. Outcome met. ChE 4366: For 2015/16, at least 60% was required in a journal article critique project, a design project, and a lab group project. All 27 students scored at least 60% on ALL projects. Outcome met. ChE 4555: For 2015/16, the individual AIChE SACHE certificate for HAZOP analysis was used to assess. All students completed the online training and received the certificate. Outcome met. (06/29/2016) **Related Documents:** 20152016 ABET.xlsx **Assessment Cycle:** No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met Student learning outcome "f" met in ChE 3232, 3330, 4232, and 4356. ChE 3232: For 2014/15, 2 safety exams were given requiring	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement

each student to pass in order to continue the course. An online safety exam was administered by EH&S. Certificates from this exam were collected and placed in the Unit Ops lab. An in-class safety exam with one allowed re-take was given requiring at least 80% to pass. On the on-line exam, all students submitted safety certificates. On the in-class exam, 37/59 students passed with 22 re-taking to pass. During the scheduled lab session, no safety violation was observed. Students all wore PPE and performed experiments safely.

ChE 3330: For 2014/15, a case study on several unique materials (such as artificial bones, medical implants) involving engineering ethics was used to assess. Students were involved in the in-class group discussion and observed by the instructor. Outcome met.

ChE 4232: For 2014/15, 2 safety exams were given requiring each student to pass in order to continue the course. An online safety exam was administered by EH&S. Certificates from this exam were collected and placed in the Unit Ops lab. An in-class safety exam with one allowed re-take was given requiring at least 80% to pass. On the on-line exam, all students submitted safety certificates. On the in-class exam, all students passed with 14 re-taking to pass. During the scheduled lab session, no safety violation was observed. Students all wore PPE and performed experiments safely.

ChE 4356: For 2014/15, all students were required to pass Exam 2 and student video projects addressing OSHA and EPA rules were used to assess. all students passed Exam 2 and all team projects exhibited understanding of importance of government regulation to safety. Outcome met. (06/10/2015)

Related Documents:

Table 5-2 2015 REV.docx

Table 4-2 defg 2015.docx

Assessment Cycle: No Action Needed (Prior to 2015-2016)
Result Type: Criterion Met

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		Student learning outcome "f" met in ChE 1121, 2306, 3232, 3330, 4344, 4372, 4555, 4232 ChE 1121: For 2013/14, the grade on Report 1 was used to assess the outcome with success being > 70%. The mean was 93 +/- 7; the range was 79-100. NOTE: Few students did not turn in their HW so they received 0, thus resulting in less than 100% successful performance. Outcome met. ChE 2306: For 2013/14, one of the homework assignments and a few T/F questions in the 1st sections of the final exam were used to assess. The class was deemed to have understood the material for "Appreciation of the ethical and professional behavior expected of engineers". For "Understanding of the ethical issues involved in writing and presenting information", the absence of plagiarism in writing assignments was assessed. The instructor did not find any obvious instances of copying; there was a tendency on the part of a few students to quote purely expository material, which the instructor was able to reduce but not eradicate. Outcomes met. ChE 3232: For 2013/14, 2 safety exams were assessed. a) On-line exam administered by TTU EH&S. Safety certificates were collected and placed in the Unit Ops lab. 68/68 students submitted certificates. b) In-class safety exam with one allowed retake with 70% minimum required to pass. 68/68 students passed the in-class exam with 23 students retaking to pass. During the lab session, no safety violations were observed and no accidents occurred. Students all wore PPE and performed experiments safely. Outcomes met. ChE 3330: For 2013/14, an ethics presentation along with a full additional lecture on ethics was provided by the invited speaker from Murdough Center for Engineering	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		Professionalism National Institute for Engineering Ethics was used to assess. Ethics project grades ranged from 430 to 485 out of 500 points. The students also participated in ethics discussions during the last session of class. Outcome met. ChE 4232: For 2013/14, students were required to pass Health, Environment, and Safety quiz before entering lab. 37/37 students scored 80% or higher on lab safety quiz prior to entering lab. During the semester, no significant safety violations were noted. Overall, safety training was judged to be effective. Outcome met. ChE 4344: For 2013/14, A 'C' or better was required on the safety quiz. 11/11 students met this requirement. Outcome met. ChE 4372: For 2013/14, a grade of 70 or better on the individual project was required. All students passed the individual project. Outcome met. ChE 4555: For 2013/14, an exam was used to assess with students required to earn at least 70% on a multiple choice exam testing knowledge of equipment cost. 40 of 41 students scored 70% or higher. The mean was 91% with a std deviation of 13%. Grades ranged from 45% to 100%. Outcome met. (09/18/2014) **Related Documents:** Table 5-2.docx	
	Instructor Course Evaluation - Environmental, Health, and Safety quiz in ChE 3232 and 4232 **Criterion:** 100% of students receive C or better **Schedule:** Yearly	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met For 2015/16, all students passed the safety quizzes in both courses. (06/29/2016) **Related Documents:** 20152016 ABET.xlsx	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met 100% of students received C or better for quizzes in both	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		courses. (06/15/2015) **Related Documents:** Table 4-2 defg 2015.docx	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met 100% of students received C or better for quizzes in both courses (09/18/2014) **Related Documents:** Table 4-2 defg.docx	
	Capstone Assignment/Project - External judging of capstone design posters **Criterion:** 100 % of teams obtain above 60 % on understanding of process hazards associated with their design **Schedule:** Yearly	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met Average safety score: 91.05; low score 74.07; none of the 16 teams scored under 60%. Outcome met. (06/08/2016)	
		Assessment Cycle: Action To Be Defined (Prior to 2015-2016) **Result Type:** Criterion Not Met Average safety score: 62.44; Low score: 20.00; One group out of 15 scored < 60 %. (06/05/2015) **Related Documents:** Capstone Project Eval 2015 (2).doc	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Inconclusive This was not evaluated for the 2014 Capstone projects. (09/20/2014) **Related Documents:** Capstone Project Eval 2015 (2).doc	
ABET Criteria 3g - An ability to communicate effectively **Outcome Status:** Active **Outcome Type:** Student Learning **Start Date:** 09/01/2006	**Survey - Student -** Exit Interviews of Graduating Seniors **Criterion:** Value of 4.0 or higher **Schedule:** Yearly **Related Documents:** Exit Survey Results 2009	**Assessment Cycle:** 2015 - 2016 **Result Type:** Inconclusive 4.03 on Q1 (Writing Skills); 3.82 on Q2 (Speaking Skills). (05/23/2016)	
		Assessment Cycle: Action To Be Defined (Prior to 2015-2016) **Result Type:** Inconclusive 4.02 on Q1 (Writing Skills); 3.80 on Q2 (Speaking Skills) (06/05/2015) **Related Documents:** Exit Survey Data Table 21 2015.doc	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met 4.00 on Q1 (Writing Skills); 4.00 on Q2 (Speaking Skills) (09/18/2014) **Related Documents:** Table 4-2 defg.docx	
	Instructor Course Evaluation - Instructor self-evaluation of course **Criterion:** Student learning outcome "g" met in course as evaluated by one or more performance indicators using HWs, quizzes, exams, and/or projects. **Schedule:** Yearly	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met For 2015/16, student learning outcome "g" was met in ChE 1121, 1305, 3232, 4232, 4315, 4366, and 4555. ChE 1121: For 2015/16, a written assignment on chemical engineering careers and needs was evaluated. 95% of the students completed this assignment with a passing grade. Outcome met. ChE 1305: For 2015/16, students were required to score at least 70% on weekly individual projects requiring handwritten and typewritten engineering calculations and at least 70% on Pop Quiz 1. 91/97 students satisfied the handwritten calculations, 96/97 students satisfied the typewritten calculations, and 94/97 students satisfied Pop Quiz 1. Outcome met. ChE 3232: For 2015/16, Lab reports were assess writing skills. Fluid Friction - mean: 70.2; range: 48.2 - 87.5 Free and Forced Convection - mean: 72; range: 35.7 - 87.5 Pump Performance - mean: 74.2; range: 55.5 - 93.7 Diffusion - mean: 83.2; range: 63 - 97 Outcome met. ChE 4232: For 2015/16, 4 lab reports were required to evaluate students' written communication skills. Mean: B (range 50 - 100) was achieved for each experiment report. Outcome met. ChE 4315: For 2015/16, valid contribution from all group members during presentations was required. All group members were present and took part in their group	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		presentations throughout the semester. Outcome met. ChE 4366: For 2015/16, at least 60% was required in a journal article critique project, a design project, and a lab group project. All 27 students scored at least 60% on ALL projects. Outcome met. ChE 4555: For 2015/16, group assessments were used on the intermediate design report, the Capstone design report, and the project design presentation. 14/17 groups scored "good" or "excellent" on intermediate design report. 17/17 groups scored "good" or "excellent" on the Capstone design report; range: 70.8 - 97; mean: 87.4 +/- 8.3. On the project presentation, an independent committee of faculty and industrial representatives were used. Range: 63 - 100; mean: 80.1. Outcome met. (06/29/2016) **Related Documents:** 20152016 ABET.xlsx	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met Student learning outcome "g" met in ChE 1121, 1305, 3232, 3330, 4232, and 4356. ChE 1121: For 2014/15, a written assignment on chemical engineering careers and needs was assessed. 95% of the students completed this assignment with a passing grade. Outcome met. ChE 1305: For 2014/15, > 70% scores on group projects with one requiring submission of a handwritten engineering calculation and another requiring submission of a typewritten engineering calculation were required. On each, all submittals scored above 70%. Outcome met. ChE 3232: For 2014/15, an oral presentation was given by every group. Assessment was based on presentation slide content, oral presenting skills, and Q&A. 13/16 groups were able to achieve A or B for the presentations. Outcome met.	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		ChE 3330: For 2014/15, a case study on several unique materials (such as artificial bones, medical implants) was used to assess. Students were involved in in-class group discussion and performances were based on instructor's observation. Outcome met. ChE 4232: For 2014/15, 5 lab reports were used to assess each student's written communication skills. An average of B was achieved for each experiment report. ChE 4356: For 2014/15, all students were required to pass Exam 2. In addition, student video projects addressing OSHA and EPA rules, HW 1-3 requiring certification in assigned SACHE modules, and video projects showing attentiveness to the hazards in chemical process safety were assessed. All students passed Exam 2; all team projects exhibited understanding of importance of government regulation to safety; all students completed required certifications; and, all video projects showed student awareness of the importance of chemical process safety and how it affects lives. (06/10/2015) **Related Documents:** Table 4-2 defg 2015.docx Table 5-2 2015 REV.docx	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met Student learning outcome "g" met in ChE 1121, 2306, 3232, 3330, 4344, 4341, 4353, 4356, 4364 ChE 1121: For 2013/14, grades on attendance, HWs 1-5, and Report 1 were used to assess. Attendance - mean 99 +/- 6, range 97-100 HW1 - mean 91 +/- 10, range 30-100 HW2 - mean 80 +/- 8, range 10-97 HW3 - mean 83 +/- 8, range 59-100 HW4 - mean 89 +/- 8, range 33-100 HW5 - mean 94 +/- 8, range 50-100	**Action for Improvement:** Move ChE 2306 Exposition of Technical Information from spring sophomore year to fall junior year. Move ChE 3315 Fluid Mechanics to spring junior year. The move is anticipated to solve two problems: i) students are ill prepared to write technical reports in ChE 3232 in the spring of their junior year due to the lag between when technical writing ChE 2306 is taught and the lab and students lack technical maturity in

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		(NOTE: a few students did not turn in their HW so they received a 0 grade, thus resulting in less than 100% successful performance) Report 1 - mean 93 +/- 7, range 79-100 Outcome met. ChE 2306: For 2013/14, several assessments were used. "Ability to write clearly and effectively, and ability to adapt the writing style/format to specific purposes" - 4 HW assignments (essays) plus the technical report component of the final project was used to assess. Students showed marked improvement in the quality of their written work over the course of the semester. Outcome met. "Ability to give clear and effective oral presentations, to gauge an audience, and to select an appropriate method and style of presentation" - 4 lab assignments (short presentations) plus the conference talk component of the final project was used to assess. Students showed decent improvement, subject to the fact that some already were quite competent in this area ("the gift of gab"). ChE 3232: For 2013/14, to measure "Ability to perform experiments, write reports, and perform oral presentation to analyze and explain data", data analysis and sample calculation of lab reports were used to evaluate students' ability to analyze data. Also, discussion part of lab reports was used to evaluate their ability to interpret data/results. Less than 30% of the first reports provided clear structure, good writing skills and proper data analysis with statistical analysis. For that, the mean was 73.2 with a range of 65 to 82. 80% of the last reports provided acceptable technical writing and proper data analysis/interpretation. Mean: 80.9 Range: 72.0 to 94.0	their sophomore year to write meaningful technical assignments. (09/01/2014)

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		60% of the groups were able to consistently achieve grade A or B for their presentations. Average grade was based on the grades from both instructor and TAs. - outcome met ChE 3330: For 2013/14, a graded ethics presentation with combined instructor and peer grades. Overall, the instructor and peer evaluations were very satisfactory. The students functioned well and the students seemed to enjoy the project. All students participated actively and were fully engaged based on student evaluations and on the instructor observations of individual participation. The ethics project grades ranged from 430 to 485 out of 500. The students also participated in ethics discussions during the last session of class. Outcome met. ChE 4341: For 2013/14, in-class discussions and course presentations were assessed. All students participated in discussions and conducted peer-review evaluation on course presentations. Mean performance score: 9.2/10 - outcome met. ChE 4344: For 2013/14, the assessment was a grade of B- or better on the final lab report. 10/11 students met (91%) this outcome. ChE 4353: For 2013/14, students were required to contribute to preparation of a written group design report. All students contributed to writing of the reports, as indicated by all students passing peer evaluations - outcome met. ChE 4356, For 2013/14, a final project was directly associated with OSHA and EPA regulations. All students completed this project with a passing grade - outcome met. ChE 4364, For 2013/14, a group project written report and oral presentation were used. All students passing the course passed group project written report and oral presentation.	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		Written report - mean 90, min 90 (out of 100) Oral presentation - mean 90, min 90 Outcome met (09/18/2014) **Related Documents:** Table 5-2.docx	
	Capstone Assignment/Project - External judging of capstone design project posters **Criterion:** Presentation score of > 60 % with 100 % of teams meeting this minimum score **Schedule:** annual	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met Average score of 92.18; low score is 71.67; all teams satisfied ABET Category g. Outcome met. (06/08/2016)	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met Average score of 81.2; low score of 65.3 on 2015 capstone design project poster presentations. All design groups scored > 60 % on their presentation scores. (06/05/2015) **Related Documents:** Capstone Project Eval 2015 (2).doc	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met Average score of 82.7; low score of 60.7 on 2014 capstone design project poster average presentation score. All design groups scored > 60 % on their average presentation scores. One group scored < 50 % on presentation of conclusions. (09/20/2014) **Related Documents:** Capstone Project Eval 2015 (2).doc	
ABET Criteria 3h - The broad education necessary to understand the impact of engineering solutions in a global and societal context **Outcome Status:** Active **Outcome Type:** Student Learning **Start Date:** 09/01/2006	**Survey - Student -** Exit Interviews of Graduating Seniors **Criterion:** Value of 4.0 or higher on Question 19 (Awareness of the political and societal context of engineering) **Schedule:** Yearly **Related Documents:** Exit Survey Results 2009	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Not Met 3.85 on Q19 (Awareness of the Political & Societal Context of Engineering). Criterion not met. (05/23/2016)	
		Assessment Cycle: Action To Be Defined (Prior to 2015-2016) **Result Type:** Criterion Not Met 3.76 on Q19 (Context of engineering) (06/05/2015) **Related Documents:** Exit Survey Data Table 21 2015.doc	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met 4.02 on Q19 (Context of Engineering) (09/18/2014) **Related Documents:** Table 4-2 hijk.docx	
	Instructor Course Evaluation - Instructor self-evaluation of course **Criterion:** Student learning outcome "h" met in course as evaluated by one or more performance indicators using HWs, quizzes, exams, and/or projects. **Schedule:** Yearly	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met For 2015/16, student learning outcome "h" met in ChE 4366. ChE 4366: For 2015/16, at least 60% was required in a journal article critique project and a design project. All 27 students scored at least 60% on BOTH projects. Outcome met. (02/17/2016) **Related Documents:** 20152016 ABET.xlsx	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met Student learning outcome "h" met in ChE 4356. ChE 4356: For 2014/15, all students were required to pass Exam 2. In addition, student video projects addressing OSHA and EPA rules, HW 1-3 requiring certification in assigned SACHE modules, and video projects showing attentiveness to the hazards in chemical process safety were assessed. All students passed Exam 2; all team projects exhibited understanding of importance of government regulation to safety; all students completed required certifications; and, all video projects showed student awareness of the importance of chemical process safety and how it affects lives. In addition, students were required to develop a "short course" for a chemical industry setting during Exam 2. All students passed this part as they passed Exam 2. Outcome met. (06/10/2015) **Related Documents:** Table 5-2 2015 REV.docx Table 4-2 hijk 2015.docx	
		Assessment Cycle: No Action Needed (Prior to 2015-2016)	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		Result Type: Criterion Met Student learning outcome "h" met in ChE 1121, 3330 ChE 1121: For 2013/14, grades on HWs and attendance were used in the assessment. Attendance - mean 99 +/- 6, range 97-100 HW1 - mean 84 +/- 10, range 34-95 HW2 - mean 80 +/- 8, range 21-97 HW3 - mean 90 +/- 8, range 40-100 (NOTE: a few students did not turn in their HW resulting in a 0. This resulted in less than 100% successful performance). Outcome met. ChE 3330: An ethics project used to evaluate outcomes "d", "f", and "g" addressed this outcome indirectly because of the problems included (Upper Big Branch mine disaster, levee failures during Hurricane Katrina, Hurricane Bhopal, Ford Pinto, UA Flight 232, Challenger disaster, Titanic, Deepwater Horizon, Exxon Valdez, etc.) - Outcome met. (09/18/2014) **Related Documents:** Table 5-2.docx	
	Capstone Assignment/Project - External judging of capstone design posters **Criterion:** 100 % of teams receive above 60 % concerning analysis of the impact of their design in a societal context **Schedule:** annual	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met Mean score was 87.65. Lowest score was 61.11. Outcome met. (06/15/2016)	
		Assessment Cycle: Action To Be Defined (Prior to 2015-2016) **Result Type:** Criterion Not Met Mean score was 55.33. Four groups failed to meet this criteria. (06/05/2015) **Related Documents:** Capstone Project Eval 2015 (2).doc	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Inconclusive This was not evaluated for 2014 Capstone projects.	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		(09/20/2014) **Related Documents:** Capstone Project Eval 2015 (2).doc	
ABET Criteria 3i - A recognition of the need for, and an ability to engage in life-long learning **Outcome Status:** Active **Outcome Type:** Student Learning **Start Date:** 09/01/2006	**Survey - Student -** Exit Interviews of Graduating Seniors **Criterion:** Value of 4.0 or higher on Question 20 (Ability to learn on own) **Schedule:** Yearly **Related Documents:** Exit Survey Results 2009	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met 4.57 on Q20 (Ability to Learn on Your Own). Criterion met. (05/23/2016)	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met 4.49 on Q20 (Ability to learn on own) (06/05/2015) **Related Documents:** Exit Survey Data Table 21 2015.doc	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met 4.63 on Q20 (Ability to Learn on Own) (09/18/2014) **Related Documents:** Table 4-2 hijk.docx	
	Instructor Course Evaluation - Instructor self-evaluation of course **Criterion:** Student learning outcome "i" met in course as evaluated by one or more performance indicators using HWs, quizzes, exams, and/or projects. **Schedule:** Yearly	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met For 2015/16, student learning outcome "i" was met in ChE 3232, 4232, 4366, and 4555. ChE 3232: For 2015/16, all 25 groups were able to find crucial data such as physical properties and theoretical value through Internet or handbook and all groups provided references in their reports. Outcome met. ChE 4232: For 2015/16, all lab reports were required to provide reference sources. 2 references were required for the introduction paragraph. Reference formatting followed American Chemical Society style guide. All groups were able to find crucial data such as physical properties. All 13 groups were able to provide 2 references for introduction and provided reference sources in the lab reports. Outcome met. ChE 4366: For 2015/16, at least 60% was required in a journal article critique project and a design project. All 27	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		students scored at least 60% on BOTH projects. Outcome met. ChE 4555: For 2015/16, students were required to earn at least 60% of the possible sum of report, poster, and presentation points. They were also required to obtain open-ended and undefined process and costing information from the literature, Internet, and company sources. All reports showed adequate independent work to obtain information and techniques. Presentations were peer scored using a rubric. Range: 82% - 92%; mean: 87%. Total design experience grades range: 61% - 94%; mean: 81%. Outcome met. (06/29/2016) **Related Documents:** 20152016 ABET.xlsx	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met Student learning outcome "i" met in ChE 3232, 4232, and 4555. ChE 3232: For 2014/15, part of the lab report questions required students to answer questions through self-learning process. Also, all the lab reports and presentations were required to provide reference sources with the format of these references following American Chemical Society style guide. All groups were able to find crucial data such as physical properties and theoretical value through Internet or handbook. All groups provided reference sources in the lab reports. Outcome met. ChE 4232: For 2014/15, all lab reports were required to provide reference sources. 2 references were required for the introduction paragraph. Format of references followed American Chemical Society style guide. All groups were able to find crucial data such as physical properties. 14/17 groups were able to provide 2 references for introduction. All groups provided reference sources in the lab reports. Outcome met.	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		ChE 4555: For 2014/15, the Capstone oral and poster presentations were assessed. Presentations were peer scored using a rubric. Scores ranged from 82% to 92% with a mean of 87%. Total design experience grades ranged from 61% to 94% with an average of 81%. Outcome met. (06/10/2015) **Related Documents:** Table 4-2 hijk 2015.docx Table 5-2 2015 REV.docx	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met Student learning outcome "i" met in ChE 4555, 4232 ChE 4232: For 2013/14, all lab reports were required to include references formatted according to the American Chemical Society Style Guide, including non-Internet literature citations. 100% of collected lab reports adhered to guidelines for providing references (journal articles and books). Students' use of library and Internet resources to locate technical material was judged satisfactory by course end. Outcome met. ChE 4555: For 2013/14, the Capstone report and poster session was used to assess. Each report showed adequate research and independent gathering of data and information. Outcome met. (09/18/2014) **Related Documents:** Table 5-2.docx	
	Student Exit Survey - Participation in research or co-op and plans for advanced degree **Criterion:** 30% or higher do student research, 15% or higher do student co-op, and 15% or higher plan on advanced degree **Schedule:** Yearly	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met For 2015/16, 46% did student research, 56% did co-ops, and 46% plan on higher degree. Criterion met. (06/15/2016)	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met 43% perform student research, 69% are student co-ops, and 16% pursuing advanced degree. (06/15/2015)	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		31% perform student research, 65% are student co-ops, and 19% pursuing advanced degrees (09/18/2014) **Related Documents:** Table 4-2 hijk.docx	
	Student Exit Survey - Participation in professional organization **Criterion:** 50 % of students participate in a professional organization **Schedule:** Yearly	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met For 2015/16, 55 seniors participated in a professional organization. Outcome met. (06/15/2016)	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Inconclusive New assessment method. Results to be added 2016 (08/17/2015)	
ABET Criteria 3j - A knowledge of contemporary issues **Outcome Status:** Active **Outcome Type:** Student Learning **Start Date:** 09/01/2006	**Instructor Course Evaluation -** CH E 4555: Chemical Process Design and Simulation CH E electives	**Assessment Cycle:** 2015 - 2016 **Result Type:** Inconclusive ChE 4555: For 2015/16, no criteria "j" specified on syllabus. (06/27/2016)	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Inconclusive New assessment method. Results to be added 2016 (08/17/2015)	
	Survey - Student - Exit Interviews of Graduating Seniors **Criterion:** Value of 4.0 or higher on Question 16 (Contemporary Issues) **Schedule:** Yearly **Related Documents:** Exit Survey Results 2009	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Not Met 3.74 on Q16 (Understanding of Contemporary Issues in Science/Technology). Criterion not met. (05/23/2016)	
		Assessment Cycle: Action To Be Defined (Prior to 2015-2016) **Result Type:** Criterion Not Met 3.91 on Q16 (Contemporary Issues) (06/05/2015) **Related Documents:** Exit Survey Data Table 21 2015.doc	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met 4.12 on Q16 (Contemporary Issues) (09/18/2014) **Related Documents:** Table 4-2 hijk.docx	
	Instructor Course Evaluation - Instructor self-evaluation of course	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
	Criterion: Student learning outcome "j" met in course as evaluated by one or more performance indicators using HWs, quizzes, exams, and/or projects. **Schedule:** Yearly	For 2015/16, student learning outcome "j" met in ChE 1121 and 4366. ChE 1121: For 2015/16, a written assignment on chemical engineering careers and needs was evaluated. 95% of the students completed this assignment with a passing grade. Outcome met. ChE 4366: For 2015/16, at least 60% was required in a journal article critique project and a design project. All 27 students scored at least 60% on BOTH projects. Outcome met. (02/18/2016) **Related Documents:** 20152016 ABET.xlsx	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met Student learning outcome "j" met in ChE 1121, 3315, 3341, 4340, and 4356. ChE 1121: For 2014/15, a written assignment on chemical engineering careers was assessed. 95% of the students completed this assignment with a passing grade. Outcome met. ChE 3315: For 2014/15, 80% of the students attempting all weekly challenge assignments was required to meet the outcome. > 80% of the students turned in weekly fluid dynamics challenges each week. ChE 3341: For 2014/15, this assessment was tested throughout the course in the concept questions' section of each of the 3 exams. Mean for concept question on Exam 1: 85%; 53/58 students scoring at least 65%. Mean for concept question on Exam 2: 80%; 56/76 students scoring at least 65%. Mean for concept question on Exam 3: 75%; 58/76 students scoring at least 65%. Outcome met. ChE 4340: For 2014/15, 90% of the students were required to attend relevant lectures and participate in discussions.	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		All (21/21) students did this. ChE 4356: For 2014/15, all students were required to pass Exam 2. In addition, student video projects addressing OSHA and EPA rules, HW 1-3 requiring certification in assigned SACHE modules, and video projects showing attentiveness to the hazards in chemical process safety were assessed. All students passed Exam 2; all team projects exhibited understanding of importance of government regulation to safety; all students completed required certifications; and, all video projects showed student awareness of the importance of chemical process safety and how it affects lives. (06/11/2015) **Related Documents:** Table 5-2 2015 REV.docx Table 4-2 hijk 2015.docx **Assessment Cycle:** No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met Student learning outcome "j" met in ChE 1121, 3341, 4356, 4372 ChE 1121: For 2013/14, a presentation was used to assess this outcome. Mean 98 +/- 8 with a range of 80-100. (NOTE: a few students did not turn in their HW so they received 0; this resulted in less than 100% successful performance) Outcome met. ChE 3341: For 2013/14, an in-class quiz was used to assess. 41/57 students who passed this course successfully met the outcome. Outcome met. ChE 4356: For 2013/14, a final project directly associated with OSHA and EPA was used to assess. All students completed this project with a passing grade. Outcome met. ChE 4372: For 2013/14, a grade of 70 or better on exams	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		and software assignments (ex. Minitab). Minitab (or other statistical software: R, SOFA, etc.) was used for the 2 projects and one class assignments. All students passed - outcome met. (09/18/2014) **Related Documents:** Table 5-2.docx	
ABET Criteria 3k - An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice **Outcome Status:** Active **Outcome Type:** Student Learning **Start Date:** 09/01/2006	**Instructor Course Evaluation -** CH E 1305: Engineering Analysis I CH E 2410: Introduction to Chemical Process CH E 4555: Chemical Process Design and Simulation	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met For 2015/16: ChE 1305: Read and write programming flowcharts using the top-down programming paradigm - students were required to score at least 70% on Project 7 and at least 70% on Pop Quiz 4. 85/97 students satisfied Project 7 and 80/97 students satisfied Pop Quiz 4. Criterion met. Construct, debug, and execute a procedural computer program (MATLAB) - students were required to score at least 70% on Pop Quiz 6, at least 70% on Project 11, and at least 70% on Group Project. 85/97 students satisfied Pop Quiz 6, 78/97 satisfied Project 11, and all students satisfied the Group Project. Criterion met. Set up a steady state simulation of a chemical process (HYSIS) - students were required to score at least 70% on Project 14, at least 70% on Pop Quiz 7, and were required to answer 3 of 4 questions on Exam 4 (Q27-30) correctly. 93/97 students satisfied Project 14 and 71/97 students satisfied Pop Quiz 7. 70% of Q27-30 were answered correctly. Criterion met. Outcome met. ChE 2410: A small group design project was used to access. The project was to determine the process requirements for a system to dehydrate, compress, and burn a	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		multicomponent gas mixture. This project came from an industry contact and based on an actual project. The assessment was based on demonstrating an understanding of design trade-offs and good judgment in selecting and using the proper equations and physical properties. A design report was required consisting of a project summary, calculated compositions, flows, stream conditions, and material and energy balance sheets and their HYSIS program. A passing grade was 5/10. Groups were GPA balanced and each group was required to submit a project. 50/53 students scored at least 5 on the project. Range: 2-10. Mean: 7.4. Criterion met for 2410. ChE 4555: Students were required to score at least 50% on economics exam. 64/69 students accomplished this; mean: 66.2 +/- 12. Range: 39 - 98. Each student was also required to complete a safety analysis for the Capstone Project. All students completed either a HAZOP analysis or a Fire and Explosion Index Analysis of one unit in the Capstone Project. Outcome met. (06/22/2016)	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Inconclusive New assessment method. Results to be added 2016 (08/17/2015)	
	Survey - Student - Exit Interviews of Graduating Seniors **Criterion:** Value of 4.0 or higher on Question 7 (Computing skills) **Schedule:** Yearly **Related Documents:** Exit Survey Results 2009	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Not Met 3.66 on Q7 (Computing Skills). Criterion not met. (05/23/2016)	**Action for Improvement:** Change design sequence so that the Chemical Engineering Review course is 3 credits and focuses on design of individual units to ensure that students can use engineering simulation software. (06/13/2016)
		Assessment Cycle: Action To Be Defined (Prior to 2015-2016) **Result Type:** Criterion Not Met 3.89 on Q7 (Computing Skills) (06/05/2015)	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		Related Documents: Exit Survey Data Table 21 2015.doc	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met 4.10 on Q7 (Computing Skills) (09/18/2014) **Related Documents:** Table 4-2 hijk.docx	
	Instructor Course Evaluation - Instructor self-evaluation of course **Criterion:** Student learning outcome "k" met in course as evaluated by one or more performance indicators using HWs, quizzes, exams, and/or projects. **Schedule:** Yearly	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met For 2015/16, student learning outcome "k" met in ChE 1121, 3232, 3322, 3326, 4232, 4315, 4363, 4391, and 4555. ChE 1121: For 2015/16, a specific assignment reproducing a PFD using Visio was evaluated. 90% of the students completed the assignment with a passing grade. Outcome met. ChE 3232: For 2015/16, 3/4 of the experiments required students to use MATLAB or Excel to extrapolate data and 3/4 of those experiments required students to take a minimum of 3 measurements at EACH condition and use Excel to perform statistical analysis. Fluid Friction - 24/25 groups used MATLAB/Excel to estimate the true roughness of the pipe. Free and Forced Convection - 24/25 groups used MATLAB/Excel to extrapolate steady state temperature. FF and FFC labs: 23/25 groups were able to perform basic statistical analysis and correctly present results in tables or graphs. Pump Performance labs: all 25 groups were able to use Excel to analyze pump characteristics including power, efficiency, and head. MATLAB was also used to calculate required system head for the determination of duty point. All groups were able to perform basic statistical analysis and 5 groups were able to apply Q-test and t-test. Outcome met. ChE 3322: For 2015/16, students passing the course needed more than 55% cumulatively on 2 projects. 69 students met	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement

this criteria. Outcome met.

ChE 3326: For 2015/16, a score on MATLAB project was evaluated with at least 50% required. 81/92 students scored at least 50%
Mean: 89
Range: 0 - 100 (0 represents an assignment not submitted)
Outcome met.

ChE 4232: For 2015/16, several criteria were used. One statistics quiz was given to evaluate students' individual ability of statistics analysis; MATLAB/Excel was required to analyze data; statistics analysis in lab reports were evaluated; and, 2 questions related to statistics analysis were assessed in a double quiz.
Statistics quiz
Mean: 67.19 +/- 18.64
Range: 20 - 100

MATLAB/Excel
All 13 groups were able to use MATLAB or Excel to complete data analysis.

Lab reports
Mean of 79.5 (9.54/12) was achieved.

Double quiz
Mean of 85.71 (6.86/8); range of 50-100.

Outcome met.

ChE 4315: For 2015/16, scores of at least 60% on lab reports 3-6 were required. All students scored at least 75% on all lab reports. Outcome met.

ChE 4363: For 2015/16, HW5 and Q8 on the Final Exam were used for evaluation. At least 55% on each were required to meet the outcome. Mean score for HW5 was 3.8/4.0. Mean score for the Final Exam was 22.3/30. Outcome met.

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement

ChE 4391: For 2015/16, HW2 (Eclipse simulation) and HW4 (FDTD software used for silicon solar cell simulation) were used for evaluation. 11/12 students (91%) scored at least 60% and all students scored at least 60%. Outcome met.

ChE 4555: Students were required to score at least 50% on economics exam. 64/69 students accomplished this; mean: 66.2 +/- 12. Range: 39 - 98. Each student was also required to complete a safety analysis for the Capstone Project. All students completed either a HAZOP analysis or a Fire and Explosion Index Analysis of one unit in the Capstone Project. Outcome met. (02/24/2016)

Related Documents:

20152016 ABET.xlsx

Assessment Cycle: No Action Needed (Prior to 2015-2016)
Result Type: Criterion Met

Student learning outcome "k" met in ChE 1121, 1305, 2410, 3232, 3315, 3322, 3326, 4232, 4353, 4356, 4363, and 4555.

ChE 1121: For 2014/15, a specific assignment in the course to reproduce a PFD using Visio was assessed. 85% of the students completed the assignment with a passing grade. Outcome met.

ChE 1305: For 2014/15, for Excel, 90/100 students scored > 70% on a Excel exam. For MATLAB, 96/100 students scored > 70% on a MATLAB exam. Also, > 70% score on a group project that converted a flowchart to a MATLAB program was required along with 3 correct exam question answers to convert a flowchart to a MathCAD program. 92% of MATLAB project submissions exceeded 70%. 45% of MathCAD questions were correctly answered. Outcomes met.

ChE 2410: For 2014/15, a small group design project was assessed. This involved determining process requirements for a system to dehydrate, compress, and burn a multicomponent gas mixture. This system required

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		multiple compressors, heat exchangers, mixers, recycle, and combustion equipment. This open-ended project came from an industry contact and was based on an actual project. Assessment was based on demonstrating an understanding of design trade-offs and good judgment in selecting and using the proper equations and physical properties. The students turned in a design report, consisting of a project summary, calculated compositions, flows, stream conditions, and material and balance sheets and their HYSYS program. The passing grade was 6 of 10 with each group member receiving the group grade. The students were partitioned into self-selected teams with each team required to submit a design project. Of the students who passed the course, 45/46 groups had at least 9 points on the design project. Grades ranged from 5 to 10; mean of 8.9. Outcome met. ChE 3232: For 2014/15, 2/3 of the experiments required students to use MATLAB/Excel to extrapolate data and all 3 experiments required students to take a minimum 3 measurements at each condition and use Excel to perform statistical analysis. In addition, a question from the Final Exam tested the students' ability of statistical analysis. 15/16 groups could use either MATLAB or Excel to extrapolate data and complete data analysis. 14/16 groups were able to perform basic statistical analysis such as calculating averages, standard deviations, and error propagations. Also, these groups were able to correctly add error bars on the graph. On the Final Exam question, 12/59 students were able to get the statistical problem solved. Outcome met. ChE 3315: For 2014/15, all groups handing in solved problems with at least 80% of the groups correctly solving problems. Fall - 19/20 groups correctly solving the problems. Spring - 18/20 groups correctly solving the problems. Outcome met. ChE 3322: For 2014/15, students needed to receive > 55%	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		cumulatively on the 2 projects to meet the objective. 69 students met this. Outcome met. ChE 3326: For 2014/15, students needed to score > 50 on the MATLAB project. 54/55 students scored at least 50 on the assignment. Mean: 97; range: 0-100. Outcome met. ChE 4232: For 2014/15, all experiments required students to use MATLAB/Excel to analyze data. All groups could use either MATLAB/Excel to complete data analysis. 14/17 groups were able to perform basic statistical analysis and correctly indicate statistical results on graphs. Outcome met. ChE 4353: For 2014/15, Exam 1 Q1-10 and 15-30; Exam 2 Q1-10, 17-20, and 22-30; a Simulink project requiring > 70% grade; Exam 4 Q4-21; and an individual group project requiring a > 70% individual grade were assessed. Exam 1 Q1-10 and 15-30: 56% correct responses Exam 2 Q17-20: 38% of exam answers correct Simulink project: all students scored > 70% Exam 2 Q1-10 and 22-30: 61% correct responses Exam 4 Q4-21: 65% of exam answers correct Group Project: 57/59 students scored at least 70% Outcome met ChE 4356: For 2014/15, students were required to score either > 60% on Exam 1 or have all the safety certifications from HW1-3. 21 of the students scored > 60% on Exam 1. All students completed the safety modules and received certification. Outcome met. ChE 4363: For 2014/15, HW5 (minimum 55%) and Final Exam Q8 (minimum 55%) were assessed. Mean for HW5: 3.7/4.0; Mean for Final Exam: 24.8/30. Outcome met. ChE 4555: For 2014/15, students were required to average at least 80% on 3 design HW sets and score at least 70% on the individual HW sets. All students (15/15) scored at least	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		70% on each HW set. Mean was 91% with a range of 70%-100%. This objective met. Capstone Report - Students were required to score 70% of possible rubric points for equipment description, equipment specification sheets, and must demonstrate working simulations of the equipment or show detailed design. Equipment specification sheets appended to each report were satisfactory with all major equipment included. All students demonstrated the ability to use Aspen or HYSYS as a tool to size the components and generate specification sheets. Rubric scores ranged 80%-100%. Objective met. (06/11/2015) **Related Documents:** Table 5-2 2015 REV.docx Table 4-2 hijk 2015.docx	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met Student learning outcome "k" met in ChE 1121, 2410, 3232, 3315, 3322, 3323, 3326, 3341, 4341, 4344, 4353, 4555, 4232 ChE 1121: For 2013/14, the Hysis tutorial was used to assess - outcome met. ChE 2410: For 2013/14, a small group design project was used to assess. The project was to determine process requirements for a system to dehydrate, compress, and burn a multicomponent gas mixture. The system required multiple compressors, heat exchangers, mixers, recycle, and combustion equipment. This open-ended project came from an industry contact and was based on an actual project. Assessment was based on demonstrating an understanding of design trade-offs and good judgment in selecting and using the proper equations and physical properties. The students turned in a design report, consisting of a project summary, calculated compositions, flows, stream conditions and material and energy balance sheets and their HYSYS program. A passing grade was 9 of 15. Each group member received the group grade. Up to 2	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		extra credit points were available for clever application, and unusually detailed and careful work. Students were partitioned into self-selected teams with each team required to submit a design project. Of the students who passed the course, 45 of 46 groups had 9 or more points on the design project; range 8-17, mean 11.0. 2 students passed the course but did not have passing grades on the project. Their project work was adequate, but they did not follow instructions as to the form and content of the project submission. All students who passed were members of a group that turned in the project - outcome met. ChE 3232: For 2013/14, 3/4 experiments required students to use MATLAB/Excel to extrapolate data; 4/4 experiments required students to take a minimum of 3 measurements at each condition and use Excel to perform statistical analysis. 19/20 groups could use either MATLAB or Excel to extrapolate data and complete data analysis. 16/20 groups were able to perform basic statistical analysis and correctly add error bars on graphs - outcome met. ChE 3315: For 2013/14, a project involved Hysys to solve a piping/pump design problem, in addition to verification by hand calculations. The project involved using MATLAB to solve for flow rates in a complex piping network. 80/80 students scored 50% or higher - Outcome met. ChE 3322: For 2013/14, applications of principles of phase and reaction equilibria in engineering practice was discussed - outcome met. ChE 3323: For 2013/14, a HYSIS project was used to assess. The students knew how to design a reactor on HYSIS - outcome met. ChE 3326: For 2013/14, a MATLAB project was used to assess. 71/72 passing students received 50% or higher	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		score in MATLAB assignment. Mean - 99 Range - 20-100 Outcome met. ChE 3341: For 2013/14, a MATLAB programming project and a HYSYS programming project were used to assess. 56/57 students passed the MATLAB project and 57/57 students passed the HYSYS project - outcome met. ChE 4232: For 2013/14, appendices to lab reports were required to contain spreadsheet calculations and all graphs must have been prepared electronically. Students' mastery of spreadsheet calculations were judged to be effective for 100% of the students enrolled in the course. Lab reports collected exhibited adequate use of spreadsheets for performing calculations and preparing figures where appropriate - outcome met. ChE 4341: For 2013/14, HW4 Q4 and Mid-term 2 Q1 were used to assess. All students solved HW4 Q4. Mean score of Mid-term 2 Q1 was 2.5/3. Outcome met. ChE 4344: For 2013/14, successful completion of all labs were required. 11/11 students met this - outcome met. ChE 4353: For 2013/14, students were to earn more than 70% on 2 individual projects using Simulink transfer function software and use the HYSYS process simulator to design a control loop in a group project. 34/42 students scored >= 70% on Project 1; 39/42 students scored >= 70% on Project 2; all students contributed to writing of the reports, as indicated by all students passing peer evaluations - outcome met. ChE 4555: For 2013/14, the initial project report, Capstone report, poster presentation, and project oral presentation were used to assess.	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		Equipment specification sheets appended to each report were satisfactory. All major equipment was included. All students demonstrated the ability to use Aspen and/or HYSYS as a tool to size the components and generate specification sheets. Report scores ranged from 144-185 with a mean of 174 and a std dev of 11. Each design report included a section addressing regulatory and environmental regulations. All reports covered these details adequately. An independent committee of faculty and an industrial representative judged the posters. The presentation scores ranged from 72%-94% with a mean of 81%. Outcome met. (09/18/2014) **Related Documents:** Table 5-2.docx	
	Instructor Course Evaluation - 100% of students receive C or better in ChE 4555 Capstone Design **Criterion:** 100% of students receive C or better **Schedule:** Yearly	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met For 2015/16, all students received at least a C. Outcome met. (06/27/2016)	
		Assessment Cycle: Action To Be Defined (Prior to 2015-2016) **Result Type:** Criterion Not Met 98.3% of students received C or better in 2014/15. (06/15/2015) **Related Documents:** Table 4-2 hijk 2015.docx	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met 100% received C or better (09/18/2014) **Related Documents:** Table 4-2 hijk.docx	
Students - The program must evaluate student performance and enforce procedures to ensure and	**Self-Assessments -** Preparation of a self-study report for review by program faculty and an ABET	**Assessment Cycle:** Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014)	**Action for Improvement:** Prepare mock ABET report in June 2014 to prepare for the next ABET visit.

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
document that students who graduate meet all graduation requirements. Students must be advised regarding curriculum and career matters. **Outcome Status:** Active **Outcome Type:** Program **Start Date:** 09/01/2005	designated external accreditation evaluator. The report must describe processes and standards relating to student admissions, advisement, performance evaluation, and certification of degree completion. **Criterion:** Program faculty and an ABET designated external accreditation evaluator confirm that students receive appropriate advisement and that administrative processes are effective in evaluating student admissions, academic performance, and degree completion. **Schedule:** 6 year cycle	**Related Documents:** 2011 ABET Self Study 2010-2011 Student Learning Outcome Narrative **Assessment Cycle:** Action Complete (Prior to 2015-2016) **Result Type:** Criterion Met . (09/18/2014) **Related Documents:** 2005 ABET Evaluation Report	(04/30/2014) **Action for Improvement:** Currently preparing mock study document in preparation for the 2017 ABET review (09/30/2015)
Program Educational Objectives - The program must have published program educational objectives that are consistent with the mission of the institution, the needs of the program's various constituencies, and the ABET accreditation criteria. There must be a documented and effective process, involving program constituencies, for the periodic review and revision of these program educational objectives. **Outcome Status:** Active **Outcome Type:** Program **Start Date:** 09/01/2005	**Self-Assessments -** Preparation of a self-study report for review by program faculty and an ABET designated external accreditation evaluator. The report must include a listing of the program eduational objectives, a description of their relationship to the institutional and program mission statements, and a description of the process for their revision. **Criterion:** Program faculty and an ABET designated external accreditation evaluator confirm that the published program educational objectives are consistent with the institutional mission and that the program consistently utilizes an appropriate process for their revision. **Schedule:** 6 year cycle	**Assessment Cycle:** Action In Progress (Prior to 2015-2016) **Result Type:** Criterion Met Mock self-study report under preparation in anticipation of 2017 ABET program review (09/30/2015) **Assessment Cycle:** Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014) **Related Documents:** 2011 ABET Self Study Assessment of Program Objectives **Assessment Cycle:** Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014) **Related Documents:** 2005 ABET Evaluation Report	**Action for Improvement:** Prepare mock ABET report in June 2014 to prepare for the next ABET visit. (04/30/2014) **Action for Improvement:** Following the procedure described in the 2005 ABET Self-Study Report, the program revised the Program Educational Objectives to follow the recommendations of the ABET evaluator. (09/01/2006)
Student Learning Outcomes - The	**Self-Assessments -** Preparation of a	**Assessment Cycle:** Action In Progress (Prior to 2015-2016)	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
program must have documented student learning outcomes that prepare graduates to attain the program educational objectives. **Outcome Status:** Active **Outcome Type:** Program **Start Date:** 09/01/2005	self-study report for review by program faculty and an ABET designated external accreditation evaluator. The report must include a listing of the program's student learning outcomes and a description their relationship to the program educational objectives **Criterion:** Program faculty and an ABET designated external accreditation evaluator confirm that student learning outcomes prepare graduates to attain the program educational objectives. **Schedule:** 6 year cycle	**Result Type:** Criterion Met Mock self-study report under preparation in anticipation of 2017 ABET program review (09/30/2015)	
		Assessment Cycle: Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014) **Related Documents:** 2011 ABET Self Study Assessment of Student Outcomes	**Action for Improvement:** Prepare mock ABET report in June 2014 to prepare for the next ABET visit. (04/30/2014)
		Assessment Cycle: Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014) **Related Documents:** 2005 ABET Evaluation Report	
Continuous Improvement - The program must regularly use appropriate and documented processes for evaluating the extent to which both the program educational objectives and the student learning outcomes are attained. The results of these evaluations and other available information must be utilized as input to effect continuous improvement of the program. **Outcome Status:** Active **Outcome Type:** Program **Start Date:** 09/01/2005	**Directly related to Objective**	**Assessment Cycle:** Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014) **Related Documents:** Continuous Improvement Actions 2012-2013.docx	
		Assessment Cycle: Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014) **Related Documents:** Continuous Improvement 2011/12	**Action for Improvement:** added two new continuous improvement action items (09/30/2015)
	Self-Assessments - Preparation of a self-study report for review by program faculty and an ABET designated external accreditation evaluator. The report must include descriptions of the assessment processes used for evaluating the extent to which the program educational objectives and the student learning outcomes are attained. The report must also include summaries and analyses of the assessment results.	**Assessment Cycle:** Action Complete (Prior to 2015-2016) **Result Type:** Criterion Met added continuous improvement narrative (09/30/2015) **Related Documents:** continuous improvement narrative	
		Assessment Cycle: Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014) **Related Documents:** 2011 ABET Self Study 2010-2011 Student Learning Outcome Narrative	**Action for Improvement:** Prepare mock ABET report in June 2014 to prepare for the next ABET visit. (04/30/2014)
		Assessment Cycle: Action Complete (Prior to 2015-2016)	**Action for Improvement:**

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
	Criterion: Program faculty and an ABET designated external accreditation evaluator confirm that appropriate and documented processes are used for evaluating the extent to which both the program educational objectives and the student learning outcomes are attained. **Schedule:** 6 year cycle	**Result Type:** Inconclusive . (09/18/2014) **Related Documents:** 2005 ABET Evaluation Report	Continue preparing mock self-study report (09/30/2015)
	Self-Assessments - Preparation of a self-study report for review by program faculty and an ABET designated external accreditation evaluator. The report must include a listing of intiatives taken to improve the program and the assessment results or other available information which motivated the initiative. **Criterion:** Program faculty and an ABET designated external accreditation evaluator confirm that the program is engaged in a process of continuous program improvement that is guided by assessment results and other available information. **Schedule:** continuous	**Assessment Cycle:** Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014) **Related Documents:** Outcome Improvement Chemical Enigneering.pdf	**Action for Improvement:** To try to improve student outcomes h and j, these outcomes were added explicitly to CH E 1121 course objectives prior to Fall 2009. To improve student outcomes c and f, changes were made prior to the Fall of 2010, as indicated in Table 3. These changes included ensuring that three ethics films available from the Murdough Center have been incorporated into the curriculum. (09/01/2009)
		Assessment Cycle: Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014) **Related Documents:** Outcome Improvement Chemical Enigneering.pdf	**Action for Improvement:** Assessment initiatives within this degree program will be re-evaluated in Fall 2014; therefore, no assessment data are available to report. Administrator of assessment in this degree program will receive assessment training in Fall 2014 from the Office of Planning and Assessment (OPA). OPA staff will provide guidance and methodological expertise to assist faculty members, graduate advisors, and administrators with the development of a meaningful and

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
			sustainable program-level assessment plan. The assessment plan will take effect in Fall 2014; because of Texas Tech's assessment schedule, assessment evidence will be documented beginning in October 2015. (09/18/2014)
Curriculum - The program curriculum must devote adequate attention and time to each component, consistent with the outcomes and objectives of the program and institution. Students must be prepared for engineering practice through a curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints. **Outcome Status:** Active **Outcome Type:** Program **Start Date:** 09/01/2005	**Self-Assessments -** Preparation of a self-study report for review by program faculty and an ABET designated external accreditation evaluator. The report must include a curriculum table, discussion of the alignment of the curriculum with the program educational objectives, and a description of the major capstone design experience. **Criterion:** Program faculty and an ABET designated external accreditation evaluator confirm that the program curriculum design and implementation are consistent with the program educational objectives and outcomes. **Schedule:** 6 year cycle	**Assessment Cycle:** Action In Progress (Prior to 2015-2016) **Result Type:** Criterion Met Added two new action items for improving the undergraduate curriculum (09/30/2015) **Related Documents:** Curriculum action items	
		Assessment Cycle: Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014) **Related Documents:** 2011 ABET Self Study	**Action for Improvement:** Prepare mock ABET report in June 2014 to prepare for the next ABET visit. (04/30/2014)
		Assessment Cycle: Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014) **Related Documents:** 2005 ABET Evaluation Report	
Faculty - The faculty must be of sufficient number and must have the competencies to cover all of the curricular areas of the program. There must be sufficient faculty to accommodate adequate levels of student-faculty interaction, student advising and counseling, university service activities, professional development, and interactions with industrial and professional practitioners, as well as employers of	**Directly related to Objective**	**Assessment Cycle:** Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014)	
		Assessment Cycle: Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014)	
	Self-Assessments - Preparation of a self-study report for review by program faculty and an ABET designated external accreditation evaluator. The report should	**Assessment Cycle:** Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014) **Related Documents:** 2011 ABET Self Study	**Action for Improvement:** Prepare mock ABET report in June 2014 to prepare for the next ABET visit. (04/30/2014)

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
students. **Outcome Status:** Active **Outcome Type:** Program **Start Date:** 09/01/2005	describe the sufficiency of the faculty to cover all curricular areas of the program. This description should include the composition, size, credentials, and experience of the faculty. **Criterion:** Program faculty and an ABET designated external accreditation evaluator confirm that the qualifications of the faculty are sufficient to cover all curricular areas of the program. **Schedule:** 6 year cycle	**Assessment Cycle:** Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014) **Related Documents:** 2005 ABET Evaluation Report	
Facilities - Classrooms, offices, libraries, computing resources, and laboratories and associated equipment must be adequate to support the attainment of the program educational objectives and the student learning outcomes. **Outcome Status:** Inactive **Outcome Type:** Program **Start Date:** 09/01/2006	**Self-Assessments -** Preparation of a self-study report for review by program faculty and an ABET designated external accreditation evaluator. The report should describe the program's facilities in terms of their adequacy to support the attainment of the program educational objectives and the student learning outcomes and to provide an atmosphere conducive to learning. **Criterion:** Program faculty and an ABET designated external accreditation evaluator confirm that the program's facilities are adequate to support the attainment of the program educational objectives and the student learning outcomes. **Schedule:** 6 year cycle	**Assessment Cycle:** Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014) **Related Documents:** 2011 ABET Self Study **Assessment Cycle:** Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014) **Related Documents:** 2005 ABET Evaluation Report	
Institutional Support - Institutional support and leadership must be adequate to ensure the quality and continuity of the program. Resources including institutional services,	**Self-Assessments -** Preparation of a self-study report for review by the program faculty and an ABET designated external accreditation evaluator. The report should	**Assessment Cycle:** Action In Progress (Prior to 2015-2016) **Result Type:** Criterion Met . (09/18/2014) **Related Documents:** 2011 ABET Self Study	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
financial support, and administrative and technical staff provided to the program must be adequate to meet program needs, attract qualified faculty, and to provide an environment in which the program educational objectives and student learning outcomes can be attained. **Outcome Status:** Inactive **Outcome Type:** Program **Start Date:** 09/01/2005	describe the commitment and adequacy of the institutional support for financial, faculty, staff, and facility resources. **Criterion:** Program faculty and the ABET designated external accreditation evaluator confirm that the institutional support is adequate to ensure the quality and continuity of the program . **Schedule:** 6 year cycle	**Assessment Cycle:** Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014) **Related Documents:** 2005 ABET Evaluation Report	
Program Objective 1 - Graduates will be successful in chemical engineering-related careers and other diverse career paths. **Outcome Status:** Inactive **Outcome Type:** Student Learning **Start Date:** 09/01/2006	**Survey - Alumni -** Question 38 on University Alumni Survey **Criterion:** 100% employed	**Assessment Cycle:** Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/17/2014)	
		Assessment Cycle: Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/17/2014)	
		Assessment Cycle: Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/17/2014)	
		Assessment Cycle: Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/17/2014)	
	Employer Survey - Question 1 on Recruiter/Employer survey **Criterion:** Value of 4.0 or higher	**Assessment Cycle:** Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014)	
		Assessment Cycle: Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014)	
	Employer Survey - Question 4 on Recruiter/Employer survey **Criterion:** Value of 4.0 or higher	**Assessment Cycle:** Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014)	
		Assessment Cycle: Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014)	
		Assessment Cycle: Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		. (09/18/2014)	
	Employer Survey - Question 3 on Recruiter/Employer survey **Criterion:** Value of 4.0 or higher	**Assessment Cycle:** Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014)	
		Assessment Cycle: Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014)	
	Student Exit Survey - Questions 1 - 20 on Exit Survey querying Chemical Engineering Skills **Criterion:** Value of 4.00 or higher **Schedule:** Yearly	**Assessment Cycle:** Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014)	
		Assessment Cycle: Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014) **Related Documents:** Exit Survey Data	
Program Objective 2 - Graduates will continue professional development and will pursue continuing education opportunities relevant to their careers. **Outcome Status:** Inactive **Outcome Type:** Student Learning **Start Date:** 09/01/2006	**Survey - Alumni -** Questions 31, 33, 34 on University Alumni Survey **Criterion:** 8% of graduates will pursue professional licensure; 20% will pass FE exam	**Assessment Cycle:** Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014)	
		Assessment Cycle: Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014)	
	Survey - Alumni - Questions 35, 36, 37 on University Alumni Survey **Criterion:** 20% participation in professional organization and activities	**Assessment Cycle:** Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014)	
		Assessment Cycle: Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014)	
	Standardized Test - Percent of students taking and passing FE exam **Criterion:** 20 percent of students take and pass FE exam **Schedule:** Yearly	**Assessment Cycle:** Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014)	
		Assessment Cycle: Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014)	
Program Objective 3 - Some graduates will pursue advanced degrees.	**Student Exit Survey -** Questions 35, 38 on Senior Exit Survey and Interview	**Assessment Cycle:** Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014)	

Student Learning Outcomes	*Assessment Methods*	*Results*	*Actions for Improvement*
Outcome Status: Inactive **Outcome Type:** Student Learning **Start Date:** 09/01/2006	**Criterion:** 10% of students will pursue advanced degrees in chemical engineering based on exit interviews	**Assessment Cycle:** Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive 9.0 % of students pursued graduate degrees in chemical engineering directly after graduation, based on senior exit interviews from 2006 to 2010. (09/18/2014)	
		Assessment Cycle: Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014)	
		Assessment Cycle: Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014)	
	Student Exit Survey - Questions 35, 38 on Senior Exit Survey and Interview **Criterion:** 5% of graduate will pursue advanced degrees in a field other than chemical engineering based on exit interviews.	**Assessment Cycle:** Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014)	
		Assessment Cycle: Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014)	
		Assessment Cycle: Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014)	
		Assessment Cycle: Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive . (09/18/2014)	

Assessment: Account Information Four Column

TEXAS TECH UNIVERSITY
Office of the Provost
Office of Planning & Assessment

Degree Program - ENG - Chemical Engineering (MSCHE)

CIP Code: 14.0701.00
Degree Program Coordinator: Sindee Simon
Degree Program Coordinator Email: Sindee.Simon@ttu.edu
Degree Program Coordinator Phone: +18068348470
Degree Program Coordinator Mail Stop: 3121
Program Purpose Statement: Major objectives of the department during the next decade will be: (1) to provide students with a high quality education at both the undergraduate and graduate levels to enable them to adapt to a rapidly changing technical environment, (2) to produce graduates who will be productive throughout their careers in a wide range of industrial, professional, and academic environments, and (3) to develop graduates with a strong sense of ethics and professionalism and the ability to succeed as both individual and team contributors.
Assessment Coordinator: Sindee Simon

Student Learning Outcomes	*Assessment Methods*	*Results*	*Actions for Improvement*
Program Outcome Masters 1 - Graduates have advanced knowledge of the field and are able to effectively apply this knowledge. **Outcome Status:** Active **Outcome Type:** Student Learning **Start Date:** 09/01/2013	**Student Transcript Evaluation -** Mastery of ChE core concepts. **Criterion:** All students pass required core curriculum with GPA of 3.0 or higher. **Schedule:** Annually	**Assessment Cycle:** 2015 - 2016 **Result Type:** Inconclusive For 2016 MS graduates, 2 passed the required core curriculum with a GPA of 3.4 - 4.0 (above 3.0). 4 had core curriculum GPA's < 3.4 (uncertain if GPAs were at least 3.0). (06/21/2016)	
		Assessment Cycle: 2015 - 2016 **Result Type:** Criterion Not Met For 2015 MS graduates, 1/3 graduating MS students passed the core curriculum with GPA of 3.0 or higher (2 did not answer). (01/25/2016) **Related Documents:** Program Objectives MS PhD 2015 V4.docx	
		Assessment Cycle: Action To Be Defined (Prior to 2015-2016) **Result Type:** Criterion Not Met For 2014 MS graduates, 3/5 passed the core courses with	**Action for Improvement:** Graduate Committee will develop a program to remediate non-ChE students who are not prepared for

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		GPA of 3.0 or higher (06/12/2015)	ChE core graduate curriculum. (06/12/2015)
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met For 2013, no MS degrees were awarded from Chemical Engineering. (06/01/2014)	
	Instructor Course Evaluation - Mastery of ChE core concepts **Criterion:** Learning outcomes associated with concept mastery in core courses ChE 5312, 5321, and 5343 are met according to instructor self-evaluations of the courses. **Schedule:** Annually	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met For 2015/16, ChE 5312: outcomes met ChE 5321: outcomes met ChE 5343: outcomes met (02/04/2016) **Related Documents:** 5321 5343.pdf	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met For 2014/15, ChE 5312: outcomes met ChE 5321: outcomes met ChE 5343: outcomes met (05/21/2015)	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met ChE 5312: For 2013/14, outcomes 1-4 met; ChE 5321: For 2013/14, outcome 1 partially met; outcome 2 met; ChE 5343: For 2013/14, outcomes 1-3 met (06/01/2014)	
	Instructor Course Evaluation - Ability to use computational and modeling tools to solve ChE problems **Criterion:** Learning outcomes associated with computational and modeling tools in core courses ChE 5310 and 5323 are met according to instructor self-evaluations of the courses.	**Assessment Cycle:** 2015 - 2016 **Result Type:** Inconclusive For 2015/16, ChE 5310: outcomes met ChE 5323: no data yet (02/04/2016) **Related Documents:** 5310.pdf	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Inconclusive	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
	Schedule: Annually	ChE 5310: For 2014/15, outcomes 1-3 met; ChE 5323: not yet available (05/21/2015)	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met ChE 5310: For 2013/14, outcome 1 met; outcome 2 partially met; ChE 5323: For 2013/14, outcomes 1-3 met (06/01/2014)	
Program Outcome Masters 2 - Graduates have an understanding of research and use literature to creatively solve problems. **Outcome Status:** Active **Outcome Type:** Student Learning **Start Date:** 05/01/2014	**Student Projects -** Performance in thesis research **Criterion:** Students publish one refereed journal article from their thesis research (Web of Science) **Schedule:** Yearly	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Not Met For 2016 MS graduates: Average # and std deviation of publications: 0.5 +/- 0.76 1/6 MS graduates submitted more than 1 publication. (06/21/2016)	
		Assessment Cycle: 2015 - 2016 **Result Type:** Criterion Not Met For 2015 MS graduates: Ave. # of publications: 0 0/3 students with >= 1 publications (independent of author order) (01/25/2016) **Related Documents:** Program Objectives MS PhD 2015 V4.docx	
		Assessment Cycle: Action To Be Defined (Prior to 2015-2016) **Result Type:** Criterion Not Met For 2014 MS graduates: Ave. # of Pubs: 0.6 +/- 0.9 2/5 with >= 1 pubs (independent of author order) (05/21/2015)	
	Employment - Graduate Exit Survey **Criterion:** 100 % of students are placed within six months of graduation	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Not Met 1 of 6 MS graduates placed within 6 months of graduation. (06/20/2016)	
		Assessment Cycle: Action In Progress (Prior to 2015-2016) **Result Type:** Inconclusive 2/3 graduating students have been placed within 6 months of graduation. (02/25/2014)	**Action for Improvement:** The department will re-assess the method of assessing students for this outcome based on comments

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
			from our graduate program review. (04/30/2014) **Action for Improvement:** Encourage students to attend job fairs and more broadly explore their options. (02/25/2014)
Program Outcome Masters 3 - Graduates are able to effectively communicate technical information. **Outcome Status:** Active **Outcome Type:** Student Learning **Start Date:** 09/01/2013	**Student Exit Survey -** Student presentations **Criterion:** 100% of the students present their work at local, regional, or national meetings **Schedule:** Yearly	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Not Met For 2016 MS graduates, only 1 student of the 6 MS graduates presented. (06/20/2016)	
		Assessment Cycle: 2015 - 2016 **Result Type:** Criterion Not Met For 2015 MS graduates, 1/3 presented their work (unknown about other 2 students). (01/25/2016) **Related Documents:** Program Objectives MS PhD 2015 V4.docx	
		Assessment Cycle: Action To Be Defined (Prior to 2015-2016) **Result Type:** Criterion Not Met For 2014 MS graduates, 2/5 presented their work. (05/21/2015)	
		Assessment Cycle: Action To Be Defined (Prior to 2015-2016) **Result Type:** Criterion Not Met For 2012 MS graduates, 1/3 presented their work. (06/01/2014)	
	Student Exit Survey - Student awards for presentations **Criterion:** 20% of the graduating students receive local, regional, or national awards for poster or oral presentations **Schedule:** Yearly	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Not Met For 2016 MS graduates, none of the 6 received an award. (06/20/2016)	
		Assessment Cycle: 2015 - 2016 **Result Type:** Criterion Met For 2015 MS graduates, 1/3 received an award (unknown about other 2 students). (01/25/2016) **Related Documents:** Program Objectives MS PhD 2015 V4.docx	
		Assessment Cycle: No Action Needed (Prior to 2015-2016)	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		Result Type: Criterion Met For 2014 MS graduates, 1/5 received an award. (05/21/2015)	
Program Outcome Masters 4 - Graduates have a strong sense of professionalism and a good understanding of research ethics and safety **Outcome Status:** Active **Outcome Type:** Student Learning **Start Date:** 05/01/2014	**Student Projects -** Safe conduct of research **Criterion:** Reported safety incidents **Schedule:** Yearly	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met For 2015/16, no safety issues were reported among MS graduates. (06/20/2016)	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met For 2014/15, one safety incident was reported to EH&S. (05/21/2015)	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met For 2013/14, no safety incidents were reported to EH&S. (06/01/2014)	
	Student Projects - Understanding of research ethics **Criterion:** 100% participated in the TTU RCR program or took a professional ethics course (VPR) **Schedule:** Yearly	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Not Met For 2016 MS graduates, 3/6 graduates participated in RCR. (06/20/2016)	
		Assessment Cycle: 2015 - 2016 **Result Type:** Criterion Not Met For 2015 MS graduates, 1/3 students successfully completed RCR training (unknown about other 2 students). (01/26/2016) **Related Documents:** Program Objectives MS PhD 2015 V4.docx	
		Assessment Cycle: Action In Progress (Prior to 2015-2016) **Result Type:** Criterion Not Met For 2014 MS graduates, 1/5 successfully completed RCR training. (05/21/2015)	**Action for Improvement:** Graduate committee to make recommendation concerning whether all graduate students must participate in TTU RCR program (06/12/2015)
	Student Exit Survey - Membership or participation in professional and student organizations **Criterion:** 100% of graduating students are members of	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Not Met For 2016 MS graduates, 4/6 graduates participated in professional groups or organizations. (06/20/2016)	
		Assessment Cycle: 2015 - 2016	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
	professional organizations **Schedule:** Yearly	**Result Type:** Criterion Met For 2015 MS graduates, 1/1 participated in professional organizations. (01/26/2016) **Related Documents:** Program Objectives MS PhD 2015 V4.docx	
		Assessment Cycle: Action In Progress (Prior to 2015-2016) **Result Type:** Inconclusive Data unavailable for 2014 MS graduates. (05/21/2015)	**Action for Improvement:** Add question to Graduate Exit Survey. (06/12/2015) **Follow-Up: Evidence of Improvement:** Question has been added. Data will be tracked in the future. (07/03/2015)
	Student Exit Survey - Membership or participation in professional and student organizations **Criterion:** 50% participate in TTU graduate student organizations **Schedule:** Yearly	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met For 2016 MS graduates, 5/6 students participated in TTU graduate student organizations. (06/21/2016)	
		Assessment Cycle: 2015 - 2016 **Result Type:** Criterion Met For 2015 MS graduates 1/1 participated in TTU student organizations. (01/26/2016) **Related Documents:** Program Objectives MS PhD 2015 V4.docx	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met For 2014 MS graduates, 3/5 participated in TTU student organizations. (05/21/2015)	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Inconclusive Data unavailable for 2012 MS graduates. (06/01/2013)	**Action for Improvement:** Add question querying participation in professional organizations to Graduate Exit Survey (01/01/2015) **Follow-Up: Evidence of Improvement:** Survey question added. (01/01/2015)
Enrollment and/or Degrees Conferred - This outcome reflects	**Self-Assessments -** TTU Factbook (2010 data has not yet been certified	**Assessment Cycle:** Action In Progress (Prior to 2015-2016) **Result Type:** Criterion Met	**Action for Improvement:** Continue increasing graduate

Student Learning Outcomes	*Assessment Methods*	*Results*	*Actions for Improvement*
trends in enrollment and/or degrees conferred. **Outcome Status:** Active **Outcome Type:** Program **Start Date:** 09/01/2006	from Institutional Research)	2010/11: 1; 2011/12: 1; 2012/13: 0; 2013/14: 4 (02/28/2014)	enrollments, including enrollments of US citizens. (02/28/2014)
Program Review Data - Historical Program Review Data **Outcome Status:** Active **Outcome Type:** Program **Start Date:** 09/01/2006	**Self-Assessments -** Please see attached program review report.	**Assessment Cycle:** Action In Progress (Prior to 2015-2016) **Result Type:** Criterion Met 13 MS degrees were awarded from 2007/08 through 2011/12. (02/25/2014) **Related Documents:** 2013 Graduate Program Review	

Assessment: Account Information Four Column

TEXAS TECH UNIVERSITY
Office of the Provost
Office of Planning & Assessment

Degree Program - ENG - Chemical Engineering (PHD)

CIP Code: 14.0701.00
Next Program Review: 12-13
Degree Program Coordinator: Sindee Simon
Degree Program Coordinator Email: Sindee.Simon@ttu.edu
Degree Program Coordinator Phone: 8067423553
Degree Program Coordinator Mail Stop: 3121
Program Purpose Statement: The Graduate Program (PhD) in Texas Tech?s Department of Chemical Engineering is dynamic and internationally visible. The purpose of the PhD program is to graduate very high quality PhD students who can think independently on a research topic and carry out research supported by federal, state and industrially funded research in diverse fields such as polymers and soft matter, complex fluids,bioengineering, computational chemical engineering, biofuels, process system engineering, and nano-science and engineering . Major objectives of the department during the next decade will be: (1) to provide students with a high quality education at both the undergraduate and graduate levels to enable them to adapt to a rapidly changing technical environment, (2) to produce graduates who will be productive throughout their careers in a wide range of industrial, professional, and academic environments, and (3) to develop graduates with a strong sense of ethics and professionalism and the ability to succeed as both individual and team contributors.
Assessment Coordinator: Sindee Simon

Student Learning Outcomes	*Assessment Methods*	*Results*	*Actions for Improvement*
Program Outcome PhD 1 - Graduates have advanced knowledge of the field and are able to effectively apply this knowledge. **Outcome Status:** Active **Outcome Type:** Student Learning **Start Date:** 09/01/2013	**Student Transcript Evaluation -** Mastery of ChE core concepts in coursework **Criterion:** All students pass required core curriculum with GPA of 3.0 or higher. **Schedule:** Annually	**Assessment Cycle:** 2015 - 2016 **Result Type:** Inconclusive For 2015/16 PhD graduates, the student did not answer the question (3b) re: GPA on Core Curriculum. (06/21/2016)	
		Assessment Cycle: 2015 - 2016 **Result Type:** Criterion Not Met For 2015, 7/8 graduating PhDs passed core courses with GPA of 3.0 or higher (2 students unknown) (01/22/2016) **Related Documents:** Program Objectives MS PhD 2015 V4.docx	**Action for Improvement:** Improve quality of students admitted. (06/13/2016)
		Assessment Cycle: Action In Progress (Prior to 2015-2016) **Result Type:** Criterion Not Met For 2014 PhD graduates, 11/12 passed core courses with	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		GPA of 3.0 or higher (05/08/2015)	
		Assessment Cycle: Action In Progress (Prior to 2015-2016) **Result Type:** Criterion Met For 2013 PhD graduates, 10/10 passed the core curriculum with GPA of 3.0 or higher. (06/01/2014)	**Action for Improvement:** Ensure that students understand expectations by providing a Graduate Student Handbook where these are explicitly stated. (06/01/2014) **Follow-Up: Evidence of Improvement:** Graduate Student Handbook provided to students and published. (09/01/2014)
	Instructor Course Evaluation - Mastery of ChE core concepts in coursework **Criterion:** Learning outcomes associated with concept mastery in core courses ChE 5312, 5321, and 5343 are met according to instructor self-evaluations of the courses. **Schedule:** Annually	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met For 2015/16, ChE 5312: outcomes met ChE 5321: outcomes met ChE 5343: outcomes met (02/04/2016) **Related Documents:** 5321 5343.pdf	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met For 2014/15, outcomes met for ChE 5312, 5321, and 5343. (05/08/2015)	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met ChE 5312: For 2013/14, outcomes 1-4 met; ChE 5321: For 2013/14, outcome 1 met partially, outcome 2 met; ChE 5343: For 2013/14, outcomes 1-3 met (06/01/2014) **Related Documents:** Program Objectives MS PhD 2015 V4.docx	
	Instructor Course Evaluation - Ability to use computational and modeling tools to solve ChE problems **Criterion:** Learning outcomes associated with computational and	**Assessment Cycle:** 2015 - 2016 **Result Type:** Inconclusive For 2015/16, ChE 5310: outcomes met ChE 5323: no data yet (02/04/2016)	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
	modeling tools in core courses ChE 5310 and 5323 are met according to the instructor self-evaluation of the courses. **Schedule:** Annually	**Related Documents:** 5310.pdf	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Inconclusive For 2014/15, ChE 5310: Outcomes 1-3 met; Data not yet available for ChE 5323 (05/08/2015)	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met ChE 5310: For 2013/14, outcome 1 met, outcome 2 met partially; ChE 5323: For 2013/14, outcomes 1-3 met (06/01/2014)	
Program Outcome PhD 2 - Graduates are able to perform state-of-the-art research and use literature to creatively solve problems. **Outcome Status:** Active **Outcome Type:** Student Learning **Start Date:** 09/01/2013	**Portfolio Review -** Performance in dissertation research **Criterion:** Students publish at least four refereed journal articles from their dissertation research and at least three first-author publications (Web of Science) **Schedule:** Annually	**Assessment Cycle:** 2015 - 2016 **Result Type:** Inconclusive For the 2016 PhD graduate, 3 publications have been submitted with 4 to be submitted. 2 publications so far are first-author. (06/21/2016)	
		Assessment Cycle: 2015 - 2016 **Result Type:** Criterion Met For 2015 PhD graduates: Average # of publications was 4.7 +/- 4.1 Average # of First-Author publications: 2.3 +/- 1.2 2/10 students with >= 4 first-author pubs 4/10 students with >= 3 first-author pubs 5/10 students with >= 4 pubs (independent of author order) (01/25/2016) **Related Documents:** Program Objectives MS PhD 2015 V4.docx	**Action for Improvement:** Expectations added to Graduate Student Handbook. (06/13/2016)
		Assessment Cycle: Action In Progress (Prior to 2015-2016) **Result Type:** Criterion Met For 2014 PhD graduates: Ave. # of Pubs: 5.9 +/- 5.6, Ave. # of First-Author Pubs: 2.9 +/- 2.4, 4/12 with >= 4 first-author pubs, 6/12 with >= 3 first-author pubs,	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		6/12 with >= 4 pubs (independent of author order) (05/21/2015)	
		Assessment Cycle: Action In Progress (Prior to 2015-2016) **Result Type:** Criterion Not Met For 2013 PhD graduates: Ave. # of Pubs: 3.6 +/- 2.2, Ave. # of First-Author Pubs: 2.9 +/- 1.8; 1/10 with >= 4 first-author pubs, 5/10 with >= 3 first-author pubs, 5/10 with >= 4 pubs (independent of author order) 6 of 10 students published at least 2 first-author journal articles from their dissertation research. 2 of 10 students published one first-author journal article from their dissertation research. 2 of 10 students had no publications yet. This is probably due to the thesis advisor leaving TTU. (06/01/2014)	**Action for Improvement:** Ensure that students understand expectations by providing a Graduate Student Handbook where these are explicitly stated. Further encourage students and thesis supervisors to publish their work by emphasizing the importance of scholarship at departmental seminars and meetings. (06/01/2014) **Follow-Up: Evidence of Improvement:** Graduate Student Handbook provided to students and published. (09/01/2014)
	Student Exit Survey - Placement of students **Criterion:** 100% of students are placed within six months of graduation **Schedule:** Yearly	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Not Met For 2016, the PhD graduate has not been placed. (06/21/2016)	
		Assessment Cycle: 2015 - 2016 **Result Type:** Criterion Not Met For 2015 PhD graduates, 3/10 students placed within 6 months of graduation (2 students unknown) (01/25/2016) **Related Documents:** Program Objectives MS PhD 2015 V4.docx	
		Assessment Cycle: Action In Progress (Prior to 2015-2016) **Result Type:** Criterion Not Met For 2014 PhD graduates, 8/12 were placed within six months of graduation. (05/21/2015)	**Action for Improvement:** Encourage students to attend job fairs at national conferences prior to graduation; track on exit interview. (06/12/2015)
		Assessment Cycle: Action To Be Defined (Prior to 2015-2016) **Result Type:** Criterion Not Met For 2013 PhD graduates, 9/10 were placed within six	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		months of graduation. (06/01/2014)	
Program Outcome PhD 3 - Graduates are able to effectively communicate technical information. **Outcome Status:** Active **Outcome Type:** Student Learning **Start Date:** 09/01/2013	**Student Exit Survey -** Student presentations **Criterion:** 100% of the graduating students presented their work at regional or national meetings **Schedule:** Yearly	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met For the 2016 PhD graduate, 8 presentations were made. 2 were poster presentations; 6 were oral presentations. (06/21/2016)	
		Assessment Cycle: 2015 - 2016 **Result Type:** Criterion Met For 2015 PhD graduates, all students presented their work. On average, 9.3 presentations per student. (01/25/2016) **Related Documents:** Program Objectives MS PhD 2015 V4.docx	**Action for Improvement:** Make limited funds available from the department to help send students to the national AIChE Meeting. (06/13/2016)
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met For 2014 PhD graduates, all students presented their work in 2014. On average, 4.5 presentations per student in 2014. (05/08/2015)	
		Assessment Cycle: Action Complete (Prior to 2015-2016) **Result Type:** Inconclusive Data unavailable for 2013 PhDs. (06/01/2014)	**Action for Improvement:** Add question to Graduate Exit Survey concerning number of presentations given. (01/01/2015) **Follow-Up: Evidence of Improvement:** Survey question added. Future data will be tracked. (01/01/2015)
			Action for Improvement: Ensure that faculty encourage their students to present their work at regional or national meetings prior to graduation. (06/01/2014)
	Student Exit Survey - Student awards for research **Criterion:** 40% of the graduating students received local or national awards for presentations **Schedule:** Yearly	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Not Met For 2016 PhD graduates, no students received awards for presentations. (06/20/2016)	
		Assessment Cycle: 2015 - 2016 **Result Type:** Criterion Met	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
		For 2015 PhD graduates, 5/10 graduating students received awards for presentations (2 students unknown). (01/25/2016) **Related Documents:** Program Objectives MS PhD 2015 V4.docx	
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met For 2014 PhD graduates, 6/12 of graduating students received awards for presentations. (05/21/2015)	
		Assessment Cycle: Action To Be Defined (Prior to 2015-2016) **Result Type:** Criterion Not Met For 2013 PhD graduates, 2/10 received awards for presentations. (06/01/2014)	
Program Outcome PhD 4 - Graduates have a strong sense of professionalism and a good understanding of research safety and ethics **Outcome Status:** Active **Outcome Type:** Student Learning **Start Date:** 05/01/2014	**Student Projects -** Safe conduct of research **Criterion:** Reported safety incidents (EHS) **Schedule:** Yearly	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met For 2016 PhD graduates, no safety issues were reported. (06/20/2016)	
		Assessment Cycle: 2015 - 2016 **Result Type:** Criterion Met For 2015, no safety incidents were reported to EH&S. (06/13/2016)	**Action for Improvement:** Improve safety culture in the department using news flashes, safety posters, and pointing out good safety behavior, as well as using incidents around the country as learning tools. (06/13/2016)
		Assessment Cycle: Action In Progress (Prior to 2015-2016) **Result Type:** Criterion Met For 2014/15, one safety incident was reported to the Environmental, Health, and Safety Office. (05/21/2015)	**Action for Improvement:** Continue fall and spring safety seminar, informal monitoring of laboratories, and twice-annual formal departmental safety inspections (07/01/2015)
		Assessment Cycle: No Action Needed (Prior to 2015-2016) **Result Type:** Criterion Met For 2013/14, No safety incidents were reported to the Environmental, Health, and Safety Office. (06/01/2014)	
	Student Projects - Understanding of research ethics	**Assessment Cycle:** 2015 - 2016	

Student Learning Outcomes	Assessment Methods	Results	Actions for Improvement
	Criterion: 100% completed TTU RCR training or took a professional ethics course (VPR) **Schedule:** Yearly	**Result Type:** Criterion Not Met For 2016 PhD graduates, 0/1 students participated in RCR training. (06/20/2016)	
		Assessment Cycle: 2015 - 2016 **Result Type:** Criterion Not Met For 2015 PhD graduates, 5/10 students successfully completed RCR training (one did not complete RCR, 2 were not asked question/different form, and 2 did not answer survey). (01/26/2016) **Related Documents:** Program Objectives MS PhD 2015 V4.docx	**Action for Improvement:** Require all graduate students to participate in RCR training, starting with students matriculating in fall 2016. Change Graduate Student Handbook to include this requirement. (06/13/2016)
		Assessment Cycle: Action In Progress (Prior to 2015-2016) **Result Type:** Criterion Not Met For 2014 PhD graduates, 6/12 successfully completed RCR training. (05/21/2015)	**Action for Improvement:** Recommendation to be made by Graduate Committee that all graduate students participate in TTU RCR training. (06/12/2015)
		Assessment Cycle: Action To Be Defined (Prior to 2015-2016) **Result Type:** Criterion Not Met For 2013 PhD graduates, 3/10 successfully completed RCR training. (06/01/2014)	
	Student Exit Survey - Membership or participation in professional and student organizations **Criterion:** 100% of graduating students are members of professional organizations **Schedule:** Yearly	**Assessment Cycle:** 2015 - 2016 **Result Type:** Criterion Met For 2016 PhD graduates, 1/1 student participated in professional organizations. (06/20/2016)	
		Assessment Cycle: 2015 - 2016 **Result Type:** Criterion Met For 2015 PhD graduates, 4/8 students reported being members of professional organizations and 8/8 are members of TTU graduate student orgs. (01/26/2016) **Related Documents:** Program Objectives MS PhD 2015 V4.docx	
		Assessment Cycle: Action In Progress (Prior to 2015-2016) **Result Type:** Inconclusive Data unavailable (05/21/2015)	**Action for Improvement:** Add question to graduate exit survey. (06/12/2015)
Program Review Data - Historical	**Self-Assessments -** Please see	**Assessment Cycle:** Action In Progress (Prior to 2015-2016)	**Action for Improvement:** Assess

Student Learning Outcomes	*Assessment Methods*	*Results*	*Actions for Improvement*
Program Review Data **Outcome Status:** Active **Outcome Type:** Student Learning **Start Date:** 09/01/2006	attached program review report.	**Result Type:** Criterion Met Graduate Program Review report (November 2013) indicates that the PhD program is strong with faculty and graduate students performing in line with the vision of becoming ranked in the top 50 graduate programs in the nation. (02/14/2014) **Related Documents:** Graduate Program Review	PhD Outcomes 1-3 to ensure progress is being made towards goal. (02/25/2014) **Follow-Up: Evidence of Improvement:** Overall Faculty and Scholarly Productivity ranked 47 in the nation by Academic Analytics. (06/13/2016)
Enrollment and/or Degrees Conferred - This outcome reflects trends in enrollment and/or degrees conferred. **Outcome Status:** Active **Outcome Type:** Program **Start Date:** 09/01/2006	**Self-Assessments -** TTU Factbook (2010 data has not yet been certified from Institutional Research)	**Assessment Cycle:** Action In Progress (Prior to 2015-2016) **Result Type:** Criterion Met 2010/11: 53; 2011/12: 53; 2012/13: 57; 2013/14: 61 (02/28/2014)	**Action for Improvement:** Continue increasing graduate enrollments, including enrollments of US citizens. (02/28/2014)