Mission / Purpose

The chemical and biological engineering program at The University of Alabama derives its education and scientific purpose from its responsibilities to and relationship with the citizens of Alabama and the international community of chemical engineering professionals. Our mission is to provide the technical workforce and expertise needed by the chemical and related industries. This mission is fulfilled through three visions, which are: To provide students with a multidisciplinary undergraduate/graduate education of the highest standard of excellence, recognized by both industry and the national academic community, enabling them to perform to their maximum potential in a technologically-based and environmentally-sensitive society; and to sustain an international position of leadership in dynamic scientific and technological research that is engaged by students and faculty and that is focused on global issues of significance to the interests of Alabama; and to contribute to the economic and technical well being of the state and nation through innovative educational, professional, and information service. Program Objectives: To sustain a nationally-accredited undergraduate program, internationally-recognized research and a graduate program focused on doctoral level achievements. To attain leadership in innovative educational and research areas that recognized the diversity of Alabama's human and natural resources. To place all graduates in meaningful, challenging and rewarding careers that impact the strength of the technological and industrial base. To provide outreach activities for those within Alabama and the nation who can benefit from the unique educational and professional opportunities offered by our program.

Student Learning Outcomes, with Any Associations and Related Measures, Targets, Findings, and Action Plans

SLO 4: Knowledge of math, engineering, and basic science (ABET a)
The ability to apply knowledge of mathematics and engineering and have a thorough grounding in the basic sciences including chemistry, physics and biology.

Connected Documents
chemical engineering bachelors Curriculum Map I
chemical engineering bachelors Curriculum Map II

Related Measures

M 7: Skills Inventory test CHE 493/CHE 125
A quiz to test students general ability to apply knowledge of mathematics, science, and engineering to problems involving order of magnitude estimates, unit conversions, weight versus mass, and more. Results are compared for freshman students entering the program (CHE 125 introductory 1 hr course) to seniors who take the exam in CHE 493.

Source of Evidence: Academic direct measure of learning - other

Target:
For students completing the program (CHE 493) more than half should answer at least 19 out of the 24 questions correctly.

M 8: Criterion based grading: basic sciences
Criterion Based Grading (CBG) in CH 101, 102, 231, 232, 237; PH 105, 106; and BSC 114 to assess grounding in the basic sciences of chemistry, physics and biology. CBG refers to "criterion based grading" by which attainment of an outcome is determined by the final grade assigned to a student in a course. Criterion based grading will be phased out and replaced by rubric type scoring of a special problem during the 2013-2019 ABET cycle.

Source of Evidence: Academic direct measure of learning - other

M 28: Six year graduate survey
Six-year surveys of graduates of the ChBE department
Source of Evidence: Alumni survey or tracking of alumni achievements

SLO 5: Laboratory skills (ABET b)
The ability to operate in a laboratory environment, specifically to design and conduct experiments as well as to analyze and interpret experimental data

Connected Documents
chemical engineering bachelors Curriculum Map I
chemical engineering bachelors Curriculum Map II

Related Measures

M 9: CHE 319 experimental design exam with rubric
A Criterion Based Exam scored using a Rubric in CHE 319 to address ability to design and conduct experiments

Source of Evidence: Project, either individual or group

Target:
The ability of students to design an experiment has been evaluated using a rubric, and students all scored more than 80 out of 100 and thus the outcome was deemed "met". A better classroom is needed to assess more completely the ability to use modern tools of engineering. As of summer 2012, the facilities have been provided for presentations in the CHE 319 course. Based on the assessment that was completed, however, no other action is necessary.
M 10: CHE 320 written communication rubric
A rubric is used in CHE 320 to assess the ability to communicate effectively in writing the concepts of designed experiments, analyzed data, and interpretation of data. For example, written reports on heat transfer (and other equivalent topic), authored by individual students are scored using a Rubric in CHE 320 to address ability to analyze and interpret data from experiments designed by the students.
Source of Evidence: Writing exam to assure certain proficiency level

M 11: CHE 320 oral communication rubric
A rubric is used in CHE 320 to assess the ability to communicate effectively in speaking the concepts of designed experiments, analysis of data, and interpretation of data
Source of Evidence: Presentation, either individual or group

M 19: CHE 320 data analysis writing assignment with rubric
Written reports on heat transfer (or other equivalent topic), authored by individual students are scored using a Rubric in CHE 320 to address ability to analyze and interpret data.
Source of Evidence: Written assignment(s), usually scored by a rubric

M 28: Six year graduate survey
Six-year surveys of graduates of the ChBE department
Source of Evidence: Alumni survey or tracking of alumni achievements

M 37: ********
Senior exit interviews conducted during the graduate luncheon by the advisory board or the department head 2
Source of Evidence: Exit interviews with grads/program completers

SLO 6: Design physical, chemical, and biological processes (ABET c)
The content knowledge to designing physical, chemical, and biological processes to meet desired needs within realistic economic, health, and safety constraints.
Connected Documents
chemical engineering bachelors Curriculum Map I
chemical engineering bachelors Curriculum Map II

Related Measures

M 3: Advisory Board Questionnaire
Advisory Board members meet with graduating students and assess student quality, student learning objective, and the program's educational objectives. The questionnaire contains two pages. One page is for the members to discuss the appropriateness of each learning objective with the student. Typical questions are: Are our objectives appropriate? Do we need to add, delete or modify any objectives? Feedback may be positive or negative. The second page is for the members to assess the senior’s ability to communicate the principles of chemical engineering as they relate to knowledge of design of processes.
Source of Evidence: Advisory board or community feedback on program

M 12: CHE 481 design rubric
A rubric, applied in CHE 481, assesses the knowledge of chemical engineering principles as they are used to design of physical, chemical, and biological processes within realistic economic, health and safety constraints
Source of Evidence: Project, either individual or group

M 13: CHE 482 design problems
Individual and team projects are assessed using a rubric to measure the concept knowledge of chemical engineering principles in the design of physical, chemical, and biological processes with a state-of-the-art a chemical process simulator based on concept knowledge of chemical and biological engineering principles.
Source of Evidence: Project, either individual or group

M 16: ********
Senior exit interviews conducted during the graduate luncheon by the advisory board or the department head 9
Source of Evidence: Exit interviews with grads/program completers

M 28: Six year graduate survey
Six-year surveys of graduates of the ChBE department
Source of Evidence: Alumni survey or tracking of alumni achievements

SLO 7: Multi-disciplinary teams (ABET d)
The ability to function on multi-disciplinary teams
Connected Documents
chemical engineering bachelors Curriculum Map I
chemical engineering bachelors Curriculum Map II

Related Measures

M 14: CHE 481 teaming rubric
A Criterion Based Exam scored using a Rubric is graded in CHE 481 to determine ability to function on multi-disciplinary teams
Source of Evidence: Project, either individual or group

M 15: CHE 320 teaming rubric
A Criterion Based Exam scored using a Rubric is graded in CHE 320 to determine ability to function on multi-disciplinary teams
Source of Evidence: Project, either individual or group
Other Outcomes, with Any Associations and Related Measures, Targets, Findings, and Action Plans

OthOtcn 1: Program Quality
The program will improve and sustain a high level of recognized quality.

Related Measures

M 1: Co-Op and Intern Reports
Data from employer evaluation of the co-op and intern students will be evaluated.
Source of Evidence: Employer survey, incl. perceptions of the program

M 2: Senior Exit Interviews
The Senior Exit Interview (SEI) has been completed for two decades in the students’ last semester on campus. The SEI provides each student the opportunity to express their opinions of The University, the ChE Program, specific courses, faculty and staff. For the department, the SEI provides timely information and evaluation from the students as they complete their matriculation. The SEI has two parts: a written form and a face-to-face interview. The written SEI form allows students to numerically rate our objectives, as well as provide written feedback regarding their modification. The second part of the SEI is the face-to-face interview. Every semester each graduating senior meet with the ChBE department head. The interview is 20 minutes and many days are required to complete the face-to-face interviews for the graduating class.
Source of Evidence: Exit interviews with grads/program completers

M 3: Advisory Board Questionnaire
Advisory Board members meet with graduating students and assess student quality, student learning objective, and the program’s educational objectives. The questionnaire contains two pages. One page is for the members to discuss the appropriateness of each learning objective with the student. Typical questions are: Are our objectives appropriate? Do we need to add, delete or modify any objectives? Feedback may be positive or negative. The second page is for the members to assess the senior’s ability to communicate the principles of chemical engineering as they relate to knowledge of design of processes.
Source of Evidence: Advisory board or community feedback on program

OthOtcn 2: Program Optimum Enrollment
The program will build and sustain an optimal level of annual program enrollments and degree completions.

Related Measures

M 4: ASEE DATA
A comparison of trends and actual enrollments and faculty/student ratios with other departments of chemical engineering in the southeastern US will be used. These data are available from the America Association of Engineering Educators (ASEE) annually.
Source of Evidence: External report
Target: No Target Established

M 5: OIRA Statistical Profile
Statistical profiles generated by the OIRA for the program will be used to establish multiple year enrollment trends and graduation rates.
Source of Evidence: Existing data
Target: No Target Established

OthOtcn 3: Program Highly Valued
The program will be highly valued by its program graduates and other key constituencies it serves.

Related Measures

M 1: Co-Op and Intern Reports
Data from employer evaluation of the co-op and intern students will be evaluated.
Source of Evidence: Employer survey, incl. perceptions of the program
Target: 75% of employers express willingness to rehire the evaluated co-op or intern.

M 6: Placement Data
First Destination Reports for the May and December undergraduate class, prepared by the Career Center, will be analyzed to measure the placement of the program's graduated in full-time, part-time, further education and military service.
Source of Evidence: Job placement data, esp. for career/tech areas
Details of Action Plans for This Cycle (by Established cycle, then alpha)

Textbook change for CHE 324 "Transport Phenomena"
As identified in the survey comments and also a consistent trend from year-to-year, the curriculum committee recommends that the textbook be changed from the current "Transport Phenomena" by Bird, Stewart and Lightfoot to a book that is more geared to undergraduates rather than graduate students.

Established in Cycle: 2011-2012
Implementation Status: Finished
Priority: High
Implementation Description: Dr. Eric Carlson will be using a different textbook geared towards undergraduates. Also, Dr. Carlson is a new instructor for this course, replacing Dr. David Arnold.
Responsible Person/Group: Dr. Eric Carlson

Develop new rubrics to replace CBG
The term “rubric” refers to a quiz, test or special problem that is scored using a rubric (rubrics are provided in section 4.D), while CBG refers to “criterion based grading” by which attainment of an outcome is determined by the final grade assigned to a student in a course. Criterion based grading will be phased out and replaced by rubric type scoring of a special problem during the 2013-2019 ABET cycle.

Established in Cycle: 2012-2013
Implementation Status: In-Progress
Priority: High
Implementation Description: Faculty and the Curriculum and ABET Committee (CAC) will be developing the rubrics over the next two years. Assessment/interpretation tools will be developed.
Responsible Person/Group: The Curriculum and ABET Committee (CAC)
Additional Resources: None. There is a need for the rubrics to be tested over the two year period prior to approval by the faculty and subsequent implementation.
Detailed Assessment Report
2012-2013 Chemical Engineering B.S.Che.E
As of: 7/15/2014 03:14 PM CENTRAL

Mission / Purpose
The chemical and biological engineering program at The University of Alabama derives its education and scientific purpose from its relationship with the citizens of Alabama and the international community of chemical engineering professionals. Our mission is to provide the technical workforce and expertise needed by the chemical and related industries. This mission is fulfilled through three visions, which are: To provide students with a multidisciplinary undergraduate/graduate education of the highest standard of excellence, recognized by both industry and the national academic community, enabling them to perform to their maximum potential in a technologically-based and environmentally-sensitive society; and to sustain an international position of leadership in dynamic scientific and technological research that is engaged by students and faculty and that is focused on global issues of significance to the interests of Alabama; and to contribute to the economic and technical well being of the state and nation through innovative educational, professional, and informational service. Program Objectives: To sustain a nationally-accredited undergraduate program, internationally-recognized research and a graduate program focused on doctoral level achievements. To attain leadership in innovative educational and research areas that recognized the diversity of Alabama's human and natural resources. To place all graduates in meaningful, challenging and rewarding careers that impact the strength of the technological and industrial base. To provide outreach activities for those within Alabama and the nation who can benefit from the unique educational and professional opportunities offered by our program.

Student Learning Outcomes, with Any Associations and Related Measures, Targets, Findings, and Action Plans

SLO 4: Knowledge of math, engineering, and science (ABET a)
The ability to apply knowledge of mathematics and engineering and have a thorough grounding in the basic sciences including chemistry, physics and biology.

Connected Documents
chemical engineering bachelors Curriculum Map I
chemical engineering bachelors Curriculum Map II

Related Measures

M 7: Skills Inventory test CHE 493/CHE 125
A quiz to test students general ability to apply knowledge of mathematics, science, and engineering to problems involving order of magnitude estimates, unit conversions, weight versus mass, and more. Results are compared for freshman students entering the program (CHE 125 introductory 1 hr course) to seniors who take the exam in CHE 493.

Source of Evidence: Faculty pre-test / post-test of knowledge mastery

Target:
For students completing the program (CHE 493) more than half should answer at least 19 out of the 24 questions correctly.

M 8: Criterion based grading: grounding in basic sciences
Criterion Based Grading (CBG) in CH 101, 102, 231, 232, 237; PH 105, 106; and BSC 114 to assess grounding in the basic sciences of chemistry, physics and biology. CBG refers to “criterion based grading” by which attainment of an outcome is determined by the final grade assigned to a student in a course. Criterion based grading will be phased out and replaced by rubric type scoring of a special problem during the 2013-2019 ABET cycle.

Source of Evidence: Academic direct measure of learning - other

M 19: ABET(a) Measure 1
Courses taught outside the ChBE department in Chemistry, Math, Physics, Biology and the Engineering Elective address ABET (a) and ChBE Student Outcome 1: The ability to apply knowledge of mathematics and engineering, and have a thorough grounding in the basic sciences including chemistry, physics, and biology. Courses outside of the ChBE department are difficult to assess by ChBE faculty, therefore Outcome 1 is measured in CHE 125 and CHE 493 using the CSL and these "service" courses are not included in Table 4.B.1. Also, courses typically cover more outcomes than are shown, but for clarity, only measured outcomes in each course are mapped. The term "rubric" refers to a quiz, test or special problem that is scored using a rubric (rubrics are provided in section 4.D), while CBG refers to "criterion based grading" by which attainment of an outcome is determined by the final grade assigned to a student in a course. Criterion based grading will be phased out and replaced by rubric type scoring of a special problem during the 2013-2019 ABET cycle.

Source of Evidence: Curriculum SYllabus analysis of course to program

M 32: Six year graduate survey
Six-year surveys of graduates of the ChBE department

Source of Evidence: Alumni survey or tracking of alumni achievements

SLO 5: Laboratory skills (ABET b)
The ability to operate in a laboratory environment, specifically to design and conduct experiments as well as to analyze and interpret experimental data.

Connected Documents
chemical engineering bachelors Curriculum Map I
chemical engineering bachelors Curriculum Map II
Related Measures

**M 9**: CHE 319 experimental design exam with rubric
A Criterion Based Exam scored using a Rubric in CHE 319 to address ability to design and conduct experiments
Source of Evidence: Project, either individual or group

**Target:**
The ability of students to design an experiment has been evaluated using a rubric, and students all scored more than 80 out of 100 and thus the outcome was deemed "meet". A better classroom is needed to assess more completely the ability to use modern tools of engineering. As of summer 2012, the facilities have been provided for presentations in the CHE 319 course. Based on the assessment that was completed, however, no other action is necessary.

**M 10**: CHE 320 Laboratory written communication rubric
A rubric is used in CHE 320 to assess the ability to communicate effectively in writing the concepts of designed experiments, analyzed data, and interpretation of data. For example, written reports on heat transfer (and other equivalent topic), authored by individual students are scored using a Rubric in CHE 320 to address ability to analyze and interpret data from experiments designed by the students.
Source of Evidence: Writing exam to assure certain proficiency level

**M 11**: CHE 320 Laboratory oral communication rubric
A rubric is used in CHE 320 to assess the ability to communicate effectively in speaking the concepts of designed experiments, analysis of data, and interpretation of data.
Source of Evidence: Presentation, either individual or group

**M 32**: Six year graduate survey
Six-year surveys of graduates of the ChBE department
Source of Evidence: Alumni survey or tracking of alumni achievements

**M 37**: Senior exit interviews conducted during the graduate luncheon by the advisory board or the department head
Source of Evidence: Exit interviews with grads/program completers

**SLO 6**: Design physical, chemical, and biological processes (ABET c)
The content knowledge to design physical, chemical, and biological processes to meet desired needs within realistic economic, health, and safety constraints.

**Connected Documents**
- chemical engineering bachelors Curriculum Map I
- chemical engineering bachelors Curriculum Map II

Related Measures

**M 3**: Advisory Board Questionnaire
Advisory Board members meet with graduating students and assess student quality, student learning objective, and the program's educational objectives. The questionnaire contains two pages. One page is for the members to discuss the appropriateness of each learning objective with the student. Typical questions are: Are our objectives appropriate? Do we need to add, delete or modify any objectives? Feedback may be positive or negative. The second page is for the members to assess the senior's ability to communicate the principles of chemical engineering as they relate to knowledge of design of processes.
Source of Evidence: Advisory board or community feedback on program

**M 12**: CHE 481 design rubric
A rubric, applied in CHE 481, assesses the knowledge of chemical engineering principles as they are used to design of physical, chemical, and biological processes within realistic economic, health and safety constraints
Source of Evidence: Project, either individual or group

**M 13**: CHE 482 design problems
Individual and team projects are assessed using a rubric to measure the concept knowledge of chemical engineering principles in the design of physical, chemical, and biological processes with a state-of-the-art a chemical process simulator based on concept knowledge of chemical and biological engineering principles.
Source of Evidence: Project, either individual or group

**M 32**: Six year graduate survey
Six-year surveys of graduates of the ChBE department
Source of Evidence: Alumni survey or tracking of alumni achievements

**M 39**: Senior exit interviews conducted during the graduate luncheon by the advisory board or the department head
Source of Evidence: Exit interviews with grads/program completers

**SLO 7**: Multi-disciplinary teams (ABET d)
An ability to function on multidisciplinary teams

**Connected Documents**
- chemical engineering bachelors Curriculum Map I
- chemical engineering bachelors Curriculum Map II

Related Measures

**M 14**: CHE 481 teaming rubric
A Criterion Based Exam scored using a Rubric is graded in CHE 481 to determine ability to function on multi-
disciplinary teams.

Source of Evidence: Project, either individual or group

M 15: CHE 320 teaming rubric
A Criterion Based Exam scored using a Rubric is graded in CHE 320 to determine ability to function on multi-disciplinary teams

Source of Evidence: Project, either individual or group

M 32: Six year graduate survey
Six-year surveys of graduates of the ChBE department

Source of Evidence: Alumni survey or tracking of alumni achievements

M 34: ********
Senior exit interviews conducted during the graduate luncheon by the advisory board or the department head

Source of Evidence: Exit interviews with grads/program completers

M 36: ********
Six-year surveys of graduates of the ChBE department

Source of Evidence: Academic direct measure of learning - other

Other Outcomes, with Any Associations and Related Measures, Targets, Findings, and Action Plans

OthOtcn 1: Program Quality
The program will improve and sustain a high level of recognized quality.

Related Measures

M 1: Co-Op and Intern Reports
Data from employer evaluation of the co-op and intern students will be evaluated.

Source of Evidence: Employer survey, incl. perceptions of the program

M 2: Senior Exit Interviews
The Senior Exit Interview (SXI) has been completed for two decades in the students' last semester on campus. The SXI provides each student the opportunity to express their opinions of The University, the ChE Program, specific courses, faculty and staff. For the department, the SXI provides timely information and evaluation from the students as they complete their matriculation. The SXI has two parts: a written form and a face-to-face interview. The written SXI form allows students to numerically rate our objectives, as well as provide written feedback regarding their modification. The second part of the SXI is the face-to-face interview. Every semester each graduating senior meet with the ChBE department head. The interview is 20 minutes and many days are required to complete the face-to-face interviews for the graduating class.

Source of Evidence: Exit interviews with grads/program completers

M 3: Advisory Board Questionnaire
Advisory Board members meet with graduating students and assess student quality, student learning objective, and the program's educational objectives. The questionnaire contains two pages. One page is for the members to discuss the appropriateness of each learning objective with the student. Typical questions are: Are our objectives appropriate? Do we need to add, delete or modify any objectives? Feedback may be positive or negative. The second page is for the members to assess the senior's ability to communicate the principles of chemical engineering as they relate to knowledge of design of processes.

Source of Evidence: Advisory board or community feedback on program

OthOtcn 2: Program Optimum Enrollment
The program will build and sustain an optimal level of annual program enrollments and degree completions.

Related Measures

M 4: Comparative Enrollment from ASEE data
A comparison of trends and actual enrollments and faculty/student ratios with other departments of chemical engineering in the southeastern US will be used. These data are available from the America Association of Engineering Educators (ASEE) annually.

Source of Evidence: External report

Target: No Target Established

M 5: OIRA Statistical Profile
Statistical profiles generated by the OIRA for the program will be used to establish multiple year enrollment trends and graduation rates.

Source of Evidence: Existing data

Target: No Target Established

OthOtcn 3: Program Highly Valued
The program will be highly valued by its program graduates and other key constituencies it serves.

Related Measures

M 1: Co-Op and Intern Reports
Data from employer evaluation of the co-op and intern students will be evaluated.

Source of Evidence: Employer survey, incl. perceptions of the program

Target:
75% of employers express willingness to rehire the evaluated co-op or intern.

M 6: Placement Data
First Destination Reports for the May and December undergraduate class, prepared by the Career Center, will be analyzed to measure the placement of the program's graduated in full-time, part-time, further education and military service.

Source of Evidence: Job placement data, esp. for career/tech areas

Target: No target established

Details of Action Plans for This Cycle (by Established cycle, then alpha)

Textbook change for CHE 324 "Transport Phenomena"
As identified in the survey comments and also a consistent trend from year-to-year, the curriculum committee recommends that the textbook be changed from the current "Transport Phenomena" by Bird, Stewart and Lightfoot to a book that is more geared to undergraduates rather than graduate students.

Established in Cycle: 2011-2012
Implementation Status: Planned
Priority: High
Implementation Description: Dr. Eric Carlson will be using a different textbook geared towards undergraduates. Also, Dr. Carlson is a new instructor for this course, replacing Dr. David Arnold.
Responsible Person/Group: Dr. Eric Carlson

Develop new rubrics to replace CBG
The term “rubric” refers to a quiz, test or special problem that is scored using a rubric (rubrics are provided in section 4.D), while CBG refers to “criterion based grading” by which attainment of an outcome is determined by the final grade assigned to a student in a course. Criterion based grading will be phased out and replaced by rubric type scoring of a special problem during the 2013-2019 ABET cycle.

Established in Cycle: 2012-2013
Implementation Status: In-Progress
Priority: High
Implementation Description: Faculty and the Curriculum and ABET Committee (CAC) will be developing the rubrics over the next two years. Assessment/interpretation tools will be developed.
Responsible Person/Group: The Curriculum and ABET Committee (CAC)
Additional Resources: None. There is a need for the rubrics to be tested over the two year period prior to approval by the faculty and subsequent implementation.
University of Alabama

Detailed Assessment Report
2011-2012 Chemical Engineering B.S.Che.E
As of: 7/19/2014 03:15 PM CENTRAL

Mission / Purpose
The chemical and biological engineering program at The University of Alabama derives its education and scientific purpose from its responsibilities to and relationship with the citizens of Alabama and the international community of chemical engineering professionals. Our mission is to provide the technical workforce and expertise needed by the chemical and related industries. This mission is fulfilled through three visions, which are: To provide students with a multidisciplinary undergraduate/graduate education of the highest standard of excellence, recognized by both industry and the national academic community, enabling them to perform to their maximum potential in a technologically-based and environmentally-sensitive society; and to sustain an international position of leadership in dynamic scientific and technological research that is engaged by students and faculty and that is focused on global issues of significance to the interests of Alabama; and to contribute to the economic and technical well being of the state and nation through innovative educational, professional, and informational service. Program Objectives: To sustain a nationally-accredited undergraduate program, internationally-recognized research and a graduate program focused on doctoral level achievements. To attain leadership in innovative educational and research areas that recognized the diversity of Alabama's human and natural resources. To place all graduates in meaningful, challenging and rewarding careers that impact the strength of the technological and industrial base. To provide outreach activities for those within Alabama and the nation who can benefit from the unique educational and professional opportunities offered by our program.

Student Learning Outcomes, with Any Associations and Related Measures, Targets, Findings, and Action Plans

SLO 1: Knowledge of math, engineering, and basic science
The ability to apply knowledge of mathematics and engineering and have a thorough grounding in the basic sciences including chemistry, physics and biology.

Connected Documents
chemical engineering bachelors Curriculum Map 1
chemical engineering bachelors Curriculum Map 2

Related Measures

M 1: Criterion based grading: mathematics
Criterion Based Grading in MA 125, 126, 227, 238; and MTE 271 or EE 320 to address the ability to apply knowledge of mathematics and engineering
Source of Evidence: Academic direct measure of learning - other

M 2: Criterion based grading: basic sciences
Criterion Based Grading in CH 101, 102, 231, 232, 237; PH 105, 106; and BSC 114 to assess grounding in the basic sciences of chemistry, physics and biology.
Source of Evidence: Academic direct measure of learning - other

M 3: Six year graduate survey
Six-year surveys of graduates of the ChBE department
Source of Evidence: Alumni survey or tracking of alumni achievements

M 4: Senior exit interviews
Senior exit interviews conducted during the graduate luncheon by the advisory board or the department head
Source of Evidence: Exit interviews with grads/program completers

Target:
Scores are 1,2,3,4, and 5 with the latter representing "strongly agree" that the learning objective has been met. If the average score is less than three then corrective action is considered.

Finding (2011-2012) - Target: Met
Data is being supplied from the May/August 2010 graduate surveys since the results are not compiled yet for the current academic year.

On a scale of 0-5 the scores were the following:
mathematics: 4.65
engineering: 4.60
science: 4.60

M 24: Skills Inventory test CHE 493/CHE 125
A quiz to test students general problem solving abilities including order of magnitude estimates, unit conversions, weight versus mass, and more. Results are compared for freshman students entering the program (CHE 125 introductory 1 hr course) to seniors who take the exam in CHE 493.

Source of Evidence: Academic direct measure of learning - other

Target:
For students completeing the program (CHE 493) more than half should answer at least 19 out of the 24 questions correctly.

Finding (2011-2012) - Target: Met
For seniors (CHE 493) only four out of 24 questions had less than half of the students answer it correctly, while for freshmen only two of the 24 questions had less than 50% answering correctly.

**SLO 2: Laboratory skills**
The ability to operate in a laboratory environment, specifically to design and conduct experiments as well as to analyze and interpret experimental data

**Connected Documents**
- chemical engineering bachelor's Curriculum Map I
- chemical engineering bachelor's Curriculum Map II

**Related Measures**

**M 3: Six year graduate survey**
Six-year surveys of graduates of the ChBE department
Source of Evidence: Alumni survey or tracking of alumni achievements

**M 4: Senior exit interviews**
Senior exit interviews conducted during the graduate luncheon by the advisory board or the department head
Source of Evidence: Exit interviews with grads/program completers

**Target:**
Scores are 1, 2, 3, 4, and 5 with the latter representing "strongly agree" that the learning objective has been met. If the average score is less than three then corrective action is considered.

**Finding (2011-2012) - Target: Met**
Survey score was 4.3 (between agree and strongly agree) for an ability to design and construct experiments and 4.4 for an ability to analyze and interpret experimental data.

**M 5: CHE 319 experimental design exam with rubric**
A Criterion Based Exam scored using a Rubric in CHE 319 to address ability to design and conduct experiments
Source of Evidence: Project, either individual or group

**Target:**
The ability of students to design an experiment has been evaluated using a rubric, and students all scored more than 80 out of 100 and thus the outcome was deemed "met". A better classroom is needed to assess more completely the ability to use modern tools of engineering. As of summer 2012, the facilities have been provided for presentations in the CHE 319 course. Based on the assessment that was completed, however, no other action is necessary.

**Finding (2011-2012) - Target: Met**
An excerpt of the attached documents (319_Fall 11 and 319 Spring 12) reporting the assessment findings are the following:

"I am satisfied with the results of the oral exam rubric testing the ABET outcome "an ability to design and conduct experiments." It is truly an evaluation of each individual student. However, a better method is with formal proposal presentations. This was impossible because a suitable classroom was not available. The second ABET outcome "a working knowledge of modern experimental techniques" was more difficult to test because it was difficult to distinguish individual contributions to the reports. The lack of a suitable classroom made it difficult to give written examinations to establish individual understanding of the techniques. Proposal presentations and written examinations will be once again possible if a suitable classroom can be provided. Since the instructor needs to meet with one section for lecture, proposals, and tests while a second section is actually in the lab conducting experiments, the classroom must be in close proximity. This past year all possible space was unavailable because of logistical difficulties resulting from construction. A large graduate student office will become available for Fall, 2012 across the hall from the lab. A proposal is in preparation to repurpose this room for this lab course and other specific uses."

**M 6: CHE 320 data analysis writing assignment with rubric**
Written reports on heat transfer (or other equivalent topic), authored by individual students are scored using a Rubric in CHE 320 to address ability to analyze and interpret data
Source of Evidence: Written assignment(s), usually scored by a rubric

**M 26: **********
Six-year surveys of graduates of the ChBE department 2
Source of Evidence: Academic direct measure of learning - other

**M 34: **********
Senior exit interviews conducted during the graduate luncheon by the advisory board or the department head 2
Source of Evidence: Exit interviews with grads/program completers

**SLO 3: Design physical, chemical, and biological processes**
The ability to design physical, chemical, and biological processes to meet desired needs within realistic economic, health and safety constraints

Connected Documents
chemical engineering bachelor's curriculum Map I
chemical engineering bachelor's curriculum Map II

Related Measures

M 3: Six year graduate survey
Six-year surveys of graduates of the ChBE department
Source of Evidence: Alumni survey or tracking of alumni achievements

M 4: Senior exit interviews
Senior exit interviews conducted during the graduate luncheon by the advisory board or the department head
Source of Evidence: Exit interviews with grads/program completers
Target:
Scores are 1,2,3,4, and 5 with the latter representing "strongly agree" that the learning objective has been met. If the average score is less than three then corrective action is considered.

Finding (2011-2012) - Target: Met
The score was 4.3 for an ability to design a process to meet desired needs

M 7: CHE 481 design rubric
A rubric applied in CHE 481 addresses the ability to design processes within realistic economic, health and safety constraints
Source of Evidence: Project, either individual or group

M 25: ********
Six-year surveys of graduates of the ChBE department
Source of Evidence: Academic direct measure of learning - other

M 36: ********
Senior exit interviews conducted during the graduate luncheon by the advisory board or the department head
Source of Evidence: Exit interviews with grads/program completers

SLO 4: Multi-disciplinary teams
The ability to function on multi-disciplinary teams

Connected Documents
chemical engineering bachelor's curriculum Map I
chemical engineering bachelor's curriculum Map II

Related Measures

M 3: Six year graduate survey
Six-year surveys of graduates of the ChBE department
Source of Evidence: Alumni survey or tracking of alumni achievements

M 4: Senior exit interviews
Senior exit interviews conducted during the graduate luncheon by the advisory board or the department head
Source of Evidence: Exit interviews with grads/program completers
Target:
Scores are 1,2,3,4, and 5 with the latter representing "strongly agree" that the learning objective has been met. If the average score is less than three then corrective action is considered.

Finding (2011-2012) - Target: Met
The score was 4.4 for an ability to function on multidisciplinary teams.

M 8: CHE 481 teaming rubric
A Criterion Based Exam scored using a Rubric is graded in CHE 481 to determine ability to function on multi-disciplinary teams
Source of Evidence: Project, either individual or group

M 31: ********
Senior exit interviews conducted during the graduate luncheon by the advisory board or the department head
Source of Evidence: Exit interviews with grads/program completers

M 33: ********
Six-year surveys of graduates of the ChBE department
Source of Evidence: Academic direct measure of learning - other

SLO 5: Identify, formulate, and solve engineering problems
The ability to identify, formulate, and solve engineering problems

Connected Documents
chemical engineering bachelor's curriculum Map I
chemical engineering bachelor's curriculum Map II

Related Measures

M 3: Six year graduate survey
Six-year surveys of graduates of the ChBE department
Source of Evidence: Alumni survey or tracking of alumni achievements
M 4: Senior exit interviews
Senior exit interviews conducted during the graduate luncheon by the advisory board or the department head
Source of Evidence: Exit interviews with grads/program completers

Target:
Scores are 1,2,3,4, and 5 with the latter representing "strongly agree" that the learning objective has been met. If the average score is less than three then corrective action is considered.

Finding (2011-2012) - Target: Met
The average score was 4.5 for the ability to identify, formulate and solve engineering problems.

M 9: CHE 306 problem solving exam with rubric
A Criterion Based Exam scored using a Rubric is used in CHE 306 to assess ability to identify, formulate and solve engineering problems.
Source of Evidence: Standardized test of subject matter knowledge

Target:
A rubric score of at least three out of five as the class average in at least three out of the five skills: Understanding a problem statement and defining a problem, understanding fundamental principles in a problem, ability to find appropriate data to formulate a solution, developing equations as a solution strategy, and ability of concisely present the problem and its solution.

Finding (2011-2012) - Target: Met
Two out of 5 skills had class average scores less than three out of five and those were "understanding fundamental principles" (2.8 out of 5) and "develop a strategy to solve a problem using equations" (2.7 out of 5)

M 29: ********
Senior exit interviews conducted during the graduate luncheon by the advisory board or the department head
5
Source of Evidence: Exit interviews with grads/program completers

M 30: ********
Six-year surveys of graduates of the ChBE department
5
Source of Evidence: Academic direct measure of learning - other

M 35: ********
Six-year surveys of graduates of the ChBE department
6
Source of Evidence: Academic direct measure of learning - other

SLO 6: Communicate effectively in writing and verbally
The ability communicate effectively in writing and verbally

Connected Documents
chemical engineering bachelors Curriculum Map I
chemical engineering bachelors Curriculum Map II

Related Measures

M 3: Six year graduate survey
Six-year surveys of graduates of the ChBE department
Source of Evidence: Alumni survey or tracking of alumni achievements

M 4: Senior exit interviews
Senior exit interviews conducted during the graduate luncheon by the advisory board or the department head
Source of Evidence: Exit interviews with grads/program completers

Target:
Scores are 1, 2, 3, 4, and 5 with the latter representing "strongly agree" that the learning objective has been met. If the average score is less than three then corrective action is considered.

Finding (2011-2012) - Target: Met
The score was 4.4 for communicating effectively in writing, while verbally the score was 4.35

M 10: CHE 320 written communication rubric
A Criterion Based Exam scored using a Rubric is used in CHE 320 to assess the ability to communicate effectively in writing.
Source of Evidence: Writing exam to assure certain proficiency level

M 11: CHE 320 oral communication rubric
A Criterion Based Exam scored using a Rubric is used in CHE 320 to assess the ability to communicate effectively verbally.
Source of Evidence: Presentation, either individual or group

SLO 7: Use engineering tools necessary for engineering practice.
The ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Connected Documents
chemical engineering bachelors Curriculum Map I
chemical engineering bachelors Curriculum Map II

Related Measures

M 3: Six year graduate survey
Six-year surveys of graduates of the ChBE department
Source of Evidence: Alumni survey or tracking of alumni achievements

**M 4: Senior exit interviews**
Senior exit interviews conducted during the graduate luncheon by the advisory board or the department head
Source of Evidence: Exit interviews with grads/program completers

**Target:**
Scores are 1,2,3,4,and 5 with the latter representing "strongly agree" that the learning objective has been met. If the average score is less than three then corrective action is considered.

**Finding (2011-2012) - Target: Met**
The score for engineering tools was 4.3

**M 12: CHE 304 computer exam with rubric**
A Criterion Based Exam scored using a Rubric is used in CHE 304 to assess competency with modern engineering tools
Source of Evidence: Standardized test of subject matter knowledge

**SLO 8: Knowledge of core chemical engineering concepts**
The ability to analyze and control physical, chemical, and biological processes as demonstrated by a working knowledge of material balances, energy balances, thermodynamics, transport phenomena, reaction engineering, separations, and process dynamics and control.

**Connected Documents**
- chemical engineering bachelors Curriculum Map 1
- chemical engineering bachelors Curriculum Map II

**Related Measures**

**M 3: Six year graduate survey**
Six-year surveys of graduates of the ChBE department
Source of Evidence: Alumni survey or tracking of alumni achievements

**M 4: Senior exit interviews**
Senior exit interviews conducted during the graduate luncheon by the advisory board or the department head
Source of Evidence: Exit interviews with grads/program completers

**Target:**
Scores are 1,2,3,4,and 5 with the latter representing "strongly agree" that the learning objective has been met. If the average score is less than three then corrective action is considered.

**Finding (2011-2012) - Target: Partially Met**
The scores for the core chemical engineering concepts as required by the American Institute of Chemical Engineering are the following.

A working knowledge of:

- organic, analytical, biochemistry, materials chemistry or physical chemistry = 4.4
- material and energy balances applied to chemical processes = 4.9
- thermodynamics of physical and chemical equilibria = 3.6
- heat, mass, and momentum transfer = 4.5
- chemical and reaction engineering = 4.5
- continuous and stage-wise separation operations = 4.8
- process dynamics and control = 4.3
- process design = 4.2
- modern experimental techniques = 4.0
- modern computing techniques = 3.9

Also with this measure, students had the opportunity to express their concerns in an open question format. A summary of those comments are below:

Comments were very positive about the ChBE program. As with May/Aug 2010 grad comments, there was much praise for CHE 320 and students thought that we needed more faculty. Also, two students wished that junior and senior level classes were offered each semester be more flexible for co-op schedules.

More than one half of students participating complained about access to computers with Chem Cad and MatLab. Dr. Ritchie noted that there were senior students in his Design I class who didn't know the syntax for entering formulas in EXCEL. The curriculum committee would like our program to be able to establish another teaching classroom with computers like Bev 162 so we can teach our students how to “use the techniques, skills, and modern engineering tools necessary for engineering practice” which is Student Learning Outcome #7 for both ABET and SACS accreditation.

Based on the survey results, there is no need for action regarding our Program Educational Objectives (scores were 4.2-4.7 on a scale to 5). However, the survey revealed a possible deficiency with 8d (with an average score of 3.0 on a scale to 5) in regards to a working knowledge of “Transport Phenomena” as an program educational outcome. The committee suggested that Dr. Arnold reconsider the textbook he is using (Bird, Stewart and Lightfoot) as it is written more at the level for a graduate
student, rather than undergraduates.

**Related Action Plans (by Established cycle, then alpha):**
For full information, see the Details of Action Plans section of this report.

**Textbook change for CHE 324 "Transport Phenomena"**
Established in Cycle: 2011-2012
As identified in the survey comments and also a consistent trend from year-to-year, the curriculum committee recommends that...

**M 13: CHE 254 core concept exam with rubric**
An exam in CHE 254 graded with a rubric will be used to assess a working knowledge of material and energy balances.

Source of Evidence: Standardized test of subject matter knowledge

**Target:**
The final exam is given to only students without an A average which for the Spring 2012 was 26 out of 46 students. Five concepts are tested: Energy Balance, Coupled Mass and Energy Balance, Distillation unit operation, Combustion mole balance, Mass balance on a batch reactor. The target is for more than half of students to score perfectly on at least two of the five problems.

**Finding (2011-2012) - Target: Met**
Mole balances on combustion reactions, and mass balances on a batch reaction were the only two concepts for which more than half of the students scored perfectly. The worst performance was on distillation (15% correct) however this concept is covered in more detail in Thermodynamics (CHE 255) and Separations (CHE 306). The energy balance was correct for 38% of the students while the coupled energy and mass balance was correct for 31% of the students.

**M 14: CHE 255 core concept exam with rubric**
An exam will be graded with a rubric in CHE 255 to assess a working knowledge of thermodynamics.

Source of Evidence: Standardized test of subject matter knowledge

**Target:**
More than half of students attempting to solve a thermodynamics problem achieve a perfect score for at least five out of seven problems targeting specific topic areas. Topic areas are unsteady-state energy balance, the phase rule, ideal and non-ideal equations of state, steam tables and quality, phase equilibria, equilibrium extent of reaction, and temperature effect on reaction equilibrium.

**Finding (2011-2012) - Target: Met**
15 students took a comprehensive final with problems on the seven above topic areas. The only topic area where less than half of the students obtained a perfect score was for the temperature affect on reaction equilibrium. This was likely due to the length of the exam being too long and the problem being last so that many students ran out of time to complete the exam.

**M 15: CHE 305 core concept exam with rubric**
A exam will be graded with a rubric in CHE 305 in order to assess a working knowledge of separations.

Source of Evidence: Standardized test of subject matter knowledge

**M 16: CHE 324 core concept exam with rubric**
An exam on transport phenomena core concepts will be graded with a rubric in CHE 324 to assess a working knowledge of transport phenomena.

Source of Evidence: Standardized test of subject matter knowledge

**M 17: CHE 354 core concept exam with rubric**
A team-based project covering core reactor design concepts using an open-ended problem graded with a rubric to assess a working knowledge of reaction engineering.

Source of Evidence: Standardized test of subject matter knowledge

**Target:**
More than 90% of teams score better than 40 out of 50 total points.

**Finding (2011-2012) - Target: Met**
100% of the teams scored more than 45 out of 50.

**M 18: CHE 493 core concept exam with rubric**
An exam on core concepts learned in CHE 493 is graded using a rubric to assess a working knowledge of process dynamics and control concepts.

Source of Evidence: Standardized test of subject matter knowledge

**SLO 9: Exercise professional ethical responsibility**
The ability to understand and exercise professional ethical responsibility

**Connected Documents**
- chemical engineering bachelors Curriculum Map I
- chemical engineering bachelors Curriculum Map II

**Related Measures**
M 3: Six year graduate survey
Six-year surveys of graduates of the ChBE department
Source of Evidence: Alumni survey or tracking of alumni achievements

M 4: Senior exit interviews
Senior exit interviews conducted during the graduate luncheon by the advisory board or the department head
Source of Evidence: Exit interviews with grads/program completers
  Target:
  Scores are 1, 2, 3, 4, and 5 with the latter representing "strongly agree" that the learning objective has been met. If the average score is less than three then corrective action is considered.
  Finding (2011-2012) - Target: Met
  The score for an understanding of professional and ethical responsibility was 4.1 out of 5.

M 19: CHE 482 ethics exam with rubric
A Criterion Based Exam scored using a Rubric is used in CHE 482 to assess ability to exercise ethical behavior.
Source of Evidence: Standardized test of subject matter knowledge

M 27: ********
Senior exit interviews conducted during the graduate luncheon by the advisory board or the department head 9
Source of Evidence: Exit interviews with grads/program completers

SLO 10: Understanding engineering solutions in a global, environmental and societal context
An understanding of the impact of engineering solutions in a global, environmental and societal context

Connected Documents
  chemical engineering bachelors Curriculum Map I
  chemical engineering bachelors Curriculum Map II

Related Measures

M 3: Six year graduate survey
Six-year surveys of graduates of the ChBE department
Source of Evidence: Alumni survey or tracking of alumni achievements

M 4: Senior exit interviews
Senior exit interviews conducted during the graduate luncheon by the advisory board or the department head
Source of Evidence: Exit interviews with grads/program completers
  Target:
  Scores are 1, 2, 3, 4, and 5 with the latter representing "strongly agree" that the learning objective has been met. If the average score is less than three then corrective action is considered.
  Finding (2011-2012) - Target: Met
  The score for understanding engineering solutions in a global, environmental and societal context was 3.8 out of 5.

M 20: CHE 482 societal impact exam with rubric
A Criterion Based Exam scored using a Rubric is used in CHE 482 to assess understanding of the impact of engineering solutions in a global and societal context.
Source of Evidence: Standardized test of subject matter knowledge

M 21: CHE 305 environmental issues exam with rubric
A Criterion Based Exam scored using a Rubric is used in CHE 305 to assess understanding of the impact of engineering solutions in an environmental context.
Source of Evidence: Standardized test of subject matter knowledge

M 28: ********
Six-year surveys of graduates of the ChBE department 10
Source of Evidence: Academic direct measure of learning - other

SLO 11: Engagement in life-long learning
A recognition of the need for and to engage in life-long learning

Connected Documents
  chemical engineering bachelors Curriculum Map I
  chemical engineering bachelors Curriculum Map II

Related Measures

M 3: Six year graduate survey
Six-year surveys of graduates of the ChBE department
Source of Evidence: Alumni survey or tracking of alumni achievements

M 4: Senior exit interviews
Senior exit interviews conducted during the graduate luncheon by the advisory board or the department head
Source of Evidence: Exit interviews with grads/program completers
  Target:
  Scores are 1, 2, 3, 4, and 5 with the latter representing "strongly agree" that the learning objective has been met. If the average score is less than three then corrective action is considered.
  Finding (2011-2012) - Target: Met
  The score for a recognition of the need for, and an ability to engage in life-long learning was 4.35
**M 22:** CHE 482 life-long learning rubric
A Rubric is used in CHE 482 to assess a recognition of the need for and to engage in life-long learning

**Source of Evidence:** Standardized test of subject matter knowledge

**Target:**

The life-long learning assessment was conducted in the CHE 482- Chemical process Design II using practical life example to assess the understanding and performance of the student. The questions were divided into two categories: (1) a recognition of the need for life-long learning, and (2) ability to engage in life-long learning.

The assessment quiz had 8 questions and 43 out of 43 students completed the Quiz. 5 out of 8 questions were related to the assessment of the recognition of the need for life-long learning and 3 were related to the ability of engaging in life-long learning.

The awareness of the importance of life-long learning was assessed by understanding the following:

(1) The nature of science, engineering, technology and industry is dynamic and constantly evolving

(2) The goals and requirements vary

(3) New technology and methods become available

(4) Fundamentals need to be adjusted to fit specific environments

(5) Each person performs different roles in their lives.

The ability of engaging in life-long learning was assessed according to the performing criteria of Self-Directed, Self-Regulated, and Self-Motivated learner.

(1) Engage in professional societies and attending conferences

(2) Proactively approach experts in the fields

(3) Use advanced technologies

1.) Individual role: All the students got this one correct.

2.) New technology: 41 out of 43 got this one right. Those who failed confused the new technology and the evolving nature of technology.

3.) Fundamentals: 40 out of 43 students got this one correct. Those who failed confused the new requirements and the fundamentals.

4.) Evolving nature: all the students got this one correct.

5.) New requirements: 42 out of 43 got this one correct.

6.) Use advanced technology: the entire student got this one correct.

7.) Experts in the field: 39 out of 40 were familiar with the ways to attain this ability.

8.) Engage in professional societies and conferences: 36 out of 43 are somehow engaged.

**Target:** More than half of students answer correctly on five or more of the eight topics

**Finding (2011-2012) - Target: Met**

The topic with the lowest percentage of students achieving a correct score was "engagement in professional societies and conferences" for which 84% of the students are at least somewhat engaged.

**M 32:** ********
Six-year surveys of graduates of the ChBE department 11
Source of Evidence: Academic direct measure of learning - other

**M 37:** ********
Senior exit interviews conducted during the graduate luncheon by the advisory board or the department head 11
Source of Evidence: Exit interviews with grads/program completers

**SLO 12:** Knowledge of how the engineering profession interfaces with contemporary issues
An appreciation of how the chemical engineering profession interfaces with contemporary issues

**Connected Documents**
- chemical engineering bachelors Curriculum Map I
- chemical engineering bachelors Curriculum Map II

**Related Measures**

**M 3:** Six year graduate survey
Six-year surveys of graduates of the ChBE department
Source of Evidence: Alumni survey or tracking of alumni achievements
M 4: **Senior exit interviews**
Senior exit interviews conducted during the graduate luncheon by the advisory board or the department head
Source of Evidence: Exit interviews with grads/program completers

**Target:**
Scores are 1, 2, 3, 4, and 5 with the latter representing "strongly agree" that the learning objective has been met. If the average score is less than three then corrective action is considered.

**Finding (2011-2012) - Target: Met**
The score for a knowledge of contemporary issues was 3.9

M 23: **CHE 125 contemporary issues rubric**
A Criterion Based Exam scored using a Rubric is used in CHE 125 to assess an appreciation of how the chemical engineering profession interfaces with contemporary issues.
Source of Evidence: Standardized test of subject matter knowledge

**Target:**
A quiz is given in class to which students give their opinion (yes or no) about whether the course adequately addressed contemporary issues within the chemical engineering profession. The target is 85% saying yes.

**Finding (2011-2012) - Target: Met**
Ninety three percent of 160 students questioned answered that the CHE 125 course covered contemporary issues in chemical engineering.

M 38: ********
Six-year surveys of graduates of the ChBE department 12
Source of Evidence: Academic direct measure of learning - other

M 39: ********
Senior exit interviews conducted during the graduate luncheon by the advisory board or the department head 12
Source of Evidence: Exit interviews with grads/program completers

---

**Details of Action Plans for This Cycle (by Established cycle, then alpha)**

**Textbook change for CHE 324 "Transport Phenomena"**
As identified in the survey comments and also a consistent trend from year-to-year, the curriculum committee recommends that the textbook be changed from the current "Transport Phenomena" by Bird, Stewart and Lightfoot to a book that is more geared to undergraduates rather than graduate students.

**Established in Cycle:** 2011-2012
**Implementation Status:** Planned
**Priority:** High

**Relationships (Measure | Outcome/Objective):**
- Measure: Senior exit interviews
- Outcome/Objective: Knowledge of core chemical engineering concepts

**Implementation Description:** Dr. Eric Carlson will be using a different textbook geared towards undergraduates. Also, Dr. Carlson is a new instructor for this course, replacing Dr. David Arnold.

**Responsible Person/Group:** Dr. Eric Carlson
## Curriculum Map I (Student Learning Outcomes)

<table>
<thead>
<tr>
<th>Course</th>
<th>Student Learning Outcome 1</th>
<th>Student Learning Outcome 2</th>
<th>Student Learning Outcome 3</th>
<th>Student Learning Outcome 4</th>
<th>Student Learning Outcome 5</th>
<th>Student Learning Outcome 6</th>
<th>Student Learning Outcome 7</th>
<th>Student Learning Outcome 8</th>
<th>Student Learning Outcome 9</th>
<th>Student Learning Outcome 10</th>
<th>Student Learning Outcome 11</th>
<th>Student Learning Outcome 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH 101 (or 117)</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CH 102 (or 118)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CH 231</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CH 232</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CH 237</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MA 125 (or 145)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MA 126 (or 146)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MA 227 (or 247)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MA 238</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PH 105 (or 125)</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PH 106 (or 126)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BSC 114 (or 118)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MTE271 (or EE320)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 125</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X X X</td>
</tr>
<tr>
<td>CHE 254</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>CHE 255</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X X X</td>
</tr>
<tr>
<td>CHE 304</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>CHE 305</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X X X X</td>
</tr>
<tr>
<td>CHE 306</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X X</td>
</tr>
<tr>
<td>CHE 319</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X X X X X</td>
</tr>
<tr>
<td>CHE 320</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 324</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>CHE 354</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Course 24</td>
<td>CHE 481</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>---------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Course 23</td>
<td>CHE 482</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Course 23</td>
<td>CHE 493</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Curriculum Map II (Assessment Measures)

<table>
<thead>
<tr>
<th>Course 1</th>
<th>Math, Science &amp; Eng</th>
<th>Student Learning Outcome 1</th>
<th>CBG/survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course 2</td>
<td></td>
<td>Student Learning Outcome 2</td>
<td>Lab skills</td>
</tr>
<tr>
<td>Course 3</td>
<td></td>
<td>Student Learning Outcome 3</td>
<td>Design skills</td>
</tr>
<tr>
<td>Course 4</td>
<td></td>
<td>Student Learning Outcome 4</td>
<td>Team skills</td>
</tr>
<tr>
<td>Course 5</td>
<td></td>
<td>Student Learning Outcome 5</td>
<td>Solve Eng. Prob.</td>
</tr>
<tr>
<td>Course 6</td>
<td></td>
<td>Student Learning Outcome 6</td>
<td>Use modern tools</td>
</tr>
<tr>
<td>Course 7</td>
<td></td>
<td>Student Learning Outcome 7</td>
<td>Core ChE topics</td>
</tr>
<tr>
<td>Course 8</td>
<td></td>
<td>Student Learning Outcome 8</td>
<td>Ethics</td>
</tr>
<tr>
<td>Course 9</td>
<td></td>
<td>Student Learning Outcome 9</td>
<td>Eng. impact</td>
</tr>
<tr>
<td>Course 10</td>
<td></td>
<td>Student Learning Outcome 10</td>
<td>Life-long learn</td>
</tr>
<tr>
<td>Course 11</td>
<td></td>
<td>Student Learning Outcome 11</td>
<td>Contemporar y issues</td>
</tr>
<tr>
<td>Course 12</td>
<td></td>
<td>Student Learning Outcome 12</td>
<td></td>
</tr>
</tbody>
</table>

<p>| Course 2 | CH 101  (or 117) | CBG/survey |
| Course 3 | CH 102  (or 118) | CBG/survey |
| Course 4 | CH 231       | CBG/survey |
| Course 5 | CH 232       | CBG/survey |
| Course 6 | CH 237       | CBG/survey |
| Course 7 | MA 125  (or 145) | CBG/survey |
| Course 8 | MA 126  (or 146) | CBG/survey |
| Course 9 | MA 227 (or 247) | CBG/survey |
| Course 10 | MA 238      | CBG/survey |
| Course 11 | PH 105  (or 125) | CBG/survey |
| Course 12 | PH 106  (or 126) | CBG/survey |
| Course 13 | BSC 114 (or 118) | CBG/survey |
| Course 14 | MTE271  (or EE320) | CBG/survey |
| Course 15 | CHE 125       | CBG/survey |
| Course 16 | CHE 254       | CBG/survey |
| Course 17 | CHE 255       | CBG/survey |
| Course 18 | CHE 304       | Rubric/survey |
| Course 19 | CHE 305       | CBG/survey |
| Course 20 | CHE 306       | Rubric/survey |
| Course 21 | CHE 319       | Rubric/survey |
| Course 22 | CHE 320       | Rubric/survey |
| Course 23 | CHE 324       | CBG/survey |
| Course 24 |                     | CBG/survey |</p>
<table>
<thead>
<tr>
<th>Course 24</th>
<th>Course 23</th>
<th>Course 23</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHE 354</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 481</td>
<td>Rubric/survey</td>
<td>Rubric/survey</td>
</tr>
<tr>
<td>CHE 482</td>
<td></td>
<td>Rubric/survey</td>
</tr>
<tr>
<td>CHE 493</td>
<td></td>
<td>CBG/survey</td>
</tr>
</tbody>
</table>
ABET
Self Study Report
for the
B.S. in Chemical Engineering
at the
University of Alabama
Tuscaloosa, AL

June 30, 2013

CONFIDENTIAL

The information supplied in this Self-Study Report is for the confidential use of ABET and its authorized agents, and will not be disclosed without authorization of the institution concerned, except for summary data not identifiable to a specific institution.
# Table of Contents

**Program Self-Study Report for Chemical and Biological Engineering**

**BACKGROUND INFORMATION** .......................................................... 5

A. Contact Information ........................................................................... 5
B. Program History .................................................................................. 5
C. Options .................................................................................................. 5
D. Organizational Structure ..................................................................... 6
E. Program Delivery Modes ...................................................................... 6
F. Program Locations ................................................................................ 6
G. Deficiencies, Weaknesses or Concerns from Previous Evaluation(s) and the Actions Taken to Address Them ........................................................................................................ 7
H. Joint Accreditation .............................................................................. 8

**CRITERION 1. STUDENTS** ................................................................. 9

A. Student Admissions ............................................................................ 9
B. Evaluating Student Performance ......................................................... 9
C. Transfer Students and Transfer Courses .............................................. 10
D. Advising and Career Guidance .......................................................... 11
E. Work in Lieu of Courses ..................................................................... 12
F. Graduation Requirements .................................................................... 13
G. Transcripts of Recent Graduates .......................................................... 14

**CRITERION 2. PROGRAM EDUCATIONAL OBJECTIVES** .................. 15

A. Mission Statement ............................................................................ 15
B. Program Educational Objectives ......................................................... 15
C. Consistency of the Program Educational Objectives with the Mission of the Institution ... 16
D. Program Constituencies ...................................................................... 16
E. Process for Revision of the Program Educational Objectives .............. 16

**CRITERION 3. STUDENT OUTCOMES** .............................................. 18

A. Student Outcomes ............................................................................ 18
B. Relationship of Student Outcomes to Program Educational Objectives .......................................................................................................................... 20

**CRITERION 4. CONTINUOUS IMPROVEMENT** .................................. 21

Figure 4.1 Assessment Process Flow Diagram for ChBE Undergraduate Program .............. 21
A. Program Educational Objectives ......................................................... 22
B. Student Outcomes ............................................................................. 25
Table 4.B.1  Course linked assessment measures for each student outcome ................. 26
C. Continuous Improvement ................................................................... 32
D. Additional Information ....................................................................... 34

**CRITERION 5. CURRICULUM** ............................................................ 62

A. Program Curriculum ........................................................................... 62
B. Course Syllabi .................................................................................... 65
Table 5-1 Curriculum ........................................................................................................... 66
CRITERION 6. FACULTY ........................................................................................................ 75
A. Faculty Qualifications .................................................................................................... 75
B. Faculty Workload ....................................................................................................... 75
C. Faculty Size ................................................................................................................. 75
D. Professional Development ............................................................................................. 76
E. Authority and Responsibility of Faculty .......................................................................... 76
Table 6-1. Faculty Qualifications .......................................................................................... 77
Table 6-2. Faculty Workload Summary ............................................................................... 79
CRITERION 7. FACILITIES ................................................................................................... 81
A. Offices, Classrooms and Laboratories ............................................................................. 81
B. Computing Resources ..................................................................................................... 83
C. Guidance ..................................................................................................................... 83
D. Maintenance and Upgrading of Facilities ......................................................................... 84
E. Library Services ............................................................................................................. 84
F. Overall Comments on Facilities .................................................................................... 86
ChBE Faculty and Facilities Map ........................................................................................ 87
CRITERION 8. INSTITUTIONAL SUPPORT ......................................................................... 88
A. Leadership ................................................................................................................... 88
B. Program Budget and Financial Support ............................................................................. 89
C. Staffing ....................................................................................................................... 91
D. Faculty Hiring and Retention ............................................................................................ 92
E. Support of Faculty Professional Development ................................................................. 93
PROGRAM CRITERIA ........................................................................................................... 94
APPENDIX A. COURSE SYLLABI ..................................................................................... 95
APPENDIX B. FACULTY VITAE .......................................................................................... 162
APPENDIX C. EQUIPMENT .................................................................................................. 193
APPENDIX D. INSTITUTIONAL SUMMARY ....................................................................... 200
Table D3-1. The University of Alabama Organizational Chart ........................................... 203
Table D3-2. The College of Engineering Organizational Chart ........................................... 204
Table D-1. Program Enrollment and Degree Data ................................................................. 206
Table D-2. Personnel ........................................................................................................ 207
APPENDIX E. ADVISING INFORMATION .......................................................................... 208
Signature Attesting to Compliance ..................................................................................... 231
BACKGROUND INFORMATION

A. Contact Information
List name, mailing address, telephone number, fax number, and e-mail address for the primary pre-
visit contact person for the program.

John W. Van Zee, Ph.D.
Professor and Department Head
Chemical and Biological Engineering
The University of Alabama
Box 870203
Tuscaloosa, AL 35487-0203
Phone: 205-348-6981
Fax: 205-348-7558
Email: jwvanzee@eng.ua.edu

B. Program History
Include the year implemented and the date of the last general review. Summarize major program
changes with an emphasis on changes occurring since the last general review.

The University of Alabama’s College of Engineering was created in 1837, making it one of the five
oldest continuously-operating engineering programs in the country. The Department of Chemical
Engineering was established in 1910, and the first UA CHE degree was awarded in 1914. The first
CHE MS degree was awarded in 1924, and the first two PhD degrees in the College of Engineering
were awarded in 1964, both to CHE students.

The department name was changed to “Chemical and Biological Engineering” in 2004 to reflect the
national trend towards life-science applications for chemical engineering students.

The most recent ABET review was during the 2007-2008 cycle. The department submitted an
Interim Report in 2009 to address program weaknesses identified by the 2007-2008 ABET review.

Since the last review, the following major changes have occurred:

- Decrease in the number of Program Educational Objectives from seven to three
- Employment of a new ChBE Department Head, Dr. John W. Van Zee, effective January
  2013
- Curricular changes, including requirement of CHE 440: Health and Safety to reflect the
  increased emphasis on safety in the current AICHE program criteria, effective for the
  2013/2014 school year
- Implementation of new College of Engineering advising system (not major-specific)

C. Options
List and describe any options, tracks, concentrations, etc. included in the program.

A Bachelor of Science (BS) in Chemical Engineering is the sole undergraduate degree offered by the
Department of Chemical and Biological Engineering. Students are not required to satisfy any
particular curriculum option, track or concentration. However, suggested choices for electives are
listed for students interested in the health professions, such as additional biology coursework. In
addition, the department offers a dual major with the Department of Chemistry in the College of Arts
and Sciences requiring four additional hours of coursework above the 127 hours required for a traditional BS in Chemical Engineering. A dual major is distinguished from a dual degree in that the later requires at least 150 credit hours. [http://courseleaf.ua.edu/introduction/academicpolicies/multipledegrees/#majorsandmultiplemajors text]

The university also provides a fast track for ChBE undergraduates wishing to pursue a non-thesis master’s degree referred to as the Scholars Program. The curriculum requirements are summarized in section 5 of this document as a flowchart for the required coursework. Students must maintain a 3.3 GPA to remain eligible, and can earn an MS degree along with their BS degree in five years. The program does not include research, only coursework, and therefore students are not provided a stipend.

D. Organizational Structure
Using text and/or organizational charts, describe the administrative structure of the program (from the program to the department, college, and upper administration of your institution, as appropriate).

The B.S. degree is one of three degree programs (B.S., M.S. and Ph.D.) offered by the Department of Chemical and Biological Engineering. The Department is one of seven departments within the College of Engineering and the college is one of eleven colleges at the University of Alabama.

An organizational chart for both the University of Alabama and the College of Engineering is found in Appendix D.3 (Educational Unit).

E. Program Delivery Modes
Describe the delivery modes used by this program, e.g., days, evenings, weekends, cooperative education, traditional lecture/laboratory, off-campus, distance education, web-based, etc.

The program is delivered via traditional lectures and laboratories offered during regular weekday daytime hours. Summer unit operations laboratory (CHE 320) requires attendance on some Saturdays. A significant fraction of students participate in a cooperative education (co-op) program which has the same degree requirements as that for the non co-op students. This program does not include distance education courses or web-based courses.

F. Program Locations
Include all locations where the program or a portion of the program is regularly offered (this would also include dual degrees, international partnerships, etc.).

All portions of the program are regularly offered at the main Tuscaloosa campus. No dual degree or international partnership degree program with another institution has been initiated. Beginning in 2012 as an optional international experience, the program has offered a section of Unit Operations Laboratory (CHE 320) in Denmark using the facilities at the Technical University of Denmark in a suburb of Copenhagen. The department supplies a professor and a teaching assistant to read and grade laboratory reports. Nine (9) students chose to participate in summer 2012 and nineteen (19) students have enrolled for summer 2013 showing this option is growing in popularity among students.
G. Deficiencies, Weaknesses or Concerns from Previous Evaluation(s) and the Actions Taken to Address Them

Summarize the Deficiencies, Weaknesses, and/or Concerns remaining from the most recent ABET Final Statement. Describe the actions taken to address them, including effective dates of actions, if applicable. If this is an initial accreditation, it should be so indicated.

During the previous 2007 ABET visit to UA, the program evaluator did not note any program deficiencies or concerns, however he did report two program weaknesses:

1. Criterion 2. Program Education Objectives Program educational objectives are defined as broad statements that describe career and professional accomplishments that the program is preparing graduates to achieve. The current objectives are focused on student skills at graduation rather than career accomplishments. While a recent assessment of the objectives has been performed, some survey questions were unrelated to graduates’ accomplishments in the years after graduation.

2. Criterion 3. Program Outcomes and Assessment criterion requires that there be an assessment process, with documented results, that demonstrates the degree to which the requisite eleven outcomes are achieved. There is very limited assessment and over reliance on course grades or student opinions surveys for outcomes 3 “a,” ability to apply knowledge of mathematics, science, and engineering, and 3 “c,” ability to design a system, component, or process to meet desired needs within realistic constraints.

To address the issue of the language of the PEOs, the list was changed from:

ChE graduates are expected to:
1. Have knowledge of and a sound understanding of fundamentals
2. Have analysis and problem solving skills
3. Have synthesis and design skills
4. Understand the responsibility to society by integrating global, environmental, and ethical concerns within the engineering functions
5. Have effective oral and written communication skills
6. Have teamwork and leadership skills
7. Be prepared for post BS ChE opportunities

to the following:
1. Our graduates will convert their technical knowledge into the implementation of ideas in the practice of chemical engineering.
2. Our graduates will use their professional skills to convert knowledge into action to protect the public interest, health, safety, and environment in the practice of chemical engineering.
3. Our graduates will use effective verbal and written communication skills to transform their ideas into action to benefit the public good in the practice of chemical engineering.
4. Our graduates will apply their understanding of global and ethical concerns, within the engineering functions, as well as teamwork and leadership skill to transform their ideas into action to benefit the public good in the practice of chemical engineering.
5. Our graduates will value and actively pursue lifelong scientific inquiry, learning and creativity in the practice of chemical engineering.
In addition, a survey of graduates and employers of graduates conducted 6 years after graduation was modified to more specifically address assessment of career accomplishments and the modified surveys are included in section 4.D.

These changes, communicated to ABET in a report dated March 23, 2008, resolved Weakness 1 regarding Criterion 2.

In an upcoming change, using input from UAs Office of Institutional Research and Assessment, the ChBE advisory board and senior students, and in a process described in 4.A, the PEOs are published in the 2013-2014 undergraduate catalog as the following.

Chemical and biological engineering graduates are expected to:
- Apply fundamental principles of chemical and biological engineering in problem solving and design
- Communicate effectively in writing and speaking
- Understand the responsibility to society in the context of global, environmental, ethical and safety concerns

Weakness 2 was resolved, as stated in a July 27, 2010 letter to Dean Karr from ABET, after formal review of UA ChBE’s May 5, 2009 Interim report. To resolve the weakness regarding assessment of outcome 3 “a,” ability to apply knowledge of mathematics, science, and engineering, a Concepts and Skills Inventory Test (CSI) was developed (included in section 4.D) and given to both freshmen and seniors annually beginning in 2008. This tool allows the tracking of a cohort’s attainment of outcome 3 “a” over a period of 3 years. One three year set of data is available and is a topic of section 4 of this document.

To resolve weakness 2 regarding outcome 3 “c,” ability to design a system, component, or process to meet desired needs within realistic constraints, a test given in the first senior design course (CHE 481) was developed along with a scoring rubric that rates design approach, use of computer and other engineering resources, economics and solution practicality. The assessment device (test and rubric) can be found in section 4.D. In addition, a Health and Safety Design Constraints Test implemented in CHE 304 Fluid Flow Operations, a junior level course, was developed along the topics of hydraulic horsepower and safety requirements for pumping cement slurry into an oilfield well. These assessment tools and results are discussed in more detail in section 4.

H. Joint Accreditation

Indicate whether the program is jointly accredited or is seeking joint accreditation by more than one commission.

This degree program is not jointly accredited nor is it seeking joint accreditation by more than one commission.
GENERAL CRITERIA

CRITERION 1. STUDENTS

A. Student Admissions

The admissions requirements of the College of Engineering are the same as those required to obtain admission to the University. Admission requires acceptable evidence of previous academic performance and scores on a recognized admission test. An important factor is performance for six semesters or more in high school academic subjects. The American College Test (ACT) or the Scholastic Aptitude Test (SAT) is required of all freshmen applicants. Admissibility is determined on a sliding scale that is evaluated by university administrators on an annual basis: the lower the grade point average, the higher the ACT/SAT score must be and vice versa. Final determination of admissibility of marginal cases is aided by an analysis of trends of grades, grades earned in specific subjects, interviews, and specific scores on sections of the ACT/SAT. Once admitted, a student may enroll in courses in any term, including the interim session and summer school, provided supporting materials have been received.

The University of Alabama Core Curriculum, required of all graduates, provides the foundation of every undergraduate degree program at the University. In addition to providing a solid understanding of the subjects covered, the core curriculum acquaints students with the ways knowledge is created. The core curriculum includes academic courses in writing, the humanities, the fine arts, the social sciences, the natural sciences (including laboratory experience), and mathematics; it also requires knowledge of a language other than English or an understanding of computer language and application. To prepare for the core curriculum, applicants are encouraged to take maximum advantage of their high-school experiences by accumulating as many academic units as is practical. Students whose records or placement scores do not meet recommended standards may be required to demonstrate that they possess the competencies supposed by these standards.

The University does maintain admissions procedures for special category students, such as home-schooled students or adult students, and offers special programs such as early admission, concurrent enrollment, and admission of non-graduates of high school. Details of these programs and other admissions information can be found in the “General Undergraduate Admission Requirements” section of the UA 2010-2012 Undergraduate Catalog (https://www.ua.edu/catalogs/catalog10/500400.html#genunderadm).

B. Evaluating Student Performance

Students are allowed to declare a College of Engineering major immediately upon enrolling at the University. Students are allowed to matriculate into upper-division engineering courses without special admission requirements. However, for students to successfully progress through an engineering curriculum, the College of Engineering requires a grade of "C-" or higher in each course that serves as a prerequisite for any course in which a student enrolls for credit that will be applied to degree requirements. This policy applies to all courses in a curriculum, including all electives, that are part of degree requirements. If a grade of less than "C-" is received in a course that is a prerequisite for another course, the prerequisite course must be repeated, and a grade of "C-" or higher must be earned before a student enrolls in the subsequent course. These policies are monitored by the on-line registration and degree audit
systems maintained by the Office of the University Registrar. (Note that The University of Alabama uses a plus/minus grading system at the undergraduate level.)

C. Transfer Students and Transfer Courses

Applicants who have attended other colleges or universities are considered transfer students, regardless of the period of enrollment or amount of credit earned. Students seeking to transfer to The University of Alabama must meet the following general requirements:

- Students must have one official transcript sent to the Office of Undergraduate Admissions directly from each college or university previously attended.

- Students who have attempted fewer than 24 semester hours (or 36 quarter hours) of collegiate work must also have official copies of their ACT or SAT scores and high-school records submitted directly to the Office of Undergraduate Admissions.

- An average of "C" (2.0 on a 4.0 scale) or higher for all college-level work attempted is required for admission in good standing. Students who are ineligible to return to the last collegiate institution they attended will not normally be admitted.

- The University of Alabama is on the semester system. Credits earned as quarter hours, therefore, will be evaluated as semester hours. One quarter hour is equal to two-thirds of one semester hour. When a student is seeking to transfer credit that will be applied to degree requirements, final authority for the applicability of that credit rests with the academic division.

- Collegiate work will be considered for transfer credit from post-secondary institutions that are fully accredited by regional accrediting associations and that offer the baccalaureate degree or associate's degree leading to the baccalaureate degree. Collegiate work from post-secondary institutions not fully accredited nor in candidacy status for accreditation from regional accrediting associations will be considered for transfer credit only when approval is recommended by the dean of the academic division in which the student seeks to enroll.

- The authority to apply transferred credit toward degree requirements rests with the academic division of the student's intended major. If a student chooses to transfer to another academic division within the University, credit previously earned at another post-secondary institution will be reevaluated and applied as appropriate to the student's new degree program.

- A minimum of 50% of the coursework required to earn a baccalaureate degree at The University of Alabama must be earned at a baccalaureate degree granting institution, and a minimum of 25% of the coursework required for the degree must be earned at The University of Alabama.

In addition to the general transfer requirements of The University of Alabama, students transferring into the College of Engineering must have a cumulative grade point average equal to or greater than 2.0 for all work submitted at the time of transfer application. Also, transfer grades of "D" are accepted only when the course is not a prerequisite to another course in the curriculum.

In determining the transfer student's GPA for admission, the College of Engineering counts each enrollment in a course as hours attempted. This policy applies even though repeat
enrollments may not have been included in the computation of the GPA by the institution offering the courses. Courses classified as "institutional credit," "remedial," or "not applicable toward baccalaureate degree credit" are not ordinarily included in the computation.

Since 1994, the State of Alabama has had a general articulation agreement between 2-year and 4-year institutions mandated by state law. The General Studies Curriculum enacted by the Alabama legislature provides equivalency for first- and second-year courses taught by colleges in the State of Alabama. In 1995, engineering educators across the State presented an engineering alternative to the General Studies Curriculum that modified the articulation agreement to the specific needs of engineering colleges statewide. The engineering alternative was unanimously approved by the State’s Articulation and General Studies Committee in December 1995 and was made a part of General Studies Curriculum. Full-details of the General Studies Curriculum for Engineering can be found in the “General Undergraduate Admission Requirements” section of the UA 2010-2012 Undergraduate Catalog (https://www.ua.edu/catalogs/catalog10/500400.html#genunderadm).

Under the articulation agreement, students transferring from two-year colleges in the Alabama College System may initiate a contract with The University of Alabama under STARS (the Statewide Articulation Reporting System). The STARS system will guarantee the transfer and applicability of two-year college credit under the following restrictions:

- The contract will be honored for a period of three years from the date of its initiation. A student will be required to satisfy the requirements for graduation as described in the undergraduate catalog in effect at the time the contract is created. However, that the University may change such requirements if the student is given a reasonable opportunity to comply with the changed requirements. The student may choose to comply with the requirements in effect at the time of transfer.
- Under this contract, the student must be officially admitted and enrolled at The University of Alabama immediately following his or her tenure at an Alabama two-year college. Should the student enroll in another post-secondary institution during the interim, the contract is void.

D. Advising and Career Guidance

Advising Process:
The University of Alabama has summer orientation sessions during which all entering freshmen and transfer students come to campus prior to the beginning of classes in August. They are exposed to a thorough campus orientation, learn campus geography, and receive information about many of the available student services. They are also introduced to the College of Engineering. Both entering freshmen and transfer students are advised by College of Engineering professional advisors during these summer sessions.

After the initial summer orientation and advising session, College of Engineering students, regardless of major, work with a professional college advisor by appointment at any time during the academic year. Students must see a college advisor at least once each semester in order to be “cleared” to register for classes for the subsequent semester. Advisors counsel students on courses to take, answer questions, and also check to make sure satisfactory academic progress is being made. There is also a drop/add period at the beginning of each
semester where advisors may meet with students when adjustment to current semester
schedules may be necessary.

The College of Engineering, like each academic division on campus, has a representative who
meets as part of a campus-wide council to coordinate advising efforts throughout the campus.
The UA Academic Advising Association encourages all advisors to engage in ongoing
professional development and networking. Through participation in National Academic
Advising Association (NACADA) regional and national meetings, UA academic advisors are
appropriately informed and make use of best practices from across the nation.

**Career Guidance:**
Students within the College of Engineering have full-access to the University’s Career Center –
a central facility dedicated to maximizing career development and career opportunities for both
students and alumni. It provides career education programming, individual counseling,
personality assessments and access to library resources on occupations, career planning, and
graduate and professional schools through the Sylvester Jones Leadership and Career Resource
Center. Career Center staff assist students with self-assessment, major exploration, interview
techniques, and the development of job search strategies as they pursue a successful transition
to the world of work. Augmenting the University’s Career Center, a full-service satellite office
is physically located in the College of Engineering. The satellite office assists engineering and
computer science students with specific questions and job searches they may have.

The College of Engineering has also instituted a mentoring and professional networking
program called *Mentor UPP (Undergraduate Peer Partnering)*. Mentor UPP is designed to
cultivate relationships between upperclassmen and underclassmen to increase involvement,
retention and confidence in the newest members of the College of Engineering. Freshmen are
matched in groups with one to two junior or senior mentors who provide a support system
along with offering assistance and information to freshmen as they adapt to campus and
college life at The University of Alabama. Mentees are encouraged to complete their freshman
and sophomore years in Mentor UPP, and then give back to future students as peer mentors.

**Advising within the ChBE department:**
Freshman students taking CHE 125 Introduction to Chemical Engineering are given
information regarding the program that can be viewed in Appendix E. In addition, advising
information is accessible via the web at [http://che.eng.ua.edu/undergraduate/](http://che.eng.ua.edu/undergraduate/). Petitions from
students concerning transfer credit, electives, and course substitutions are reviewed by CAC on
a case-by-case basis, and are either approved or denied by the Undergraduate Coordinator.
The Associate Dean for Academic Programs at the college level may override these decisions.
Students are informed of ChBE professors’ open door policy in CHE 125, namely that they are
free to stop-in without appointments to any professor’s office for help with coursework, for
career guidance or for help choosing electives as long as their door is open. This allows for
contact between professors and students outside of classes to resolve advising related issues not
addressed through the college level’s system described above.

**E. Work in Lieu of Courses**
Credit by examination and credit for several types of out-of-class experiences are recognized
by The University of Alabama. The maximum credit obtainable through all programs by
placement is 45 semester hours. The most common programs are Advanced Placement (AP)
and the College Level Examination Program (CLEP) General and Subject Examinations.
Other placement credit programs include the International Baccalaureate, credit for prior military service, the United States Armed Forces Institute (USAFI), and Defense Activity for Nontraditional Education Support (DANTES) credit. Applicants must have their test scores or other supporting paperwork sent directly to the Office of Undergraduate Admissions from the appropriate agency for an extensive review. Policies for all these placement credit programs can be found in the “Credit for Examination Performance and Experience” section of the UA 2010-2012 Undergraduate Catalog (https://www.ua.edu/catalogs/catalog10/500401.html).

All credit by examination presented by transfer students will be evaluated using the same standards that apply to students enrolled at the University. Transfer students who wish to transfer credit by examination must submit official scores to the Office of Undergraduate Admissions for evaluation before the credit may be awarded.

F. Graduation Requirements

The Office of the University Registrar provides the academic and administrative infrastructure necessary for records-related service to students and the campus community with the emphasis on emerging technologies, collaborative efforts, integrated services, and efficient communication processes. The Office of the University Registrar consistently works behind the scenes to provide student record information (degree audits, transcripts, etc.), enrollment and degree verification, up-to-date catalog and timetable information (including classroom scheduling). It ensures that student records are maintained in compliance with the Family Educational Rights and Privacy Act (FERPA) and that electronic access to record information is secure and efficient.

*Degree Works*, a web-based academic planning tool, was implemented campus-wide for all undergraduate programs in May 2009. *Degree Works* includes a degree planner, degree auditing, a GPA calculator, and a "what if" option for students to determine courses that would be required if they changed majors. The University launched a "Finish in Four" campaign along with *Degree Works* to encourage students to utilize planning to complete their undergraduate degree in four years. *Degree Works* augments personalized academic advising and mentoring and it does -not replace those..

**Certification Process:**

Each curriculum in the College of Engineering is developed and approved by the faculty of the appropriate program. It is reviewed and approved by Office of the Dean of Engineering before being reviewed and approved by the University’s Office of Academic Affairs.

The College of Engineering abides by a very prescribed university procedure for certifying graduation requirements. The procedure is as follows:

- A student completes a degree application at least one semester prior to his or her anticipated graduation date.
- Staff within Engineering Student Services, using program-built curriculum templates entered into *Degree Works*, audits the student’s coursework. *Degree Works* checks each application for College and University policy requirements such as “C” prerequisites, core curriculum requirements, GPA requirements, etc.
- If discrepancies in a degree application are found, the Office of Engineering Student Services informs the student with a directive to meet with a college- advisor.
• Students, in consultation with an advisor, may request deviations from the published curriculum or a waiver of an academic policy. This is done through a formal petition process. Petitions involving professional courses or college policies are approved or rejected by the Associate Dean for Academic Programs. Petitions involving the core curriculum or university policies are sent to the University’s Vice-Provost for action.

• Once the college-level degree audit is completed, the student’s application is forwarded to the University’s Records Office as an “approved degree candidate.” The student is notified informing them that they have been approved for graduation, pending their final semester’s performance.

• When final semester grades are posted, Engineering Student Services runs a final degree audit. Should a candidate fall short on any of the degree requirements, the student is informed of their deficiency and that their name is being removed from the graduation list. A student must then re-apply for graduation.

GPA Requirements:
To fulfill the requirements for a baccalaureate degree awarded by the College of Engineering, a student must do the following:

• successfully complete all courses specified by the degree program;
• complete on the Tuscaloosa campus at least one-half of the work required within the CHE discipline;
• earn at least a "C" average (2.0 on a 4.0 scale) for all work attempted;
• earn at least a "C" average (2.0 on a 4.0 scale) for all work attempted on this campus;
• earn at least a "C" average (2.0 on a 4.0 scale) counting just highest graded attempts (i.e., repeat attempts not counted) in his or her professional courses;
• earn at least a "C" average (2.0 on a 4.0 scale) counting just the highest graded attempts (i.e., repeat attempts not counted) in his or her professional courses on this campus; and
• meet all additional academic requirements of the department of CHBE.

G. Transcripts of Recent Graduates
The program will provide transcripts from some of the most recent graduates to the visiting team along with any needed explanation of how the transcripts are to be interpreted. These transcripts will be requested separately by the team chair. State how the program and any program options are designated on the transcript. (See 2012-2013 APPM, Section II.G.4.a.)

Transcripts of recent graduates will be provided upon request from the team chair and program evaluators. The degree awarded, major, additional majors, and any minors are clearly stated on each transcript.
CRITERION 2. PROGRAM EDUCATIONAL OBJECTIVES

A. Mission Statement
Provide the institutional mission statement.

The Mission, Vision and Strategic Goals for the University of Alabama are stated below. They are also available at http://www.ua.edu/mission.html

Our Mission
To advance the intellectual and social condition of the people of the State through quality programs of teaching, research, and service.

Our Vision
The University of Alabama will be the university of choice for the best and brightest students in Alabama and a university of choice for all other students who seek exceptional educational opportunities. The University of Alabama will be a student-centered research university and an academic community united in its commitment to enhancing the quality of life for all Alabamians.

Our Strategic Goals
1. Advance the University's academic, research, scholarship and service priorities, consistent with a top tier university, and continue to promote growth and national prominence in these areas.
2. Retain and recruit outstanding faculty and staff to support the teaching, research and service mission of the University.
3. Enhance the University's learning environment to attract and retain excellent students.
4. Develop a university-wide emphasis on leadership as a primary role of the flagship university of the State of Alabama.

B. Program Educational Objectives
List the program educational objectives and state where these can be found by the general public.

The following objectives are stated in the UA 2012-2013 Undergraduate Catalog (http://www.ua.edu/catalogs/catalog10/501905.html):

Chemical and biological engineering graduates are expected to:
- Have a sound understanding and knowledge of fundamentals
- Have analysis and problem-solving skills
- Have synthesis and design skills
- Understand the responsibility to society by integrating global, environmental and ethical concerns within the engineering functions
- Have effective oral and written communication skills
- Have teamwork and leadership skills

During the 2012-2013 academic year, the Program Educational Objectives were updated, by following our procedures described below and in section 4.A, to state the following which is published in the 2013-2014 UA Undergraduate Catalog and is on the web at http://courseleaf.ua.edu/engineering/chemicalbiologicalengineering/:
Chemical and biological engineering graduates are expected to:

- Apply fundamental principles of chemical and biological engineering in problem solving and design
- Communicate effectively in writing and speaking
- Understand the responsibility to society in the context of global, environmental, ethical and safety concerns

C. Consistency of the Program Educational Objectives with the Mission of the Institution

Describe how the program educational objectives are consistent with the mission of the institution.

By attainment of the program’s educational outcomes, graduates will have advanced their intellectual and social conditions, the institution’s stated mission, by positioning themselves for gainful employment or post-graduate study.

D. Program Constituencies

List the program constituencies. Describe how the program educational objectives meet the needs of these constituencies.

The stakeholders for the Chemical Engineering Program Educational Objectives (PEOs) are the students, the graduates, the advisory board, the faculty and the staff of the Department of Chemical and Biological Engineering, as well as The University of Alabama administration.

The PEOs serve the needs of the program constituencies in that achievement of these objectives by students enables an establishment of a set of skills: problem solving, design, effective communication, leadership, and awareness and appreciation for life-long learning, which is the foundation for success in a professional career setting. Successful graduates continue to serve as advisory board members, while alumni achievements bolster the reputation of the faculty, staff and university administrators.

E. Process for Revision of the Program Educational Objectives

Describe the process that periodically reviews and revises, as necessary, the program educational objectives including how the program’s various constituencies are involved in this process. Include the results of this process and provide a description of any changes that were made to the program educational objectives and the timeline associated with those changes since the last general review.

Reviews and revisions of the program educational objectives are done using feedback from multiple constituencies. The advisory board provides input using the Advisory Board Questionnaire survey annually, while graduates and employers are surveyed every six years. Senior students are given an exit interview either by an advisory board member or by the head of the department of ChBE. Examples of these assessment devices are included in section 4D. Additionally, administrators at the college and university level have provided input regarding PEOs and this has led to recent, upcoming changes to the ChBE program educational objectives. For example, Dr. Bob Smallwood of UA’s Office of Institutional Research and Assessment which coordinates the activities related to SACS (Southern Association of Colleges and Schools) accreditation, started the most recent revision made to the PEOs while coordinating with the department’s Curriculum and ABET Committee (CAC) the establishment of an on-line system (WEAVE) for reviewing and maintaining assessment related materials. His suggestion was to reduce the number of objectives by choosing more concise wording, in effect combining several objectives into one. The new objectives were discussed by CAC during the Fall 2012 semester, reviewed by the new ChBE chair, Dr. John W. Van Zee, and the faculty in the beginning of the Spring 2013 semester, reviewed by the advisory
board during their spring meeting and then by the students during senior exit interviews. The proposed changes will go into effect for the 2013/2014 academic year and have been included in revisions for the new undergraduate catalog. Updates to the department website and ChBE’s “Guide to Accreditation” documents are forthcoming.
CRITERION 3. STUDENT OUTCOMES

A. Student Outcomes

List the student outcomes for the program and indicate where the student outcomes are documented. If the student outcomes are stated differently than those listed in Criterion 3, provide a mapping to the (a) through (k) Student Outcomes.

The student outcomes are derived from the American Institute of Chemical Engineers (AICHE) program criteria for 2007-2012 stating “The program must demonstrate that graduates have: thorough grounding in the basic sciences including chemistry, physics, and biology appropriate to the objectives of the program; and sufficient knowledge in the application of these basic sciences to enable graduates to design, analyze, and control physical, chemical, and biological processes, consistent with the program educational objectives.”

The AICHE program criteria was revised for the 2012/2013 review cycle to state: “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.”

This revision is most notable for its emphasis on safety as a student learning outcome compared to the previous version. In accordance with this emphasis, an upcoming curriculum change for the 2013/2014 academic year is to require the course CHE 440 Health and Safety, which was previously offered yearly as a popular elective choice. The CAC spearheaded this change, and with a vote by the faculty and approval by the advisory board during the Spring 2013 meeting, this change is set to go into effect for freshmen entering in the Fall 2013. A revision to the Student Outcomes list and the method of assessment for safety will be discussed at the upcoming 2013 Fall Faculty Retreat. The current list of student outcomes follows:

Our graduates will be able to:

1. Apply knowledge of:
   (a) Mathematics
   (b) And have a thorough grounding in, the basic sciences including:
       (i) Chemistry
       (ii) Physics
       (iii) Biology
   (c) Engineering

2. Operate in a laboratory environment and specifically be able to:
   (a) Design and conduct experiments
   (b) Analyze and interpret experimental data

3. Design physical, chemical, and biological processes to meet desired needs within:
   (a) Realistic economic constraints
   (b) Realistic health constraints
   (c) Realistic safety constraints

4. Function on multi-disciplinary teams

5. Identify, formulate, and solve engineering problems

6. Communicate effectively:
   (a) In writing
7. Use the techniques, skills, and modern engineering tools necessary for engineering practice
8. Analyze and control physical, chemical, and biological processes as demonstrated by a working knowledge of:
   (a) Material balances
   (b) Energy balances
   (c) Thermodynamics
   (d) Transport phenomena
   (e) Reaction engineering
   (f) Separations
   (g) Process dynamics and control

Also, graduates will:
9. Understand and exercise professional ethical responsibility
10. Understand the impact of engineering solutions in a:
    (a) Global context
    (b) Environmental context
    (c) Societal context
11. Recognize the need for, and to engage in, life-long learning
12. Appreciate how their profession interacts with contemporary issues.

ABET defined student outcomes (a-k) are as follows:

(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.

Table 3A.1 maps ABET a-k outcomes to this program’s numeric list of student outcomes as listed above:
### B. Relationship of Student Outcomes to Program Educational Objectives

Describe how the student outcomes prepare graduates to attain the program educational objectives.

The following Table 3B.1 links the student outcomes to the program educational objectives:

<table>
<thead>
<tr>
<th>Program Educational Objectives</th>
<th>Student Outcomes that support PEOs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apply fundamental principles of chemical and biological engineering in problem solving and</td>
<td>1,2,3,4,5 and 7,8</td>
</tr>
<tr>
<td>design</td>
<td></td>
</tr>
<tr>
<td>Communicate effectively in writing and speaking</td>
<td>6</td>
</tr>
<tr>
<td>Understand the responsibility to society in the context of global, environmental, ethical and</td>
<td>9,10,11,12</td>
</tr>
<tr>
<td>safety concerns</td>
<td></td>
</tr>
</tbody>
</table>
CRITERION 4. CONTINUOUS IMPROVEMENT

This section of your self-study report should document your processes for regularly assessing and evaluating the extent to which the program educational objectives and student outcomes are being attained. This section should also document the extent to which the program educational objectives and student outcomes are being attained. It should also describe how the results of these processes are being utilized to effect continuous improvement of the program.

Assessment is defined as one or more processes that identify, collect, and prepare the data necessary for evaluation. Evaluation is defined as one or more processes for interpreting the data acquired through the assessment processes in order to determine how well the program educational objectives and student outcomes are being attained.

Although the program can report its processes as it chooses, the following is presented as a guide to help you organize your self-study report. It is also recommended that you report the information concerning your program educational objectives separately from the information concerning your student outcomes.

Figure 4.1 illustrates the processes by which student outcomes and program educational objectives are established and evaluated.

![Figure 4.1 Assessment Process Flow Diagram for ChBE Undergraduate Program](image)

Program educational objectives are determined by the faculty using input from constituencies such as the advisory board, UA administrators, and current and former students. They are crafted to support the mission of the university, and are the basis for which student outcomes are derived. Student outcomes
are determined by the faculty to support the program educational objectives and published ABET criteria. These outcomes are skills and qualities students are expected to develop as they matriculate through the curriculum. Achievement of student outcomes are assessed using two categories of measurement devices: direct assessment measures and indirect assessment measures. The former involves course related material such as the evaluation of an exam or homework problem, in-class quiz, laboratory report or presentation, and are typically scored using a rubric, while the later refers to surveys of students, alumni, employers, and advisory board members. Collection of direct assessment data is undertaken by instructors of the courses linked to each student outcome (Table 4.B.1) and summary reports are submitted to the Curriculum and ABET Committee (CAC) each semester a course is taught. Indirect assessment is coordinated by the department chairman, and results are shared with and kept by the CAC. All assessment data is evaluated by the CAC at the end of each academic year so that results and recommendations by the CAC can be shared with the faculty during the annual fall faculty retreat. Decisions about changes to the program educational objectives, student outcomes, and/or assessment measures may then be discussed and input from constituencies solicited. Because a measured deficiency of an outcome or objective may be the result of a poorly designed assessment device rather than a true indicator of attainment, the CAC may also suggest an improvement to the design and implementation of an assessment measure to individual instructors (direct assessment measures) or to the department chair (indirect assessment measures) represented by a smaller loop linking evaluation with assessment measure development outside of the loop by which changes to student outcomes, curriculum, and program educational objectives are carried out.

A. Program Educational Objectives

It is recommended that this section include (a table may be used to present this information):

1. A listing and description of the assessment processes used to gather the data upon which the evaluation of each program educational objective is based. Examples of data collection processes may include, but are not limited to, employer surveys, graduate surveys, focus groups, industrial advisory committee meetings, or other processes that are relevant and appropriate to the program.
2. The frequency with which these assessment processes are carried out
3. The expected level of attainment for each of the program educational objectives
4. Summaries of the results of the evaluation processes and an analysis illustrating the extent to which each of the program educational objectives is being attained
5. How the results are documented and maintained

Indirect assessment measures are used to review the program educational objectives and include:
1.) Advisory Board Questionnaire (ABQ)
2.) Senior Exit Interview(SXI)
3.) Six-year Survey of Graduates of the ChBE Dept. (SYS-G)
4.) Six-Year Survey of Employers of Graduates of the ChBE Dept.(SYS-E)

These surveys are provided in section 4.D. Table 4.A.1 provides a summary of these processes.
Table 4.A.1 Indirect Assessment Measure Responsibility Timetable for ChBE

<table>
<thead>
<tr>
<th>Assessment Measure</th>
<th>Data Collection</th>
<th>Evaluation</th>
<th>Program Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>Responsibility</td>
<td>Frequency</td>
</tr>
<tr>
<td>ABQ</td>
<td>1 yr</td>
<td>Dept. Head</td>
<td>1 yr</td>
</tr>
<tr>
<td>SXI</td>
<td>1 yr</td>
<td>Dept. Head</td>
<td>1 yr</td>
</tr>
<tr>
<td>SYS-G</td>
<td>6 yrs</td>
<td>Dept. Head</td>
<td>6 yrs</td>
</tr>
<tr>
<td>SYR-E</td>
<td>6 yrs</td>
<td>Dept. Head</td>
<td>6 yrs</td>
</tr>
</tbody>
</table>

**Advisory Board Questionnaire (ABQ)**

The Advisory Board Questionnaire is distributed and filled out during the spring board meeting. Board members are asked to comment on the appropriateness of each ChE Program Educational Objective and to rate on a scale of 1 to 5 the appropriateness of each educational objective where 1= Strongly Disagree, 2= Disagree, 3= Neutral or Can’t Decide, 4= Agree, 5= Strongly Agree with the appropriateness of the objective. They are also asked to provide more detailed feedback including any changes that should be made to the objectives. The results are immediately compiled, and are reviewed by the Advisory Board. During the discussion, the Advisory Board members make recommendations for changes to the ChE Program Educational Objectives. In addition, suggestions for changes to the questionnaire are also sought in an effort to improve the process for evaluation and assessment of the Educational Objectives. If a PEO scores 3 or less, then a change would be initiated by the CAC, however, this has not occurred. The most recent changes were initiated by the ABET visitor during the last review cycle and then by a university level administrator overseeing assessment related activities.

Using the Spring 2013 Advisory Board Questionnaire, feedback was solicited from the advisory board regarding the proposed newly condensed Program Educational Objectives (PEO). The question and resulting responses are as follows:

**Based on the presentation in the AB meeting on Wednesday, February 27, and the lists on page 4, please comment on the appropriateness of combining the previous five PEOs into the three PEOs.**

- I like the combined statements, much clearer.
- I am of the opinion that condensing/revising the PEOs into a concise, succinct three is an excellent approach. A brief and special offering of the PEOs is much easier to communicate, understand and address.
- I think this is very good. These objectives are very clear and crisp which should help program focus.
- This is an upgrade. Much clearer and to the point.

**Senior Exit Interview (SXI)**

The SXI has been carried out for two decades in the students’ last semester on campus. The SXI provides each student the opportunity to express their opinions of The University, the ChE Program, specific courses, faculty and staff. For the department, the SXI provides timely information from students as they complete their matriculation. The SXI has two parts: a written form and a face-to-face interview. The SXI form allows students to numerically rate our objectives, as well as provide written feedback regarding their modification. The Office Assistant, Ms. Noble, summarizes the written
responses in the SXI, merging all general responses into a single summary which is sent to the department head and to the CAC.

The second part of the SXI is the face-to-face interview. In the fall the students meet with the ChBE department head. Three to four days are required for the actual face-to-face interviews because the resulting information is so important. The interview method has been very positive and excellent information has been obtained. The ChBE department head congratulates students on successful completion of a challenging plan of study. A plea is made to keep us informed of marriage, kids, promotions, transfers, and new jobs. An open letter documents highlights of the actual face-to-face interview. In the spring, Advisory Board members conduct the interviews. The second page of the ABQ document in section 4.D deals with operational issues that impact on the educational process. The last page of the three page working form is for the SXI summary, and is written by the Advisory Board member at the ABW after the actual face-to-face interview

In regard to PEOs, seniors were asked simply to rate on a scale of 1 to 5 the appropriateness of each educational objective with: 1= Strongly Disagree, 2= Disagree, 3= Neutral or Can’t Decide, 4= Agree, 5= Strongly Agree with the appropriateness of the objective. The CAC considers an average response greater than 3 to be the expected attainment level for each objective. During the entire 2007-2013 review cycle, never has a PEO become flagged by a score less than 3 using the SXI assessment device. In Spring 2013, with 48 seniors participating, the average scores for the five PEOs ranged between 4.36 and 4.55.

**Six-Year Survey of Graduates of the ChBE Department (SYS-G)**
The Six-Year Survey is composed of two parts: a survey of graduates of the ChBE Department, and a survey of the employers of these graduates. The surveys are mailed through standard US Mail. The Six-Year Survey both assesses the achievement of our objectives and reviews their appropriateness.

Efforts have been made to minimize the time required to complete the surveys, as this greatly improves both the response and completion rates. The sample size is limited to a continuous 5-year segment of graduates. Once a segment has been sampled, they are not surveyed again. In addition, the survey is given on a six–year cycle. It is also important that information be received in a timely fashion, processed rapidly and fed back to the system while it is still new. This survey method constitutes the feedback mechanism that will be used to ensure our program educational objectives are being achieved.

A sample copy of the Six-Year Survey of Graduates of the ChBE Department is given in section 4.D. The graduation years are chosen to allow our alumni to gain time and experience to properly reflect on their academic career. Just as with the Advisory Board Questionnaire, the graduates were asked to review the ChE Program Educational Objectives. However, given their status as recent graduates of the ChBE Department, they bring a unique perspective toward judging our achievement of the educational objectives as well. Respondents are asked to provide additional feedback, positive and negative, that is compiled and used in conjunction with the Advisory Board to assess the ChE Program Educational Objectives.

**Six-Year Survey of Employers of Graduates of the ChBE Department (SYS-E)**
The second part of the Six-Year Survey is a survey of employers of graduates of the ChBE Department. Again, the survey is mailed through standard US Mail. The survey is designed to both assess the achievement of our objectives and review their appropriateness. A sample copy of the ChBE Survey of Employers of Graduates of the ChBE Department is given in section 4.D below. This provides a good comparison for the different perspectives of the graduates and their employers. This also allows us to
gauge any discontinuity between how our graduates view our objectives, and how they are viewed by the outside world.

An unsatisfactory response rate of only 2% was experienced for the 2012 attempt at the six-year survey. Strategies for improvement of the six year survey will be a discussion topic for the Fall 2013 Faculty Retreat. One solution being considered is to design a web-based, short survey and use an email from a favorite faculty member to solicit responses.

B. Student Outcomes

It is recommended that this section include (a table may be used to present this information):

1. A listing and description of the assessment processes used to gather the data upon which the evaluation of each student outcome is based. Examples of data collection processes may include, but are not limited to, specific exam questions, student portfolios, internally developed assessment exams, senior project presentations, nationally-normed exams, oral exams, focus groups, industrial advisory committee meetings, or other processes that are relevant and appropriate to the program.

2. The frequency with which these assessment processes are carried out

3. The expected level of attainment for each of the student outcomes

4. Summaries of the results of the evaluation process and an analysis illustrating the extent to which each of the student outcomes is being attained

5. How the results are documented and maintained

While PEOs are assessed using indirect assessment measures, Student Outcomes are assessed using both direct and indirect assessment measures. In this section, the results of the direct assessment measures for each outcome are discussed, followed by indirect measure results pertaining to student outcomes. Table 4.B.1 maps Student Outcomes to courses utilizing course embedded direct assessment measures. In addition to mapped direct measures, the SXI and SYS indirect assessment measures also provide insight into the attainment and appropriateness of student outcomes. Indirect assessment measures are not included in the table because all student outcomes are addressed in these surveys.

Courses taught outside the ChBE department in Chemistry, Math, Physics, Biology and the Engineering Elective address ChBE Student Outcome 1: The ability to apply knowledge of mathematics and engineering, and have a thorough grounding in the basic sciences including chemistry, physics, and biology. Courses outside of the ChBE department are difficult to assess by ChBE faculty, therefore Outcome 1 is measured in CHE 125 and CHE 493 using the CSI, and these “service” courses are not included in Table 4.B.1. Also, courses typically cover more outcomes than are shown, but for clarity, only measured outcomes in each course are mapped. The term “rubric” refers to a quiz, test or special problem that is scored using a rubric (rubrics are provided in section 4.D), while CBG refers to “criterion based grading” by which attainment of an outcome is determined by the final grade assigned to a student in a course. Criterion based grading will be phased out and replaced by rubric type scoring of a special problem during the 2013-2019 ABET cycle.
Table 4.B.1 Course linked assessment measures for each student outcome

<table>
<thead>
<tr>
<th>Student Outcome 1</th>
<th>Student Outcome 2</th>
<th>Student Outcome 3</th>
<th>Student Outcome 4</th>
<th>Student Outcome 5</th>
<th>Student Outcome 6</th>
<th>Student Outcome 7</th>
<th>Student Outcome 8</th>
<th>Student Outcome 9</th>
<th>Student Outcome 10</th>
<th>Student Outcome 11</th>
<th>Student Outcome 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHE 125</td>
<td>CSI</td>
<td>CBG</td>
<td>Rubric</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 254</td>
<td></td>
<td>CBG</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 255</td>
<td></td>
<td>CBG</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 304</td>
<td></td>
<td>Rubric</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 305</td>
<td>Rubric</td>
<td></td>
<td>CBG</td>
<td>Rubric</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 306</td>
<td>Rubric</td>
<td>Rubric</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 319</td>
<td></td>
<td>Rubric</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 320</td>
<td>Rubric</td>
<td>Rubric</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 324</td>
<td></td>
<td>CBG</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 354</td>
<td></td>
<td>CBG</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 481</td>
<td>Rubric</td>
<td>Rubric</td>
<td>Rubric</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 482</td>
<td>Rubric</td>
<td>Rubric</td>
<td>Rubric</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 493</td>
<td>CSI</td>
<td>CBG</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Student Outcome 1:** The ability to apply knowledge of mathematics and engineering and have a thorough grounding in the basic sciences including chemistry, physics, and biology.

The direct assessment measure for Student Outcome 1 is the Concepts and Skills Inventory (CSI) test which is given to freshmen students in CHE 125 Introduction to Chemical Engineering, and to seniors in CHE 493 Process Dynamics and Control. Results are reported as percentage correct per question and are tabulated in Table B.4.2. The test is found in section 4.D. Beginning in 2009, the answers were changed to multiple choice, and multiple part questions were renumbered so that each part was a separate question. Data for the 2009 CHE 125 and 2012 CHE 493 cohort can be evaluated, and is compared in the last three columns. While any negative percent change represents a topic for concern, the trend requires at least two years, preferably more, before an item is determined to require a corrective action. Questions seven through nine, however, stand out as these all relate to significant figures and all demonstrated a decline between the beginning and end of the curriculum. Faculty will be told about this potential concern and encouraged to address significant figures in their courses during the annual Fall 2013 faculty retreat.

<table>
<thead>
<tr>
<th>#</th>
<th>CHE 125</th>
<th>CHE 493</th>
<th>% Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>44</td>
<td>61</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>64</td>
<td>78</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>45</td>
<td>53</td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td>22</td>
<td>90</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>42</td>
<td>66</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>9</td>
<td>9</td>
<td>-4</td>
</tr>
<tr>
<td>7</td>
<td>83</td>
<td>85</td>
<td>-2</td>
</tr>
<tr>
<td>8</td>
<td>72</td>
<td>100</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>33</td>
<td>54</td>
<td>-7</td>
</tr>
<tr>
<td>10</td>
<td>30</td>
<td>93</td>
<td>-3</td>
</tr>
<tr>
<td>11</td>
<td>47</td>
<td>7</td>
<td>-40</td>
</tr>
<tr>
<td>12</td>
<td>35</td>
<td>63</td>
<td>-28</td>
</tr>
<tr>
<td>13</td>
<td>72</td>
<td>85</td>
<td>13</td>
</tr>
<tr>
<td>14</td>
<td>23</td>
<td>46</td>
<td>23</td>
</tr>
<tr>
<td>15</td>
<td>11</td>
<td>7</td>
<td>-4</td>
</tr>
<tr>
<td>16</td>
<td>81</td>
<td>91</td>
<td>9</td>
</tr>
<tr>
<td>17</td>
<td>40</td>
<td>83</td>
<td>43</td>
</tr>
<tr>
<td>18</td>
<td>39</td>
<td>91</td>
<td>52</td>
</tr>
<tr>
<td>19</td>
<td>30</td>
<td>83</td>
<td>53</td>
</tr>
<tr>
<td>20</td>
<td>48</td>
<td>83</td>
<td>35</td>
</tr>
<tr>
<td>21</td>
<td>64</td>
<td>74</td>
<td>10</td>
</tr>
<tr>
<td>22</td>
<td>47</td>
<td>35</td>
<td>-12</td>
</tr>
<tr>
<td>23</td>
<td>41</td>
<td>65</td>
<td>24</td>
</tr>
<tr>
<td>24</td>
<td>56</td>
<td>74</td>
<td>18</td>
</tr>
</tbody>
</table>

Table 4.B.2 Results of the CSI test direct assessment measure for Student Outcome 1.
**Student Outcome 2:** The ability to operate in a laboratory environment, specifically to design and conduct experiments as well as to analyze and interpret experimental data

Data for outcome 2 for Fall 2011 and Spring 2012 is available as a rubric used to grade oral and written reports in CHE 319 Basic Chemical Engineering Laboratory. Data wasn’t collected in Spring 2011 because of the tornado which tragically struck Tuscaloosa in April that year. The rubric is included in section 4.D. The average score for the laboratory section was 95% for ’12 and 94% for ’11. No corrective action is recommended.

**Student Outcome 3:** The ability to design physical, chemical, and biological processes to meet desired needs within realistic economic, health, and safety constraints

In CHE 481 Design I, students were scored using a rubric and an assigned design project. The Ability to Design a System Rubric (provided in section 4.D) consisted of four categories: 1) Design organization, approach, and completeness, 2) Use of computer tools and engineering resources, 3) Design economics, and 4) Practicality of solution and recognition of constraints. Each report was scored based on the four categories, with 1 being the lowest and 5 being the highest score. The following table shows the raw and average scores for Spring 2010 semester:

<table>
<thead>
<tr>
<th>Category</th>
<th>Raw Scores</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design organization, approach, and completeness</td>
<td></td>
<td>0</td>
<td>4</td>
<td>1</td>
<td>8</td>
<td>4</td>
<td>3.71</td>
</tr>
<tr>
<td>Use of computer tools and engineering resources</td>
<td></td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>6</td>
<td>2</td>
<td>3.35</td>
</tr>
<tr>
<td>Design economics</td>
<td></td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>7</td>
<td>4</td>
<td>3.76</td>
</tr>
<tr>
<td>Practicality of solution and recognition of constraints</td>
<td></td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>11</td>
<td>2</td>
<td>3.82</td>
</tr>
</tbody>
</table>

A score of less than three is considered low enough to warrant remedial action. The weakest score that year was the use of computer tools and engineering resources because students didn’t consider sample calculations as an engineering resource, and too heavily depended on the use of software such as CHEMCAD in solving a design problem. No corrective action has been recommended on this outcome.

**Student Outcome 4:** The ability to function on multi-disciplinary teams

Teaming skills is assessed in CHE 481 Design I using a rubric (section 4.D) with four categories: 1) Knowledge of roles for non-chemical engineers in design, 2) Describe roles for non-chemical engineers, 3) Describe potential problems interacting with non-chemical engineers, and 4) Describe ways to resolve conflicts with non-chemical engineers. The following table shows the raw and average scores for the Spring 2010 semester:

<table>
<thead>
<tr>
<th>Category</th>
<th>Raw Scores</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge of roles for non-chemical engineers in design</td>
<td></td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>6</td>
<td>10</td>
<td>4.53</td>
</tr>
<tr>
<td>Describe roles for non-chemical engineers</td>
<td></td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>8</td>
<td>8</td>
<td>4.41</td>
</tr>
<tr>
<td>Potential problems interacting with non-chemical engineers</td>
<td></td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>7</td>
<td>4.00</td>
</tr>
<tr>
<td>Ways to resolve conflicts with non-chemical engineers</td>
<td></td>
<td>0</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>8</td>
<td>3.88</td>
</tr>
</tbody>
</table>

A score below three in any of these categories would indicate an issue with this outcome. No recommendations for remedial action have been made.
Student Outcome 5: The ability to identify, formulate, and solve engineering problems

Students are assessed on their problem solving skills in CHE 306 Heat Transfer Operations. Students are given a quiz requiring mass and energy balances on a steam reboiler and it is graded using a rubric. The quiz and rubric are included in section 4.D. The rubric had 5 categories: Problem Definition and Diagram, Applying Fundamental Principles, Ability to Find Appropriate Data, Development of a Solution Strategy, and Presentation of a Concise Solution each having a possible 5 points. If a class has an average score in any one category of less than 3, then this outcome will be considered for a corrective action. Table 4.B.3 lists the scores per category for the years between 2007 and 2012. For the year 2011, a student grader was utilized who graded more strictly and thus that year’s data, while less than 3 for two categories, was not deemed significant. No corrective action has been recommended for this outcome.

<p>| Table 4.B.3 Results of the Problem Solving Quiz/Rubric for CHE 306 |
|------------------------|----------------|----------------|----------------|----------------|----------------|</p>
<table>
<thead>
<tr>
<th>Problem Definition/Diagram</th>
<th>2007</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fundamental Principles</td>
<td>3.69</td>
<td>4.25</td>
<td>4.41</td>
<td>3.06</td>
<td>4.23</td>
</tr>
<tr>
<td>Appropriate Data</td>
<td>3.5</td>
<td>3.81</td>
<td>3.86</td>
<td>2.80</td>
<td>3.86</td>
</tr>
<tr>
<td>Strategy</td>
<td>4.23</td>
<td>4.56</td>
<td>4.48</td>
<td>3.65</td>
<td>3.78</td>
</tr>
<tr>
<td>Concise Solution</td>
<td>3.63</td>
<td>3.91</td>
<td>3.67</td>
<td>2.73</td>
<td>3.85</td>
</tr>
</tbody>
</table>

Student Outcome 6: The ability to communicate effectively in writing and verbally

The ability to effectively communicate is evaluated using two rubrics used to score a written report and an oral presentation in the summer course CHE 320 Unit Operations Laboratory. These rubrics are in section 4.D. The outcome is flagged when any one section of either rubric shows less than 75% of total possible points for an average class score. Written Rubric results from the summer 2012 show Organization 90%, Content 84%, Format 86%, Spelling and Grammar 83%, References 79%, while the sections of the oral presentation rubric for the same summer were Visual Aids 83%, Delivery and Speaking Skill 85%, Content and Knowledge 85%, Organization 86%, Presentation length 91%. No corrective action has been recommended from the results of this assessment measure for 2012 or previous years.

Student Outcome 7: The ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

The ChBE faculty considers this outcome to be directly related to students’ proficiency with software often used in the practice of chemical engineering such as CHEMCAD, EXCEL, and MATLAB. Courses with a significant computer related content and designated as a “computer language” course to substitute for the University’s requirement for foreign language are CHE 255 Chemical Engineering Thermodynamics, CHE 324 Transport Phenomena, and CHE 305 Separation Processes. Despite the inherent requirement for computer solutions in these courses, CHE 304 Fluid Flow Operations was chosen for a special rubric graded problem, because of the interest of Dr. Peter Clark in developing and applying an assessment measure on this outcome in the course he regularly taught: CHE 304. Dr. Clark, however, took a chaired faculty position at Oklahoma State University, and course embedded assessment data regarding this outcome is incomplete. At the upcoming annual Fall Faculty retreat, it will be decided by the faculty where this outcome should be assessed in the curriculum for future years.
**Student Outcome 8:** The ability to analyze and control physical, chemical, and biological processes as demonstrated by a working knowledge of material balances, energy balances, thermodynamics, transport phenomena, reaction engineering, separations, and process dynamics and control

This outcome refers to core chemical engineering topics, each having a corresponding course in the curriculum (material and energy balances are a combined topic in CHE 254 Chemical Engineering Calculations). Table 4.B.1 shows the courses in the curriculum which match these topics. Starting in the 2012-2013 academic year, faculty were asked to develop a direct assessment measure to replace CBG (criterion based grading) which is simply assessment using the final grade in the course. The use of a rubric is encouraged as an assessment tool. Data on this student outcome will be available for the next ABET report. Using the indirect assessment measure of the senior exit interviews, however, CAC did identify the topic of transport phenomena as being a weak student learning outcome. A decision was made to change instructors and discontinue the practice of using Bird, Stewart and Lightfoot’s “Transport Phenomena” as a required text. This process is described in more detail in the following section 4.C Continuous Improvement.

**Student Outcome 9:** The ability to understand and exercise professional ethical responsibility; and

**Student Outcome 10:** An understanding of the impact of engineering solutions in a global, environmental and societal context

Student outcomes 9 and 10 were combined into one assessment measure for this review cycle. Using a special exam problem given in CHE 482 Design II, students’ responses are graded using a rubric provided in this document, section 4.D. Topics included the considerations involved when building a chemical plant in a populated region, the Fukushima nuclear reactor tragedy, and the problem of procuring natural resources from a region whose government has a dismal human-rights track record. In the Spring 2012, students averaged an 85 out of 100 points on the rubric, while in 2013, students scored between 95 and 98 out of 100. No corrective action has been recommended.

**Student Outcome 11:** A recognition of the need for and to engage in life-long learning

The life-long learning student outcome is assessed at the senior level in CHE 482 Design II. Dr. Yuping Bao, who typically teaches elective classes tissue engineering and biochemical engineering, gives a guest lecture on the importance of and resources for life-long learning. After the guest lecture, students are given a quiz of eight questions to assess the student outcome. The quiz is included in section 4.D. Data is available for Spring 2012 and Spring 2013. The question with the lowest percentage correct for both years has been #8 emphasizing the importance of being active in professional societies with 84% and 83% responding correctly in Spring 2012 and Spring 2013 respectively. The average % correct for all 8 problems was 95% in both years. If this number falls below 75%, then the outcome will be recommended to be reviewed for corrective action.

**Student Outcome 12:** An appreciation of how the chemical engineering profession interfaces with contemporary issues

Contemporary issues is a topic covered most thoroughly in CHE 125 Introduction to Chemical Engineering, but other courses cover contemporary issues as well. For instance, the fertilizer plant explosion in West, Texas on April 14th, 2013 was postulated at first to be caused by a BLEVE (Boiling Liquid Expanding Vapor Explosion) of a tank of anhydrous ammonia, causing the evacuation of 2000 nearby residents, but is now believed to have been caused by ammonium nitrate. This contemporary
issue and a discussion of BLEVE were covered in CHE 255 Chemical Engineering Thermodynamics as a part of an emphasis on safety in the curriculum. In the fall 2011 CHE 125 class, students responded to the question, asked using a clicker device, “Do you feel that CHE 125 addressed contemporary issues related to Chemical and Biological Engineering?” Out of 160 students, 93% responded yes, while 7% responded no. A score of 80% is considered adequate for this measure. In the fall of 2012, 94% of students were able to identify the following as being contemporary issues related to chemical and biological engineering: Improving safety in chemical processes, developing new energy resources, reducing manufacturing impact on the environment, and designing new materials for improved human health. Furthermore, that semester, 76% of the students reported contemporary issues were addressed every class day of CHE 125. No corrective action is recommended.
C. Continuous Improvement

Describe how the results of evaluation processes for the program educational objectives and 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.

Continuous improvement of the program is represented by two changes: 1.) The program educational objectives were condensed from a list of five to three, effective for the 2013-2014 academic year and 2.) The textbook used in CHE 324 Transport Phenomena was abandoned and the instructor changed. The first change was implemented using processes described in section 4.A and using the advisory board questionnaire (ABQ) indirect assessment measure, while the second was initiated using results from the senior exit interview (SXI) indirect assessment measure.

Table 4.C.1 reports the results of the SXI for recent years. The survey is included in section 4.D. A score less than 3.5 for multiple semesters in any one student outcome is reason for recommendation of a corrective action. Outcome 8d: The ability to analyze and control physical, chemical, and biological processes as demonstrated by a working knowledge of (d) transport phenomena, consistently showed the lowest score (between 3.3 and 3.8). In addition, written comments from the seniors on the SXI, and comments made during the interview between advisory board members and seniors, emphasized the students’ dissatisfaction with the level of attainment for this student outcome. In particular, students were very unhappy with the text, “Transport Phenomena” by Bird, Stewart, and Lightfoot used in CHE 324. The CAC discussed this result and noted that while text was written for students both at the undergraduate and graduate levels, many chemical engineering programs reserved this text for graduate level transport courses. Minutes for the CAC meeting during which this change was discussed is included at the end of section 4.D. Beginning Fall 2012, Dr. Eric Carlson took up the instructor role for CHE324. Rather than choose a text, Dr. Carlson has developed a set of course materials available online via Moodle: http://bama.braidedlogix.com. A main objective for this course requires students to be able to solve transport problems using Python computer code. Because of the emphasis on problem solving using advanced computation techniques, this course is being considered for the assessment of student outcome 7: The ability to use the techniques, skills, and modern engineering tools necessary for engineering practice, which is currently assigned to CHE 304. The result of this change as reflected by the SXI will be available after the Spring 2014 semester, when the students who have taken Dr. Carlsön’s course matriculate through the curriculum.
<table>
<thead>
<tr>
<th>Outcome</th>
<th>Spring 2013</th>
<th>Fall 2012</th>
<th>Spring 2012</th>
<th>Fall 2011</th>
<th>Spring 2011</th>
<th>Fall 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>4.5</td>
<td>3.7</td>
<td>4.6</td>
<td>5</td>
<td>4.5</td>
<td>4.4</td>
</tr>
<tr>
<td>1b(i)</td>
<td>4.6</td>
<td>4.7</td>
<td>4.5</td>
<td>4.8</td>
<td>4.6</td>
<td>4.6</td>
</tr>
<tr>
<td>1b(ii)</td>
<td>4.0</td>
<td>3.3</td>
<td>3.8</td>
<td>4.6</td>
<td>3.9</td>
<td>3.9</td>
</tr>
<tr>
<td>1b(iii)</td>
<td>4.0</td>
<td>3.7</td>
<td>4.3</td>
<td>4.8</td>
<td>4.2</td>
<td>3.8</td>
</tr>
<tr>
<td>1c</td>
<td>4.4</td>
<td>4.7</td>
<td>4.6</td>
<td>5</td>
<td>4.5</td>
<td>4.5</td>
</tr>
<tr>
<td>2a</td>
<td>4.6</td>
<td>5.0</td>
<td>4.5</td>
<td>4.8</td>
<td>4.5</td>
<td>4.7</td>
</tr>
<tr>
<td>2b</td>
<td>4.7</td>
<td>4.3</td>
<td>4.5</td>
<td>4.8</td>
<td>4.7</td>
<td>4.8</td>
</tr>
<tr>
<td>3a</td>
<td>4.1</td>
<td>4.3</td>
<td>4.3</td>
<td>4.4</td>
<td>4.4</td>
<td>3.8</td>
</tr>
<tr>
<td>3b</td>
<td>4.1</td>
<td>4.7</td>
<td>4.1</td>
<td>4.6</td>
<td>4.1</td>
<td>4.1</td>
</tr>
<tr>
<td>3c</td>
<td>4.1</td>
<td>4.7</td>
<td>4.3</td>
<td>4.6</td>
<td>4.2</td>
<td>4.3</td>
</tr>
<tr>
<td>4</td>
<td>4.7</td>
<td>5.0</td>
<td>4.7</td>
<td>4.8</td>
<td>4.7</td>
<td>4.4</td>
</tr>
<tr>
<td>5</td>
<td>4.5</td>
<td>4.7</td>
<td>4.4</td>
<td>4.8</td>
<td>4.5</td>
<td>4.6</td>
</tr>
<tr>
<td>6a</td>
<td>4.7</td>
<td>4.0</td>
<td>4.4</td>
<td>4.2</td>
<td>4.4</td>
<td>4.3</td>
</tr>
<tr>
<td>6b</td>
<td>4.5</td>
<td>4.3</td>
<td>4.3</td>
<td>4.2</td>
<td>4.5</td>
<td>4.3</td>
</tr>
<tr>
<td>7</td>
<td>4.4</td>
<td>4.3</td>
<td>4.2</td>
<td>4.6</td>
<td>4.4</td>
<td>4.4</td>
</tr>
<tr>
<td>8a</td>
<td>4.5</td>
<td>4.7</td>
<td>4.6</td>
<td>5</td>
<td>4.8</td>
<td>4.6</td>
</tr>
<tr>
<td>8b</td>
<td>4.2</td>
<td>4.7</td>
<td>4.3</td>
<td>5</td>
<td>4.6</td>
<td>4.3</td>
</tr>
<tr>
<td>8c</td>
<td>3.7</td>
<td>4.0</td>
<td>3.8</td>
<td>4.4</td>
<td>4.0</td>
<td>4.2</td>
</tr>
<tr>
<td>8d</td>
<td>3.3</td>
<td>3.3</td>
<td>3.3</td>
<td>3.8</td>
<td>3.6</td>
<td>3.0</td>
</tr>
<tr>
<td>8e</td>
<td>4.0</td>
<td>4.3</td>
<td>4.2</td>
<td>4.2</td>
<td>3.8</td>
<td>3.9</td>
</tr>
<tr>
<td>8f</td>
<td>4.4</td>
<td>4.7</td>
<td>4.5</td>
<td>5</td>
<td>4.8</td>
<td>4.3</td>
</tr>
<tr>
<td>8g</td>
<td>4.4</td>
<td>3.7</td>
<td>4.0</td>
<td>4.6</td>
<td>4.5</td>
<td>4.3</td>
</tr>
<tr>
<td>9</td>
<td>4.8</td>
<td>5.0</td>
<td>4.8</td>
<td>5</td>
<td>4.9</td>
<td>4.6</td>
</tr>
<tr>
<td>10a</td>
<td>4.5</td>
<td>4.3</td>
<td>4.5</td>
<td>4.2</td>
<td>4.4</td>
<td>4.6</td>
</tr>
<tr>
<td>10b</td>
<td>4.5</td>
<td>4.7</td>
<td>4.6</td>
<td>4.2</td>
<td>4.5</td>
<td>4.3</td>
</tr>
<tr>
<td>10c</td>
<td>4.5</td>
<td>4.7</td>
<td>4.5</td>
<td>4.2</td>
<td>4.4</td>
<td>4.3</td>
</tr>
<tr>
<td>11</td>
<td>4.8</td>
<td>5.0</td>
<td>4.8</td>
<td>5</td>
<td>4.9</td>
<td>4.7</td>
</tr>
<tr>
<td>12</td>
<td>4.7</td>
<td>5.0</td>
<td>4.7</td>
<td>4.6</td>
<td>4.9</td>
<td>4.6</td>
</tr>
</tbody>
</table>
D. Additional Information

Copies of any of the assessment instruments or materials referenced in 4.A, 4.B, or 4.C must be available for review at the time of the visit. Other information such as minutes from meetings where the assessment results were evaluated and where recommendations for action were made could also be included.

The following is a list (in order) of supporting materials that are included in this section.

1. Senior Exit Interview (SXI) and Advisory Board Questionnaire (ABQ)
2. Six-Year Survey of Graduates/Employers of the ChBE Dept. (SYS)
3. Concepts and Skills Inventory Test (CSI)
4. CHE 481 Design I, Economic Design Constraints Rubric
5. CHE 481 Design I, Teaming Rubric
6. CHE 304 Fluid Flow Operations, Health and Safety Design Constraints test
7. CHE 320 Written Communication Assessment Rubric
8. CHE 320 Oral Written Assessment Rubric
9. CHE 306 Problem Solving question with Rubric
10. CHE 319 Basic Chemical Engineering Laboratory, report rubric
11. CHE 482 Design II, Rubrics for Ethics and Engineering Impact
12. CHE 482 Design II, Life-long learning quiz
13. 8-17-12 CAC meeting minutes: CHE 324 continuous improvement
Supporting Materials
Like all accredited engineering programs in the US, the UA ChE Department must prove that our curricula meet the stated objectives of the degree. We need your feedback to maintain accreditation. On page one we need your opinion on the appropriateness of the ChE program educational objectives. The ChE program educational objectives are broad statements that describe the accomplishments, or goals, that we feel you need to succeed in your career and in your chosen profession. In a few years, we will ask if our program succeeded in these goals. Right now, at graduation, we want your opinion on the appropriateness of our objectives. Are the objectives appropriate? Please circle the number that most closely matches your opinion:

Strongly Disagree=1  Disagree=2  Neutral or Can’t Decide=3  Agree=4  Strongly Agree=5

ChE Program Educational Objectives
1. Our graduates will convert their technical knowledge into the implementation of ideas in the practice of chemical engineering.
2. Our graduates will use their professional skills to convert knowledge into action to protect the public interest, health, safety, and environment in the practice of chemical engineering.
3. Our graduates will use effective verbal and written communication skills to transform their ideas into action to benefit the public good in the practice of chemical engineering.
4. Our graduates will apply their understanding of global and ethical concerns, within the engineering functions, as well as teamwork and leadership skill to transform their ideas into action to benefit the public good in the practice of chemical engineering.
5. Our graduates will value and actively pursue lifelong scientific inquiry, learning and creativity in the practice of chemical engineering.
The University of Alabama Department of Chemical and Biological Engineering

SX1 PAGE TWO CHEMICAL AND BIODEGICAL ENGINEERING PROGRAM EDUCATIONAL OUTCOMES

Your Name: __________________________ Date: ______________________

We need your opinion of your level of achievement of each of the Chemical Engineering educational outcomes. Please circle the number that most closely matches your opinion.

Strongly Disagree=1 Disagree=2 Neutral or Can’t Decide=3 Agree=4 Strongly Agree=5

I am able to:

1. Apply knowledge of:
   (a) Mathematics 1 2 3 4 5
   (b) And have a thorough grounding in, the basic sciences including:
      (i) Chemistry 1 2 3 4 5
      (ii) Physics 1 2 3 4 5
      (iii) Biology 1 2 3 4 5
      (iv) Engineering 1 2 3 4 5

2. Operate in a laboratory environment and specifically be able to:
   (a) Design and conduct experiments 1 2 3 4 5
   (b) Analyze and interpret experimental data 1 2 3 4 5

3. Design physical, chemical, and biological processes to meet desired needs within:
   (a) Realistic economic constraints 1 2 3 4 5
   (b) Realistic health constraints 1 2 3 4 5
   (c) Realistic safety constraints 1 2 3 4 5

4. Function on multi-disciplinary teams 1 2 3 4 5

5. Identify, formulate, and solve engineering problems 1 2 3 4 5

6. Communicate effectively:
   (a) In writing 1 2 3 4 5
   (b) Verbally 1 2 3 4 5

7. Use the techniques, skills, and modern engineering tools necessary for engineering practice 1 2 3 4 5

8. Analyze and control physical, chemical, and biological processes as demonstrated by a working knowledge of:
   (a) Material balances 1 2 3 4 5
   (b) Energy balances 1 2 3 4 5
   (c) Thermodynamics 1 2 3 4 5
   (d) Transport phenomena 1 2 3 4 5
   (e) Reaction engineering 1 2 3 4 5
   (f) Separations 1 2 3 4 5
   (g) Process dynamics and control 1 2 3 4 5

Also, I will:

9. Understand and exercise professional ethical responsibility 1 2 3 4 5

10. Understand the impact of engineering solutions in a:
    (a) Global context 1 2 3 4 5
    (b) Environmental context 1 2 3 4 5
    (c) Societal context 1 2 3 4 5

11. Recognize the need for, and to engage in, life-long learning 1 2 3 4 5

12. Appreciate how their profession interacts with contemporary issues 1 2 3 4 5

Thank you for agreeing to conduct an exit interview with one of our graduating students. This is an important aspect of our accreditation process. The ChE program educational objectives are five broad statements that describe the accomplishments and attributes that the seniors need to succeed in their career and chosen profession. Please discuss the appropriateness of each objective with the student. Are our objectives appropriate? Do we need to add, delete or modify any objectives? Feedback may be positive or negative.

1. Our graduates will convert their technical knowledge into the implementation of ideas in the practice of chemical engineering.

____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________

2. Our graduates will use their professional skills to convert knowledge into action to protect the public interest, health, safety, and environment in the practice of chemical engineering.

____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________

3. Our graduates will use effective verbal and written communication skills to transform their ideas into action to benefit the public good in the practice of chemical engineering.

____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________

4. Our graduates will apply their understanding of global and ethical concerns, within the engineering functions, as well as teamwork and leadership skill to transform their ideas into action to benefit the public good in the practice of chemical engineering.

____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________

5. Our graduates will value and actively pursue lifelong scientific inquiry, learning and creativity in the practice of chemical engineering.

____________________________________________________________________________________

____________________________________________________________________________________
Page two is outcomes and general questions on operational matters. Consider these as only sample questions. Please feel free to develop your own questions.

1. Are our educational outcomes adequate for the process engineer in the 21st century? Is there any subject matter, skill or ability you wish included in our curricula? Any outcome you wish deleted or modified. Continue on the back of this sheet if necessary.

____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________

2. Describe your time as a student in the BS ChE degree program (campus life, food-meals, making friends, etc.; -- would you recommend your little sister/brother attend our University).

____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________

3. Were there any operational problems (class scheduling, availability of computers, advising, etc.) that impeded your progress in obtaining the BS ChE degree?

____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________

4. What do you plan after graduation?

____________________________________________________________________________________
____________________________________________________________________________________

5. (addition concerns)

____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________
Please prepare a brief summary of what you learned on this page.
Please include recommendations for the curriculum/ABET committee on educational matters.
Please include recommendations for the department head on operational matters.
Also, list any questions to add to the interview.
Comments on “training” for interview
Comments on format of interview
Comments on interview form
Once again, thank you for interviewing one of our graduating seniors.

____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________

Alumni of The University of Alabama Department of Chemical and Biological Engineering Six-Year Survey

Like all accredited engineering programs, the UA ChBE program must show that it met the stated objectives of the BS degree. One requirement is feedback from departmental alumni. We need your help with the ABET accreditation process.

Your Name: ______________________      UA Degree(s)/Year(s): _____________

Listed below are the five educational objectives of ChE curriculum. Based on your career accomplishments, please circle one response that most closely matches your opinion:
Strongly Disagree=1  Disagree=2  Neutral or Can’t Decide=3  Agree=4 Strongly Agree=5

ChE Program Educational Objectives:
1. I have converted my technical knowledge into the implementation of ideas in the practice of chemical engineering.  
   1 2 3 4 5

2. I have used my professional skills to convert knowledge into action to protect the public interest, health, safety, and environment in the practice of chemical engineering. 
   1 2 3 4 5

3. I have used effective verbal and written communication skills to transform my ideas into action to benefit the public good in the practice of chemical engineering. 
   1 2 3 4 5

4. I have applied my understanding of global and ethical concerns, with teamwork and leadership skill to transform my ideas into action to benefit the public good in the practice of chemical engineering. 
   1 2 3 4 5

5. I value and actively pursue lifelong scientific inquiry, learning and creativity in the practice of chemical engineering. 
   1 2 3 4 5

Please give us feedback (positive or negative; additions, deletions, or rewording) on the ChBE program educational objectives (continue on back if necessary):

Thanks for your response!

Please return this page to: Dr. David Arnold, Professor  
Department of Chemical and Biological Engineering  
The University of Alabama, Box 870203  
Tuscaloosa, AL 35487-0203
Alumni of The University of Alabama Department of Chemical and Biological Engineering Six-Year Survey
Please ask your immediate supervisor to complete this form and return it directly to the address below. Write in your name and BS ChE year.

Alumnus Name: __________________________      Graduation Year: __________
The University of Alabama BS ChE Employer Survey (Estimated time to complete: five minutes).

The accreditation agency for engineering, ABET, requires each program to develop educational objectives. ABET treats educational objectives as attributes that can only be directly evaluated after the graduate is in the workforce. Please evaluate how strongly this employee demonstrates the following five attributes. We assure you that the ratings you provide will be kept in a confidential file and never shown to any of the alumni or ever attributed to you.

Please circle one response that most closely matches your opinion:
Strongly Disagree=1  Disagree=2  Neutral or Can’t Decide=3  Agree=4  Strongly Agree=5

ChE Program Educational Objectives:
1. Our graduates convert their technical knowledge into the implementation of ideas in the practice of chemical engineering.  
   1  2  3  4  5

2. Our graduates use their professional skills to convert knowledge into action to protect the public interest, health, safety, and environment in the practice of chemical engineering.  
   1  2  3  4  5

3. Our graduates use effective verbal and written communication skills to transform their ideas into action to benefit the public good in the practice of chemical engineering.  
   1  2  3  4  5

4. Our graduates apply their understanding of global and ethical concerns, within the engineering functions, as well as teamwork and leadership skill so they may transform their ideas into action to benefit the public good in the practice of chemical engineering.  
   1  2  3  4  5

5. Our graduates value and actively pursue lifelong scientific inquiry, learning and creativity in the practice of chemical engineering.  
   1  2  3  4  5

On the back, please include any feedback (positive or negative) on whether these objectives match the demands placed on entry-level ChEs in your enterprise.

Thanks for your response!

Please return this page to:    Dr. David Arnold, Professor
                              Department of Chemical and Biological Engineering
                              The University of Alabama, Box 870203
                              Tuscaloosa, AL 35487-0203
1. Professor Lane is about 6 feet and 250 pounds. Estimate his height in meters.
   1. 0.5 to 1.5 m
   2. 1.5 m to 2.5 m
   3. 2.5 to 3.5 m
   4. 3.5 to 5 m
   5. 5 m to 10 m
   6. greater than 10 m

2. Professor Lane is about 6 feet and 250 pounds. Estimate his weight in kilograms.
   1. 20-80 kg
   2. 80-150 kg
   3. 150-200 kg
   4. 200-300 kg
   5. 300-500 kg
   6. greater than 500 kg

3. What is the common name for someone with a net worth of $10^9?  
   1. kilo-dollar  
   2. megaCEO  
   3. millionaire  
   4. trillionaire  
   5. thousandaire  
   6. none of the above

4. What is the common name for technology using materials with dimensions on the order of 10^{-9} m?
   1. millitech  
   2. micrometrology  
   3. microtechnology  
   4. picotechnology  
   5. femtotechnology  
   6. nanotechnology  
   7. none of the above
5. What are the numerical value and units of gravitational acceleration, g, on Earth?
   1. 32.2 ft/s²
   2. 2.71 m/s
   3. 2.71 m/s²
   4. 9.81 m/s²
   5. 9.81 m/s
   6. 9.81 ft/s²
   7. none of the above

6. Compared to gravitational acceleration on Earth, is g more, less, or the same on the moon?
   1. MORE
   2. LESS
   3. THE SAME

7. 2.5 x 10.01 =
   1. 25.25
   2. 25.2
   3. 25.3
   4. 25
   5. 30
   6. 25.025
   7. 25.02

8. 1530 – 30.11 =
   1. 1500
   2. 1499.88
   3. 1499.89
   4. 1499.9
   5. None of the above

9. 1.05 x 10^3 x 2.0 x 10^-5 =
   1. 210
   2. 200
   3. 3.05 * 10^-2
   4. 2.05 * 10^-15
   5. 2.10 * 10^-2
   6. 2.1 * 10^-2
   7. None of the above
10. A liter of water weighs approximately how many grams?
   1. 33
   2. 453
   3. 1
   4. 62.4
   5. 100
   6. 1000
   7. None of the above

11. A liter of air contains how many moles?
   1. $6.022 \times 10^{23}$
   2. $6.022 \times 10^{27}$
   3. $6.022 \times 10^{-23}$
   4. 10
   5. 100
   6. $1/22.4 = 0.045$
   7. None of the above

12. What is the slope of the line?
   1. 3
   2. 4
   3. 2
   4. 1
   5. 0.5
   6. 0.1
   7. 0.33

13. What is the y-intercept of the line?
   1. 0
   2. 0.5
   3. 1
   4. 1.5
   5. 2
   6. -0.5
   7. -1

14. A 1 kg lead ball at sea level is brought to the space station. How does this affect the ball’s MASS?
   1. INCREASE
   2. DECREASE
   3. STAY THE SAME
15. A 1 kg lead ball at sea level is brought to the space station. How does this affect the ball’s WEIGHT?
   1. INCREASE
   2. DECREASE
   3. STAY THE SAME

16. A 1 kg lead ball at sea level is brought to the space station. How does this affect the ball’s VOLUME?
   1. INCREASE
   2. DECREASE
   3. STAY THE SAME

17. A plastic sheet has dimensions 3 ft x 6 ft. What is the approximate area in m²?
   1. Between 0.1 & 1 m²
   2. Between 1 & 2.5 m²
   3. Between 2.5 & 4 m²
   4. Between 4 & 6 m²
   5. Between 6 & 10 m²
   6. Greater than 10 m²

18. Compare the pressure at the bottom of the tanks:
   1. Left tank has higher pressure
   2. Right tank has higher pressure
   3. Tanks have equal pressure

19. What is 30 °C in Fahrenheit?
   1. Less than -3 °F
   2. Between -2 & 20 °F
   3. Between 20 and 40 °F
   4. Between 40 and 60 °F
   5. Between 60 and 80 °F
   6. Greater than 80 °F
20. What percentage of the air is oxygen?
   1. Less than 15%
   2. Between 15 & 25 %
   3. Between 25 and 40 %
   4. Between 40 and 60 %
   5. Between 60 and 80 %
   6. Greater than 80 %

21. Two equations must be solved: \(x + y = a\) and \(x - y = b\). How many of the four variables \((a,b,x,y)\) must be specified in order to solve for the others?
   1. 0
   2. 1
   3. 2
   4. 3
   5. 4

22. One mole of propylene is burned in air. How many moles of carbon dioxide are produced from propylene \((\text{C}_3\text{H}_6)\)?
   1. 0
   2. 0.5
   3. 1
   4. 1.5
   5. 2
   6. 2.5
   7. 3

23. One mole of propylene is burned in air. How many moles of water are produced from propylene \((\text{C}_3\text{H}_6)\)?
   1. 6
   2. 5
   3. 4
   4. 2
   5. 1
   6. 3
   7. more than 6

24. What is the vapor pressure of water at 100 °C?
   1. 0
   2. 1 psi
   3. 1 atm
   4. 1 torr
   5. 1 Pa
   6. 30 mm of water
   7. 212 °F
Design Rubric – Ability to design a system, component, or process to meet desired needs within realistic constraints

Student: ____________________  Course:  CHE 481
Reviewer: ___________________  Date:  ____________

<table>
<thead>
<tr>
<th>Design organization, approach, and completeness.</th>
<th>POSSIBLE POINTS</th>
<th>ACTUAL POINTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>No organization, incomplete solution.</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Some organization, mostly complete solution.</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Moderate organization, complete solution.</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Well organized, complete solution.</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Well organized, clear approach, complete solution.</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Use of computer tools and engineering resources.</th>
<th>POSSIBLE POINTS</th>
<th>ACTUAL POINTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>No use of computer, no references.</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Some computer use, but no sample calculations.</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Computer use, limited sample calculations.</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Computer used, complete sample calculations.</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Computer used, complete sample calculations, fully referenced.</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Design economics.</th>
<th>POSSIBLE POINTS</th>
<th>ACTUAL POINTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>No knowledge.</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Little knowledge, missing key components.</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Mostly correct, only missing a few key components.</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Correct solution.</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Correct solution with explanation and analysis of results.</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Practicality of solution and recognition of constraints.</th>
<th>POSSIBLE POINTS</th>
<th>ACTUAL POINTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incorrect with no analysis.</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Incorrect and some analysis.</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Correct solution with no analysis.</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Correct solution with some analysis.</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Correct solution with full analysis and suggestions for improvement.</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

Total: 20
Multidisciplinary Teaming Rubric

Student: ____________________________ Course: ____________________________
Reviewer: __________________________ Date: ____________________________

POSSIBLE POINTS  ACTUAL POINTS

Knowledge of roles for non-chemical engineers in design.
1. Identifies no roles for non-chemical engineers. ___ 1 ___
2. Identifies 1 role for non-chemical engineer. ___ 2 ___
3. Identifies 2 roles for non-chemical engineers. ___ 3 ___
4. Identifies 3 roles for non-chemical engineers. ___ 4 ___
5. Identifies 4 or more roles for non-chemical engineers. ___ 5 ___

Describe roles for non-chemical engineers.
1. No knowledge. ___ 1 ___
2. Little knowledge. ___ 2 ___
3. Moderate knowledge. ___ 3 ___
4. Adequate knowledge. ___ 4 ___
5. Complete knowledge. ___ 5 ___

Describe potential problems interacting with non-chemical engineers.
1. No knowledge. ___ 1 ___
2. Little knowledge. ___ 2 ___
3. Moderate knowledge. ___ 3 ___
4. Adequate knowledge. ___ 4 ___
5. Complete knowledge. ___ 5 ___

Describe ways to resolve conflicts with non-chemical engineers.
6. No knowledge. ___ 1 ___
7. Little knowledge. ___ 2 ___
8. Moderate knowledge. ___ 3 ___
9. Adequate knowledge. ___ 4 ___
10. Complete knowledge. ___ 5 ___

Total: ___ 20 ___
You are to design and write a report on a cement job in an 8,000 ft well. You must take into account the health and safety aspects of the job along with the engineering design. The table below gives the well conditions.

<table>
<thead>
<tr>
<th>Well</th>
<th>Description</th>
<th>Cement</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth</td>
<td>8000 ft</td>
<td>n</td>
<td>0.33</td>
</tr>
<tr>
<td>Temperature</td>
<td>175 °F</td>
<td>m</td>
<td>0.038 lb s^n / ft^2</td>
</tr>
<tr>
<td>Pressure</td>
<td>5000 psig</td>
<td>Density</td>
<td>12 # / gal</td>
</tr>
<tr>
<td>Hole size</td>
<td>9 inch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Casing size</td>
<td>N80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>outside diam</td>
<td>7.625 &quot;</td>
<td>n</td>
<td>0.33</td>
</tr>
<tr>
<td>inside diam</td>
<td>6.875&quot;</td>
<td>m</td>
<td>0.038 lb s^n / ft^2</td>
</tr>
<tr>
<td>lb / ft</td>
<td>29.7</td>
<td>r</td>
<td>12 # / gal</td>
</tr>
</tbody>
</table>

Requirements
1. Flow of cement in the annulus must be turbulent (Re > 4000).
2. Calculate the:
   - Flow rate necessary to produce turbulence in the cement slurry
   - The friction pressure loss in the pipe.
   - The friction pressure loss in the annulus.
   - The hydraulic horsepower needed to pump the cement.

Equations
Non-Newtonian fluid Reynolds number where m and n are the power law parameters.

\[ \text{Re} = \frac{\rho v^2 - n d^n}{8^{n-1} m} \]

Friction factor for a power law fluid flowing in a pipe.

\[ \sqrt{\frac{1}{f}} = A_n \log(\text{Re}_n^{1-n/2}) + C_n \quad A_n = \frac{4}{n^{0.75}} \quad C_n = -0.4 \]

Friction factor for a power law fluid flowing in a concentric annulus

\[ \sqrt{\frac{1}{f}} = A_n \log\left(\frac{2}{3} \text{Re}_n^{1-n/2}\right) + C_n \quad A_n = \frac{4}{n^{0.75}} \]

\[ \text{Re}_n = \frac{\rho v^{2-n} (d_o - d_i)^n}{12^{n-1} m} \quad C_n = \frac{-0.4}{n^{1.2}} \]
# CHE 320 Written Communication Assessment Rubric

| Student: _______________________ | Course: ___CHE 320_____
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Reviewer:______________________</td>
<td>Date:___________________</td>
</tr>
</tbody>
</table>

Unacceptable=1  Marginal=2  Acceptable=3  Good=4  Exceptional=5

<table>
<thead>
<tr>
<th>Possible</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Points</td>
<td>Points</td>
</tr>
</tbody>
</table>

## Organization

1. No structure or purpose. \( \text{Points} = 4 \)
2. Difficult to follow and purpose not clear \( \text{Points} = 8 \)
3. Limited structure, continuity, and purpose poorly stated. \( \text{Points} = 12 \)
4. Logical structure with clear purpose. \( \text{Points} = 16 \)
5. Logical structure, easy to follow with clearly stated purpose. \( \text{Points} = 20 \)

## Content

1. Clearly no knowledge of subject matter. \( \text{Points} = 8 \)
2. Limited knowledge of subject matter with no interpretation or analysis. \( \text{Points} = 16 \)
3. Only basic concepts are demonstrated with limited interpretation. \( \text{Points} = 25 \)
4. At ease with content and able to elaborate and explain to some degree. \( \text{Points} = 34 \)
5. Demonstration of full knowledge of subject with complete interpretation. \( \text{Points} = 45 \)

## Format

1. Work is illegible, inconsistent format, many changes in font type, size, etc. \( \text{Points} = 4 \)
2. Figures and tables are illegible and lack information. \( \text{Points} = 8 \)
3. Mostly consistent format. Figures and tables are legible, but lack information. \( \text{Points} = 12 \)
4. Format is generally consistent, including heading styles and captions. Figures and tables are neat and provide most information. \( \text{Points} = 16 \)
5. Consistent format, including heading styles, captions. Figures and tables are logical, neat and present complete information. \( \text{Points} = 20 \)

## Spelling & Grammar

1. Numerous spelling and grammatical errors. \( \text{Points} = 2 \)
2. Several spelling and grammatical errors. \( \text{Points} = 4 \)
3. Minor misspellings and/or grammatical errors. \( \text{Points} = 6 \)
4. Negligible misspellings and/or grammatical errors. \( \text{Points} = 8 \)
5. No misspellings or grammatical errors. \( \text{Points} = 10 \)

## References

1. No references. \( \text{Points} = 1 \)
2. Referencing system but inadequate references. \( \text{Points} = 2 \)
3. Consistent referencing system with minor inadequacies in references. \( \text{Points} = 3 \)
4. Reference section complete and comprehensive. \( \text{Points} = 4 \)
5. Consistent and logical referencing system. \( \text{Points} = 5 \)

**TOTAL= 100**
### CHE 320 Oral Communication Assessment Rubric

<table>
<thead>
<tr>
<th>Subject</th>
<th>Possible Points</th>
<th>Actual Points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Organization</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. No structure; impossible to follow talk.</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>2. Little structure; difficult to follow presentation.</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>3. Some structure; some information presented in logical order.</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>4. Most information in a logical sequence; fairly easy to follow.</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>5. All information in logical and interesting sequence; easily followed.</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td><strong>Content &amp; Knowledge</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. No grasp of information; unable to answer any questions.</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>2. Uncomfortable with information; answers rudimentary questions.</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>3. Comfortable with information; answers some questions.</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>4. At ease with content; provide elaborate answers to most questions.</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>5. Demonstrates full knowledge of subject with complete explanations.</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td><strong>Visual Aids &amp; Neatness &amp; Style</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Poor visual aids; do not support presentation; many spelling/grammar errors.</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>2. Slides barely support presentation; fewer spelling/grammar errors.</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>3. Slides give some support to presentation; no spelling/grammar errors.</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>4. Text, figure, tables in slides are large, simple; not copied from report.</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>5. Text, figure, tables in slides are complete, large, simple, very easy to read.</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td><strong>Delivery &amp; Speaking Skill</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Mumbles, too quiet &amp; monotonous, no eye contact, distracting mannerisms</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>2. Poor pronunciation, little eye contact, uneven rate, nervous.</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>3. Clear voice, good pronunciation, some eye contact, steady rate.</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>4. Clear voice; correct pronunciation, good eye contact, steady rate.</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>5. Great eye contact, perfect timing, enthusiastic &amp; confident delivery.</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td><strong>Presentation Length</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Too long or too short by 8 minutes</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>2. Too long or too short by 6 minutes</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>3. Too long or too short by 4 minutes</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>4. Too long or too short by 2 minutes</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>5. Too long or too short by 0 minutes</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>
# PROBLEM-SOLVING RUBRIC

<table>
<thead>
<tr>
<th>Category</th>
<th>1 (Low)</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5 (High)</th>
<th>Score</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Understanding Problem Statement &amp; Defining Problem</strong></td>
<td>Cannot understand the problem without assistance from others.</td>
<td>Some difficulty reducing the statement to a defined focused problem.</td>
<td>Some fundamental error in translating problem statement.</td>
<td>Problem diagram done nearly correctly.</td>
<td>Able to convert detailed problem statement to diagram, listing all knowns and unknowns.</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td><strong>Understanding Fundamental Principles in the Problem</strong></td>
<td>Does not know the principles that apply to solving the problem.</td>
<td>Misses critical principle in solution method.</td>
<td>Fundamental error in selection of equations (e.g., using transport instead of thermo)</td>
<td>Small errors in selection of equations to use.</td>
<td>Identifies the modes of heat transfer, and understands the type of problem well enough to describe to others.</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td><strong>Ability to Find Appropriate Data to Formulate a Solution</strong></td>
<td>Unable to identify need to data to complete a problem.</td>
<td>Has difficulty finding data appropriate for a problem.</td>
<td>Able to find most common data, but not able to identify all important data</td>
<td>Minor mistakes made/overlooked one piece of data</td>
<td>Knows what data to collect/look up for each fluid at the correct temperature</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td><strong>Developing a Strategy to Solve the Problem (Equation(s))</strong></td>
<td>Cannot solve the problem independently at all. Would require help from others.</td>
<td>Incorrect strategy from the beginning... would need help from an example to solve.</td>
<td>Difficulty in more than one step in solution strategy.</td>
<td>Small trouble with 1 step in strategy.</td>
<td>Understands the equations to solve, and the order to solve them in</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td><strong>Ability to Concisely Present the Problem and its Solution</strong></td>
<td>Cannot describe steps to solve or the reasons for each step.</td>
<td>Basic steps make sense, but not concise or logical enough to reproduce.</td>
<td>Solution is somewhat disorganized, difficult to reproduce.</td>
<td>Most of solution is neat and ordered; others can follow with little trouble.</td>
<td>Able to solve the problem in a way others can follow easily.</td>
<td>0.4</td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL**

Max 10
A kettle-type reboiler similar to the one shown below is used to make steam. Saturated liquid water at 1.5233 bars enters the reboiler at 45 kg/min. It is heated by hot engine oil that enters at 170 °C and passes through the heat exchanger at 800 kg/min. The reboiler is a 1-2 shell and tube heat exchanger (1 shell and two tube passes) and contains 400 30-m long tubes per pass. The tubes, made of aluminum alloy 195, have an inner diameter of 0.60 cm and a wall thickness of 0.03 cm. You may assume that the reboiler is new and has no fouling. The convective heat transfer coefficient for boiling the water, \( h_o \), is 2940 W/m\(^2\)-K. The convective heat transfer coefficient for the oil in the tubes, \( h_i \), is 67.1 W/m\(^2\)-K. To determine oil properties, you may assume the mean temperature is 157 °C.

(A) What is the rate of steam production in the reboiler (kg/min)?
(B) What is the rate of water overflowing the weir and exiting the exchanger (kg/min)?
CHE 319 – Fall, 2011
Basic Chemical Engineering Laboratory
Report Rubric

Section __________ Team ___________ Experiment ___________ Grade _____

1. Technical Style (20)
   Report shows evidence of significant editing by entire team.
   No obvious grammar, punctuation, or spelling errors. Consistent
   and conventional technical style used.
   Score ____

2. Graphs and Tables (20)
   Results presented in well-designed graphs and tables. All are
   formatted correctly.
   Score ____

3. Organization (20)
   Report organized in sections as described in text. Content
   presented in logical and consistent order.
   Score ____

4. Technical Content (20)
   Data is collected, presented, and analyzed properly.
   Understanding and meaningful interpretation of results demonstrated.
   Score ____

5. Sample Calculations (20)
   A detailed example of all non-trivial calculations is shown.
   Unit consistency is demonstrated using the picket fence method.
   Score ____
i. Recognition of the need for lifelong learning

The importance to be a lifelong learner is stated as follows:

a. The nature of science, engineering, technology, and industry is dynamic and constantly evolving.

b. The goal and requirement varies

c. New technology and methods are available

d. Fundamentals need to be adjusted to fit specific environments.

e. Personal interest can change.

f. Each person performs different roles in his/her life.

Each of the following cases indicates one of the importance for lifelong learning, please analyze each case and identify the corresponding importance. Note: one importance per question. Please give a short explanation if you can.

1. John is a chemical engineer and responsible for maintaining the optimal conditions of two batch reactors. Recently, he was promoted to be a line manager, so he decides to attend an online MBA program at nights to learning management.

2. An old-time fable tells a story about a thirsty crow, who was able to drink water out of a narrow-neck bottle by putting pebbles into it (left figure); Years later, two little crows faced a similar situation (right figure). One crow decided to do what he was taught and started looking for pebbles; the other one carefully examined the surrounding, found a hollow wheat stem, like a straw, and started drinking right away.
3. A construction company needs to design and build the same chemical plant in Japan and in middle of the United States. The manager reminder his crew that these are two totally different projects.

4. Avastin, an antibody cancer therapy drug, was designed to block the blood vessel, thus cutting off the nutrient supply of the tumors. The drug is currently in clinical trial, but recently, serious consideration was brought up, because the cancer stem cells inside the tumor are able to build its own blood vessel, increasing the chance of spreading. This new finding was just reported early 2011.

5. Lisa has been working in fuel cell field for more than 10 years, however the financial support of this field from the government and industry is fading out, so she decides to switch to solar energy. Her initial effort is to attend workshop focusing on solar energy.

ii. **Ways to attain ability to engage in lifelong learning, including:**
   a. Formal education
   b. Internet, e.g., Google and wikipedia
   c. Library, journal, and textbooks
   d. Talk to experts in academia and company,
   e. Engaging in professional societies, attending conferences
      AICHE, Intern, Co-ops

As a R&D line manager, you are responsible for a new project about the development of antibiotics targeting superbugs. Please answer the following questions using list a-e.

1. Where do you look for related information through self-learning?

2. Who could you ask to gain useful opinions?

3. Please list two ways to keep you charged?
CHE 482 Rubric for Student Outcome 9/10:
The ability to understand and exercise professional ethical responsibility/An understanding of the impact of engineering solutions in a global, environmental and societal context

Unacceptable=1 Marginal=2 Acceptable=3 Good=4 Exceptional=5

POSSIBLE ACTUAL

Strategy and Practicality: Did the student's strategy for the problem deal with every issue within the problem, and how feasible is the strategy to implement?

1. Strategy loosely responds to the problem and the given issues. No response for future problems is given. Strategy is out of the realm of possibility. __5__
2. Student gives general response to the issue, very little thought is given to future issues, and the solution is feasible but difficult to implement. __10__
3. Student covers all given issues but gives little thought to future issues and creates a solution that is feasible with little difficulty in implementing. __15__
4. Strategy completely covers given issues with good thought to future issues. The solution is easily implemented and economically sound. __20__
5. Strategy is looks at every angle of the problem. Covers the issues that have and may arise and is economically and easily implemented. __25__

Social Impact Understanding: How well did the student understand the social impacts of the problem, and did they deal with them accordingly?

1. Student understands little of the social situation of the problem and this is greatly reflected in the solution given. __5__
2. Student has a small grasp on the social standards of the situation and gives a solution that is not socially accepted. __10__
3. Student has a good understanding of social standards, but does not have a complete understanding. The solution may be socially accepted, but is on the verge of not being. __15__
4. Student understands the complex nature of social standards of the problem. The solution is socially acceptable, but does cross some social boundaries, i.e. "steps on some toes." __20__
5. Student understands the complex nature of social standards of the problem. The solution is socially acceptable and follows all standards. __25__
Global Impact Understanding: How well did the student understand the global impacts of the problem, and did they deal with them accordingly?

1. Student understands little of the global impact of the problem and this is greatly reflected in the solution given.  
   2. Student has a small grasp on the global impact of the situation and gives a solution that is not globally accepted. (If only barely)  
   3. Student has a good understanding of the global impact, but does not have a complete understanding. The solution may be globally accepted, but is on the verge of not being.  
   4. Student understands the complex nature of the global impact of the problem. The solution is globally acceptable, but does cross some national and global boundaries. i.e. "steps on some toes"  
   5. Student understands the complex nature of the global impact of the problem. The solution is globally acceptable and follows all standards.

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>1. Student understands little of the global impact of the problem and this is greatly reflected in the solution given.</td>
</tr>
<tr>
<td>10</td>
<td>2. Student has a small grasp on the global impact of the situation and gives a solution that is not globally accepted. (If only barely)</td>
</tr>
<tr>
<td>15</td>
<td>3. Student has a good understanding of the global impact, but does not have a complete understanding. The solution may be globally accepted, but is on the verge of not being.</td>
</tr>
<tr>
<td>20</td>
<td>4. Student understands the complex nature of the global impact of the problem. The solution is globally acceptable, but does cross some national and global boundaries. i.e. &quot;steps on some toes&quot;</td>
</tr>
<tr>
<td>25</td>
<td>5. Student understands the complex nature of the global impact of the problem. The solution is globally acceptable and follows all standards.</td>
</tr>
</tbody>
</table>

Organization: Does the student's work flow in a logical and understandable manner?

1. Student shows no organization and has no logical flow to the solution. No clear solution.  
   2. Student has some organization with a loosely logical flow. Solution can be mostly determined.  
   3. Student has a moderately organized solution with a moderately logical flow. Solution is complete.  
   4. Student has an organized solution with logical flow. Solution is complete.  
   5. Student has a very organized solution with a completely logical flow. Solution is complete and apparent.

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>1. Student shows no organization and has no logical flow to the solution. No clear solution.</td>
</tr>
<tr>
<td>10</td>
<td>2. Student has some organization with a loosely logical flow. Solution can be mostly determined.</td>
</tr>
<tr>
<td>15</td>
<td>3. Student has a moderately organized solution with a moderately logical flow. Solution is complete.</td>
</tr>
<tr>
<td>20</td>
<td>4. Student has an organized solution with logical flow. Solution is complete.</td>
</tr>
<tr>
<td>25</td>
<td>5. Student has a very organized solution with a completely logical flow. Solution is complete and apparent.</td>
</tr>
</tbody>
</table>

Total: 100
<table>
<thead>
<tr>
<th></th>
<th>POSSIBLE POINTS</th>
<th>ACTUAL POINTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethical understanding of</td>
<td></td>
<td></td>
</tr>
<tr>
<td>engineering in global</td>
<td></td>
<td></td>
</tr>
<tr>
<td>context.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. No understanding with</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>no analysis.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Little understanding</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>with little analysis.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Some understanding</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>with some analysis.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Excellent understanding</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>with adequate analysis.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Understanding of</td>
<td></td>
<td></td>
</tr>
<tr>
<td>relationship between</td>
<td></td>
<td></td>
</tr>
<tr>
<td>politics and engineering.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. No knowledge</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>2. Little knowledge,</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>missing key components.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Mostly correct, only</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>missing a few key</td>
<td></td>
<td></td>
</tr>
<tr>
<td>components.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Excellent understanding.</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fully address entire</td>
<td></td>
<td></td>
</tr>
<tr>
<td>problem statement.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No attempt to answer the</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>problem.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Little attempt to answer</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>the problem.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Addresses some aspects</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>of problem statement.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Addresses all aspects of</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>problem statement.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organization.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No organization,</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>incomplete solution.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some organization, mostly</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>complete solution.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate organization,</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>complete solution.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well organized, clear</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>approach, complete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>solution.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grammatically correct and</td>
<td></td>
<td></td>
</tr>
<tr>
<td>coherent.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Numerous grammatical</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>errors, no coherence.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some grammatical errors,</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>little coherence.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Few grammatical errors,</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>coherent.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No grammatical errors,</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>very coherent.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total:</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>
Curriculum and ABET Committee (CAC) meeting Minutes
8/17/12 10:30am-12noon

Present: Drs. David Arnold, Chris Brazel, Tonya Klein and Alan Lane

1. Klein reviewed for the CAC the Departmental Assessment Plan with Curriculum Maps (handout) and example rubrics and surveys.

2. Criterion Based Grading is no longer a valid assessment measure for SLO #8 (student learning outcome) The ability to analyze and control physical, chemical, and biological processes as demonstrated by a working knowledge of material balances, energy balances, thermodynamics, transport phenomena, reaction engineering, separations, and process dynamics and control. Instead, each faculty member teaching 254, 255, 305, 324, 354 and 493 is required to devise a method to assess competency on this outcome. A comprehensive final exam, for example, may be used to determine mastery of subtopics within each course.

3. Klein introduced WEAVE to CAC (on-line assessment data analysis tool)

4. Continuous improvement is being implemented this ac.yr. (12-13) in CHE 324 for which students reported during exit interviews a deficiency in a working knowledge of Transport Phenomena (pg 2 of survey, question 8d). CAC recommended the textbook (Bird, Stewart and Lightfoot) be changed as this is considered graduate-level. Dr. Carlson will implement this change.

5. 6-year alumni survey sent out last year resulted in only a couple of response (1-2% rate) while 15-20 responses would be more meaningful (10-15%)
   i.) Need to improve list with contact information
   ii.) ABET student helper can help Sues compile list and contact alumni
       ACTION ITEM: Alan Lane will contact Alex Paulson (previous student ABET help) about hiring another year, if not Lane will arrange for a different student helper

6. Fall Faculty retreat materials: ACTION ITEM: Klein will provide faculty at the retreat information of individual responsibilities regarding ABET.
   i.) Time-line
   ii.) Student work (identify three students A,B and C level, copy all graded homework/quizzes/reports/exams/projects etc.) Students may not need to know their work is being used.
   iii.) Examples of assessment methods/summary reports/analysis
   iv.) Example of ABET syllabus and Faculty CV for SSR (self-study report)

7. UA-Dublin proposal for course transfer credit was approved by CAC. A recommendation by Brazel was made to clarify that the 15 Dublin hrs of design (equivalent to 9 UA credit hrs) could count for 482 as well as a CHE elective AND a Career Elective. The text on the proposal was somewhat confusing.

8. Student petitioning for CHE 125 course credit using other technical credit: CAC would like to continue evaluating petitions on a case-by-case basis. (no change in policy)
CRITERION 5. CURRICULUM

A. Program Curriculum

1. Complete Table 5-1 that describes the plan of study for students in this program including information on course offerings in the required curriculum in the form of a recommended schedule by year and term along with maximum section enrollments for all courses in the program over the last two terms the course was offered. If there is more than one curricular path, Table 5-1 should be provided for each path. State whether you are on quarters or semesters and complete a separate table for each option in the program.

Table 5-1 is attached to the end of this section. Our program offers one degree, the B.S. in Chemical Engineering. Table 5-1 provides the requirements for this degree. The University of Alabama is on a semester-based system.

2. Describe how the curriculum aligns with the program educational objectives.

The program educational objectives have been revised to the following set:

Chemical and biological engineering graduates are expected to:
- Apply fundamental principles of chemical and biological engineering in problem solving and design
- Communicate effectively in writing and speaking
- Understand the responsibility to society in the context of global, environmental, ethical and safety concerns

All CHE prefix courses incorporate problem solving as a major component, while design concepts are touched upon in CHE 306 Heat Transfer Operations and CHE 354 Chemical Reactor Design. More extensive design concepts are developed in the senior year in CHE 481 Chemical Process Design I, and CHE 482 Chemical Process Design II. In the laboratory sequence, CHE 319 and CHE 320, students are required to write and submit written proposals and reports, which are graded for feedback and require revisions. In CHE 320, students are also required to give an oral presentation, and feedback from the instructor is given here as well. While not required for all students, ChBE Honors students take CHE 225 (1hr) and CHE 325 (1hr) in which students have the opportunity to give short oral presentations about current topics to an audience of their peers and the instructor(s). The last objective is addressed informally throughout the curriculum, but is assessed at the senior level in CHE 482 Chemical Process Design II.

3. Describe how the curriculum and its associated prerequisite structure support the attainment of the student outcomes.

The following table 5-2 provides a map of student outcomes to courses in which these outcomes are addressed.
Table 5.2  Courses which address student outcome

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CHE 125</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 254</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 255</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 304</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 305</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 306</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 319</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 320</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 324</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 354</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 481</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 482</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 493</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Attach a flowchart or worksheet that illustrates the prerequisite structure of the program’s required courses.

The flowchart for the UA Chemical Engineering program is provided immediately following Table 5-1 in this report. Flowcharts are also included for small variations in the curriculum (dual CHE/CH major, pre-medical, accelerated curriculum, Scholars Program); however, each of these flowcharts illustrates the same fundamental degree requirements.

5. Describe how your program meets the requirements in terms of hours and depth of study for each subject area (Math & Basic Sciences, Engineering Topics, and General Education) specifically addressed by either the general criteria or the program criteria.

The 2012-2013 ABET Engineering Accreditation Criteria require 1.5 years of engineering topics where 1 year is the lesser of 32 semester hours or one quarter of the total credits required for graduation. As this program requires 127 hours, 127/4 = 31.75 and 1.5 x 31.75 is 47.625 hours (48 hours rounded). A student following the basic curriculum flowchart will take five hours of engineering credit as a freshman, eight as a sophomore, 24 as a junior and 12 as a senior for a total of 49 hours, which meet the requirement. In addition, 48 hours of Math and Basic Science are required including an Advanced Science Elective and a Biology Elective. This is equivalent to ABET’s minimum of 1 year for this category. Finally, the University of Alabama requires a total of 24 hours of general education credit.
6. Describe the major design experience that prepares students for engineering practice. Describe how this experience is based upon the knowledge and skills acquired in earlier coursework and incorporates appropriate engineering standards and multiple design constraints.

The ChBE design courses are ChE 481 and ChE 482. These senior level courses cover process and plant design, including the opportunity to integrate economic, societal, environmental and multidisciplinary constraints into their projects. A final exposure to communication and its important role in a sound design project is included in this design sequence. By the time most seniors arrive at these courses they have completed the summer lab, a stand-alone, hands-on, “big-scale,” experiential course. This lab is scheduled for five weeks, 8 hours per day, six days per week during the summer between their junior and senior year. This four-hour credit course aids students in understanding the fundamental principles learned in sophomore and junior courses and allows them to apply this knowledge to “real” systems that seldom follow the simple behavior described in the textbooks. Process upsets, group dynamics, and leadership are discovered to be just as important as the laws of chemistry and physics. Five experiments, each encompassing many unit operations, provide interactions between subject matter taught as a single topic. The interactions often produce new avenues for learning and require intensive study to determine what theories or mechanisms are really operating. Once they successfully navigate this hands-on course, they have a much better understanding and feel for systems that they are asked to design in the senior design courses.

7. If your program allows cooperative education to satisfy curricular requirements specifically addressed by either the general or program criteria, describe the academic component of this experience and how it is evaluated by the faculty.

Co-operative education and internships can be used by ChBE honors students (with a GPA of 3.3 or higher) to fulfill a maximum of 3 hours of their curriculum, slotting into elective slots for the Chemical Engineering Elective or a Career Elective. Projects are submitted at the beginning of the work period through a form available through the ChBE honors program (and on the che.eng.ua.edu website). This form must include a project title and contact information for the work supervisor. A one-to-two (1-2) page description of the project must be included, and signed by both the student and supervisor and returned to the honors program chair in ChBE. The chair contacts the supervisor to verify the work project, and approves the subject matter of the project. Credits are earned when the student returns to campus and must give a 10-12 minute presentation on their project in front of ChBE faculty and students (often this is part of the ChE 125 Introduction to Chemical Engineering class or part of ChE 495 seminar or is conducted at an AIChE student chapter meeting). Students must answer questions from peers and professors, and once successfully completed, the student is assigned a grade in the honors independent study class (ChE 498), for 3 hours of credit.

8. Describe the materials (course syllabi, textbooks, sample student work, etc.), that will be available for review during the visit to demonstrate achievement related to this criterion. (See the 2012-2013 APPM Section II.G.6.b.(2) regarding display materials.)
Program materials for review will be placed in the main ChBE departmental office in Houser Hall. Binders containing syllabi, and examples of student work from the 2012-2013 academic year will be available, along with copies of required textbooks for each CHE course required in the curriculum. Copies of assessment related materials and minutes from faculty and CAC meetings will be accessible on a computer located in the main office.

B. Course Syllabi

In Appendix A, include a syllabus for each course used to satisfy the mathematics, science, and discipline-specific requirements required by Criterion 5 or any applicable program criteria.

A syllabus for each UA course used to satisfy mathematics, science, and chemical engineering requirements for the CHE degree is included in Appendix A of this report.
<table>
<thead>
<tr>
<th>Year, Semester, or Quarter</th>
<th>Course (Dept. No. Title)</th>
<th>Required, Elective, or Selected Elective</th>
<th>Math &amp; Basic Sciences</th>
<th>Engineering Topics Check if Contains Significant Design (X)</th>
<th>General Education</th>
<th>Other</th>
<th>Last Two Terms the Course was Offered: Semester and Year</th>
<th>Maximum Section Enrollment for the Last Two Terms the Course was Offered</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1st Semester</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st Semester</td>
<td>CH 101 General Chemistry I</td>
<td>R</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td>Lecture: 212 Lab: 24</td>
</tr>
<tr>
<td></td>
<td>MA 125 Calculus I</td>
<td>R</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td>88</td>
</tr>
<tr>
<td></td>
<td>CHE 125 Intro. to CHE</td>
<td>R</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>Fall 2011, Fall 2012</td>
<td>146</td>
</tr>
<tr>
<td></td>
<td>ENGR 111 Engineering the Future</td>
<td>R</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td>151</td>
</tr>
<tr>
<td></td>
<td>ENGR 131 Engineering Concepts and Design I</td>
<td>R</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>ENGR 151 Fundamental Engineering Graphics</td>
<td>R</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>EN 101 English Composition I</td>
<td>R</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td>24</td>
</tr>
<tr>
<td><strong>2nd Semester</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2nd Semester</td>
<td>CH 102 General Chemistry II</td>
<td>R</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td>Lecture: 211 Lab: 24</td>
</tr>
<tr>
<td></td>
<td>BSC 114 Principles of Biology I</td>
<td>R</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td>374</td>
</tr>
<tr>
<td></td>
<td>MA 126 Calculus II</td>
<td>R</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td>86</td>
</tr>
<tr>
<td></td>
<td>ENGR 141 Engineering Concepts and Design II</td>
<td>R</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>EN 102 English Composition II</td>
<td>R</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td>24</td>
</tr>
<tr>
<td><strong>3rd Semester</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3rd Semester</td>
<td>CH 231 Elementary Organic Chemistry I</td>
<td>R</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td>197</td>
</tr>
<tr>
<td></td>
<td>PH 105 General Physics with Cal.</td>
<td>R</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>MA 227 Calculus III</td>
<td>R</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>CHE 254 Chemical Engineering Calculations</td>
<td>R</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td>82</td>
</tr>
<tr>
<td><strong>4th Semester</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4th Semester</td>
<td>CH 232 Elementary Organic Chemistry II</td>
<td>R</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td>208</td>
</tr>
<tr>
<td></td>
<td>MA 238 Applied Differential Equations I</td>
<td>R</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td>50</td>
</tr>
<tr>
<td>Year, Semester, or Quarter</td>
<td>Course (Dept. No. Title)</td>
<td>Required, Elective, or Selected Elective</td>
<td>Subject Area (Credit Hours)</td>
<td>Engineering Topics Check if Contains Significant Design (X)</td>
<td>General Education</td>
<td>Other</td>
<td>Last Two Terms the Course was Offered: Semester and Year</td>
<td>Maximum Section Enrollment for the Last Two Terms the Course was Offered</td>
</tr>
<tr>
<td>----------------------------</td>
<td>--------------------------</td>
<td>----------------------------------------</td>
<td>----------------------------</td>
<td>--------------------------------------------------</td>
<td>---------------------</td>
<td>----------</td>
<td>--------------------------------------------------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>5th Semester</td>
<td>CHE 255 Chemical Engineering Thermodynamics</td>
<td>R</td>
<td>4</td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td>58</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Humanities/Literature/Fine Arts Elective</td>
<td>SE</td>
<td>3</td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td>variable</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>History/Social Science Elective</td>
<td>SE</td>
<td>3</td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td>variable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6th Semester</td>
<td>CHE 304 Fluid Flow Operations</td>
<td>R</td>
<td>3</td>
<td></td>
<td>Fall 2011, Fall 2012</td>
<td>56</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CHE 306 Heat Transfer Operations</td>
<td>R</td>
<td>3</td>
<td></td>
<td>Fall 2011, Fall 2012</td>
<td>104</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CHE 324 Transport Phenomena</td>
<td>R</td>
<td>3</td>
<td></td>
<td>Fall 2011, Fall 2012</td>
<td>44</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Engineering Elective</td>
<td>SE</td>
<td>3</td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td>99</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>History/Social Science Elective</td>
<td>SE</td>
<td>3</td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td>variable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer</td>
<td>CHE 305 Separations Process</td>
<td>R</td>
<td>3</td>
<td></td>
<td>Spring 2012, Spring 2013</td>
<td>111</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CHE 354 Reactor Design</td>
<td>R</td>
<td>3</td>
<td>X</td>
<td>Spring 2012, Spring 2013</td>
<td>105</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CHE 319 Basic CHE Engineering Lab</td>
<td>R</td>
<td>2</td>
<td></td>
<td>Spring 2012, Spring 2013</td>
<td>27</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Career Elective</td>
<td>SE</td>
<td>3</td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td>variable</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>History/Social Behavior Elective</td>
<td>SE</td>
<td>3</td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td>variable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7th Semester</td>
<td>CHE 320 Units Operations Lab</td>
<td>R</td>
<td>4</td>
<td></td>
<td>Summer 2011, Summer 2012</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PH 106 General Physics with Calculus II</td>
<td>R</td>
<td>4</td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td>56</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CHE 481 CHE Process Design I</td>
<td>R</td>
<td>3</td>
<td>X</td>
<td>Fall 2011, Fall 2012</td>
<td>74</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CHE 493 Process Dynamics &amp; Control</td>
<td>R</td>
<td>3</td>
<td></td>
<td>Fall 2011, Fall 2012</td>
<td>79</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CHE Elective</td>
<td>SE</td>
<td>3</td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td>57</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Humanities/Literature/Fine Arts Elective</td>
<td>SE</td>
<td>3</td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td>variable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year, Semester, or Quarter</td>
<td>Course (Dept. No. Title)</td>
<td>Subject Area (Credit Hours)</td>
<td>Required, Elective, or Selected Elective</td>
<td>Math &amp; Basic Sciences</td>
<td>Engineering Topics Check if Contains Significant Design (X)</td>
<td>General Education</td>
<td>Other</td>
<td>Last Two Terms the Course was Offered: Semester and Year</td>
</tr>
<tr>
<td>---------------------------</td>
<td>--------------------------</td>
<td>----------------------------</td>
<td>----------------------------------------</td>
<td>----------------------</td>
<td>-------------------------------------------------------------</td>
<td>------------------</td>
<td>-------</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>8th Semester</td>
<td>CHE 482 CHE Process Design II</td>
<td>R</td>
<td>3</td>
<td>X</td>
<td>Spring 2012, Spring 2013</td>
<td></td>
<td></td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>Biochemistry Elective</td>
<td>SE</td>
<td>3</td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td></td>
<td></td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>Advanced Science Elective</td>
<td>SE</td>
<td>3</td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td></td>
<td></td>
<td>variable</td>
</tr>
<tr>
<td></td>
<td>Career Elective</td>
<td>SE</td>
<td>3</td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td></td>
<td></td>
<td>variable</td>
</tr>
<tr>
<td></td>
<td>Humanities/Literature/Fine Arts Elective</td>
<td>SE</td>
<td>3</td>
<td></td>
<td>Fall 2012, Spring 2013</td>
<td></td>
<td></td>
<td>variable</td>
</tr>
<tr>
<td></td>
<td><strong>TOTALS-ABET BASIC-LEVEL REQUIREMENTS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF DEGREE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>PERCENT OF TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Totals must satisfy one set</td>
<td>Minimum semester credit hours</td>
<td>32 hours</td>
<td>48 hours</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Minimum percentage</td>
<td>25%</td>
<td>37.5%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. **Required** courses are required of all students in the program, **elective** courses (often referred to as open or free electives) are optional for students, and **selected elective** courses are those for which students must take one or more courses from a specified group.

2. For courses that include multiple elements (lecture, laboratory, recitation, etc.), indicate the maximum enrollment in each element. For selected elective courses, indicate the maximum enrollment for each option.

Note that instructional material and student work verifying course compliance with ABET criteria for the categories indicated above will be required during the campus visit.
All required ChE classes are subject to the 3-attempt rule.
Chemical and Biological Engineering Curriculum - BS CHE Degree

Fall - Fresh
- CH 192 (4)
- MA 161 (3)

Spring - Fresh
- CH 232 (3)
- MA 125 (4)

Fall - Soph
- CH 292 (3)
- MA 261 (4)

Spring - Soph
- CHE 264 (4)
- CHE 250 (4)

Fall - Jr
- CHE 280 (3)

Spring - Jr
- CHE 306 (3)
- CHE 308 (3)

Fall - Sr
- CHE 324 (3)

Spring - Sr
- CHE 384 (3)

COURSE OFFERING
- Summer Only
- Fall Only
- Spring Only

OPTIONAL COURSES
- MA 112 (3)
- MA 113 (3)

* See advisor for information on CAREER, CHE and ADV SCI electives (Check prerequisites)
* MTE 271 or ECE 320 (Check prerequisites)
* BIO Elective: CHE 445/565 or CHE 461 (Check prerequisites)
* MA112 pre-req

This flowchart requires 8 semesters plus 1 summer to graduate

* All classes subject to C- prerequisite rule

All required CHE classes are subject to the 3-attempt rule.
All required CHE classes are subject to the 3-attempt rule.
CHEMICAL AND BIOLOGICAL ENGINEERING CURRICULUM - BS CHE DEGREE
Fall - FRESH  Spring - FRESH  Fall - SOPH  Spring - SOPH
CH 101 (4)  (CH 113)
(BSC 119)  (BSC 114 (3))
PH 106 (4)
MA 125 (4)
ENGR 111 (1)
ENGR 151 (1)
ENGR 131 (1)
ENGR 141 (1)
HY/ SB (3)
HY/ SB (3)
ENG ELECT: MTE 271 or ECE 320 (Check prerequisites)
ENG ELECT: CHE 445/454 or CHE 451 (Check prerequisites)
* See advisor for information on Career, CHE and ADV SCI electives (Check prerequisites)
Prior to Fall 2012, Career Electives were called Approved Electives, see advisor for info.
** ENG Elective: MTE 271 or ECE 320 (Check prerequisites)
*** BIO Elective: CHE 445/454 or CHE 451 (Check prerequisites)
* MA112 pre-req

ALL required CHE classes are subject to the 3-attempt rule.

* Career El (3)
* Career El (3)
* Career El (3)

CHE 254 (4)
CHE 255 (4)
CHE 256 (4)
CHE 354 (3)
CHE 354 (3)
CHE 354 (3)
CHE 319 (2)

HY/ SB (3)
HY/ SB (3)

CHE 324 (3)
CHE 364 (3)
CHE 364 (3)

CHE 381 (3)
CHE 481 (3)
CHE 481 (3)

CHE 345 (3)
CHE 345 (3)
CHE 345 (3)

MA 126 (4)
MA 126 (4)
MA 227 (4)
MA 227 (4)

CHE 320 (4)
CHE 320 (4)

* CHE EL (3)
* CHE EL (3)

*ADV SCI EL(3)

COURSE OFFERING
OPTIONAL COURSES

Summer Only  Fall Only  Spring Only
MA 112 (3)  MA 113 (3)  OR
MA 115 (3)  MA 125 (4)

Corequisite
Prerequisite
Pre-requisite
Offered fall and spring
Senior Standing

ALL courses with a prerequisite are subject to the C- prerequisite rule.
Co-ops would need to be completed in the sophomore year.

*MA112 pre-req

This flow chart requires 7 semesters plus 1 summer to gradu. * Pre-med should also take Biology lab (BSC 115 - 1hr)
CRITERION 6. FACULTY

A. Faculty Qualifications
Describe the qualifications of the faculty and how they are adequate to cover all the curricular areas of the program. This description should include the composition, size, credentials, and experience of the faculty. Complete Table 6-1. Include faculty resumes in Appendix B.

Table 6.1 lists the faculty of the Department and shows that there are 17 tenure-track faculty associated with the department. All of these faculty members have PhDs in Chemical Engineering or a closely related field. Collectively their qualifications are adequate in depth and breadth to cover all the curricular of the program. Three of the 17 are women and one of the men is African American. There are six (6) professors, five (5) associate professors, and six (6) assistant professors. One of the professors, Dr. Wiest is an Associate Dean who is unavailable for teaching. Another, Dr. Weaver is an adjunct professor with primary appointment in the Department of Metallurgical and Materials Engineering and primarily co-advises graduate students rather than teaching undergraduate courses. Also, Dr. Gupta holds a joint appointment with the Department of Chemistry and the Department of Chemical and Biological Engineering and teaches elective and honors courses. The department head was hired this year and Dr. Ritchie was on sabbatical. Faculty resumes are included in Appendix B.

B. Faculty Workload
Complete Table 6-2, Faculty Workload Summary, and describe this information in terms of workload expectations or requirements.

Table 6.2 shows the faculty workload for the 17 faculty listed in Table 6.1. Again, there are sufficient faculty members to cover the existing course organization of the program. Existing expectations for workload are for research active faculty to teach no more than three courses per year and usually this is one course per semester (~25%/semester). These expectations are balanced for number of student credit hours and whether the course is a laboratory course. Service to the program and/or to professional societies is typically expected to be 15%. Research active faculty are expected to contribute more than 30% of their time to scholarly work and graduate student advising.

Some faculty in Table 6.2 had significant service obligations this year. Dr. Brazel chaired the CAC and coordinated the undergraduate program revisions. Dr. Klein focused on the ABET report this year. Dr. Lane was interim department head from May 2012 until Dr. Van Zee arrived January 2, 2013.

C. Faculty Size
Discuss the adequacy of the size of the faculty and describe the extent and quality of faculty involvement in interactions with students, student advising and counseling, university service
activities, professional development, and interactions with industrial and professional practitioners including employers of students.

The size of the faculty is sufficient to cover all of the curricular areas of the program. The Department currently has four unfilled tenure track positions and these positions will be used to lower the student/faculty ratio and provide additional electives for the program. Although the faculty members do not serve as the academic advisor, they provide substantial counseling of the students through service to student organizations.

D. Professional Development
Describe the professional development activities that are available to faculty members.

The University of Alabama offers professional development opportunities to faculty such as:
- HR Learning and Development office (http://hr.ua.edu/train_develop/) provides various regulatory compliance training, tutorials on UA educational delivery systems, and education benefits.
- Continuous Quality Improvement office (http://cqi.ua.edu/) provides training and tutorials on quality improvement and assessment methods.
- Leadership U (http://training.ua.edu/leadershipu) offers training to selected faculty to take leadership roles within the University.

E. Authority and Responsibility of Faculty
Describe the role played by the faculty with respect to their guidance of the program, and in the development and implementation of the processes for the assessment, evaluation, and continuing improvement of the program, including its program educational objectives and student outcomes. Describe the roles of others on campus, e.g., dean or provost, with respect to these areas.

The department faculty is at the center of all decisions regarding the elements of the program. As described earlier, each course must be assessed at the end of each semester on the basis of course reports prepared by the faculty member who taught the course. The course report summarizes the Student Outcome content of the course, and the Curriculum and ABET Committee members are charged with the responsibility of reviewing the reports for completeness and adequate documentation of Outcome content.

There is generally no direct role of the Dean or the Provost in these assessment and governance activities. The Office of Institutional Research, however, will mine University-wide data and produce data reports when requested. Examples are degree program enrollments and degrees offered. OIR is typically quite responsive.
<table>
<thead>
<tr>
<th>Faculty Name</th>
<th>Highest Degree Earned- Field and Year</th>
<th>Rank</th>
<th>Type of Academic Appointment</th>
<th>Years of Experience</th>
<th>Level of Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>David W. Arnold</td>
<td>Ph.D., ChE 1980</td>
<td>P</td>
<td>T</td>
<td>FT</td>
<td>NA</td>
</tr>
<tr>
<td>Yuping Bao</td>
<td>Ph.D., Materials Science and Engineering and Nanotechnology, 2006</td>
<td>AST</td>
<td>T</td>
<td>FT</td>
<td>H M L</td>
</tr>
<tr>
<td>Jason E. Bara</td>
<td>Ph.D., ChE 2007</td>
<td>AST</td>
<td>TT</td>
<td>FT</td>
<td>M M L</td>
</tr>
<tr>
<td>Christopher S. Brazel</td>
<td>Ph.D., ChE 1997</td>
<td>ASC</td>
<td>T</td>
<td>FT</td>
<td>PE-AL M M L</td>
</tr>
<tr>
<td>Eric S. Carlson</td>
<td>Ph.D., ChE 1986</td>
<td>ASC</td>
<td>T</td>
<td>FT</td>
<td>EIT-WY L H L</td>
</tr>
<tr>
<td>Arunava Gupta</td>
<td>Ph.D., Chemical Physics, 1980</td>
<td>P</td>
<td>T</td>
<td>FT</td>
<td>M L L</td>
</tr>
<tr>
<td>Ryan L. Hartman</td>
<td>Ph.D., ChE 2006</td>
<td>AST</td>
<td>TT</td>
<td>FT</td>
<td>M M L</td>
</tr>
<tr>
<td>Yonghyun (John) Kim</td>
<td>Ph.D., ChE 2008</td>
<td>AST</td>
<td>TT</td>
<td>FT</td>
<td>NA M L L</td>
</tr>
<tr>
<td>Tonya M. Klein</td>
<td>Ph.D., ChE 1999</td>
<td>ASC</td>
<td>T</td>
<td>FT</td>
<td>L L L</td>
</tr>
<tr>
<td>Name</td>
<td>Degree, Specialty, Year</td>
<td>Code</td>
<td>Tenure Status</td>
<td>Tenure Track</td>
<td>Full-time</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-------------------------------</td>
<td>------</td>
<td>---------------</td>
<td>--------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Alan M. Lane</td>
<td>Ph.D., ChE, 1984</td>
<td>P</td>
<td>T</td>
<td>FT</td>
<td>5</td>
</tr>
<tr>
<td>Xiaoguang (Margaret) Liu</td>
<td>Ph.D., Chemical and Biomolecular Engineering, 2005</td>
<td>AST</td>
<td>TT</td>
<td>FT</td>
<td>6.5</td>
</tr>
<tr>
<td>Stephen M. C. Ritchie</td>
<td>Ph.D., ChE 2001</td>
<td>ASC</td>
<td>T</td>
<td>FT</td>
<td>1</td>
</tr>
<tr>
<td>C. Heath Turner</td>
<td>Ph.D., ChE, 2002</td>
<td>ASC</td>
<td>T</td>
<td>FT</td>
<td>1</td>
</tr>
<tr>
<td>John W. Van Zee</td>
<td>Ph.D., ChE 1984</td>
<td>P</td>
<td>T</td>
<td>FT</td>
<td>4</td>
</tr>
<tr>
<td>Hung-Ta Wang</td>
<td>Ph.D., ChE 2008</td>
<td>AST</td>
<td>TT</td>
<td>FT</td>
<td>0</td>
</tr>
<tr>
<td>Mark L. Weaver</td>
<td>Ph.D., Materials Science and Engineering, 1995</td>
<td>A</td>
<td>T</td>
<td>FT</td>
<td>1</td>
</tr>
<tr>
<td>John M. Wiest</td>
<td>Ph.D., ChE 1986</td>
<td>P</td>
<td>T</td>
<td>FT</td>
<td>0</td>
</tr>
</tbody>
</table>

Instructions: Complete table for each member of the faculty in the program. Add additional rows or use additional sheets if necessary. Updated information is to be provided at the time of the visit.

1. Code: P = Professor   ASC = Associate Professor   AST = Assistant Professor   I = Instructor   A = Adjunct   O = Other
2. Code: T = Tenured   TT = Tenure Track   NTT = Non Tenure Track
3. Code: FT = Full-time   PT = Part-time   Appointment at the institution.
4. The level of activity (high, medium or low) should reflect an average over the year prior to the visit plus the two previous years.
Table 6-2. Faculty Workload Summary  
Department of Chemical and Biological Engineering

<table>
<thead>
<tr>
<th>Faculty Member (name)</th>
<th>PT or FT</th>
<th>Classes Taught (Course No./Credit Hrs.)</th>
<th>Program Activity Distribution</th>
<th>% of Time Devoted to the Program^1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Term and Year^2</td>
<td>Teaching</td>
<td>Research or Scholarship</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cross-listed 400/500 courses are listed as [45]xx</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fall 2012</td>
<td>Spring 2013</td>
<td></td>
</tr>
<tr>
<td>David W. Arnold</td>
<td>FT</td>
<td>[45]40/3</td>
<td>482/3 482/3</td>
<td>90</td>
</tr>
<tr>
<td>Yuping Bao</td>
<td>FT</td>
<td>[45]18/3</td>
<td>[45]45/3</td>
<td>50</td>
</tr>
<tr>
<td>Jason E. Bara</td>
<td>FT</td>
<td>254/4</td>
<td>254/4 325/1</td>
<td>50</td>
</tr>
<tr>
<td>Christopher S. Brazel</td>
<td>FT</td>
<td>125/1 125/1 306/3</td>
<td>[45]12/3</td>
<td>50</td>
</tr>
<tr>
<td>Eric S. Carlson</td>
<td>FT</td>
<td>324/3 324/3</td>
<td>N/A (Research Buyout)</td>
<td>25</td>
</tr>
<tr>
<td>Arunava Gupta</td>
<td>FT</td>
<td>325/1</td>
<td>N/A (Adjunct/Chemistry)</td>
<td>10</td>
</tr>
<tr>
<td>Ryan L. Hartman</td>
<td>FT</td>
<td>New Faculty Release</td>
<td>354/3</td>
<td>25</td>
</tr>
<tr>
<td>Yonghyun (John) Kim</td>
<td>FT</td>
<td>304/3</td>
<td>New Faculty Release</td>
<td>25</td>
</tr>
<tr>
<td>Tonya M. Klein</td>
<td>FT</td>
<td>255/4 325/1</td>
<td>255/4 255/4</td>
<td>75</td>
</tr>
<tr>
<td>Alan M. Lane</td>
<td>FT</td>
<td>481/3</td>
<td>305/3 319/2 319/2</td>
<td>50</td>
</tr>
<tr>
<td>Xiaoguang (Margaret) Liu</td>
<td>FT</td>
<td>New Faculty Release</td>
<td>319/2 319/2</td>
<td>25</td>
</tr>
<tr>
<td>Stephen M. C. Ritchie</td>
<td>FT</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td>Status</td>
<td>Time Distribution</td>
<td>Effort Distribution</td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>--------</td>
<td>-------------------</td>
<td>--------------------</td>
<td></td>
</tr>
<tr>
<td>C. Heath Turner</td>
<td>FT</td>
<td>304/3 493/3</td>
<td>325/1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>50 35 15 100</td>
<td></td>
</tr>
<tr>
<td>John W. Van Zee</td>
<td>FT</td>
<td>N/A Not Employed by UA</td>
<td>N/A Department Head</td>
<td>0 25 25 Admin. 50</td>
</tr>
<tr>
<td>Hung-Ta Wang</td>
<td>FT</td>
<td>254/4</td>
<td>New Faculty Release</td>
<td>25 60 15 100</td>
</tr>
<tr>
<td>Mark L. Weaver</td>
<td>FT</td>
<td>N/A Adjunct Materials Engineering</td>
<td>N/A Adjunct Materials Engineering</td>
<td>0 5 0 5</td>
</tr>
<tr>
<td>John M. Wiest</td>
<td>FT</td>
<td>N/A Associate Dean</td>
<td>N/A Associate Dean</td>
<td>0 0 0 0</td>
</tr>
</tbody>
</table>

1. FT = Full Time Faculty or PT = Part Time Faculty, at the institution
2. For the academic year for which the self-study is being prepared.
3. Program activity distribution should be in percent of effort in the program and should total 100%.
4. Indicates service to Department or Profession unless specified as sabbatical leave, etc., under "Other."
5. Out of the total time employed at the institution.
CRITERION 7. FACILITIES

In this Facilities section, Criterion 7, we review the adequacy of our classrooms, laboratories, and associated equipment to safely accomplish the program objectives and provide an atmosphere conducive to learning. The picture above is a panoramic view of part of the Science and Engineering green space quad. The building from left to right are: Shelby Hall (Department of Chemistry), Science and Engineering Complex (SEC), and South Engineering Research Center (SERC).

A. Offices, Classrooms and Laboratories

Summarize each of the program’s facilities in terms of their ability to support the attainment of the program educational objectives and student outcomes and to provide an atmosphere conducive to learning.

1. Offices (such as administrative, faculty, clerical, and teaching assistants) and any associated equipment that is typically available there.

Faculty members in the Chemical Engineering program are housed in multiple building: the Bevill Building, South Engineering Research Center (SERC), and Science and Engineering Complex (SEC). Each faculty member has his/her own private office. The department’s main office is located in Houser Hall, in close proximity to the faculty offices. The office space is shared with the Metallurgical Engineering department. The CHBE department head, Dr. John W. Van Zee, and two clerical staff members have offices in Houser Hall.
2. Classrooms and associated equipment that is typically available where the program courses are taught.

The College of Engineering adopted a centralized classroom management system in 2012. The system optimizes room allocation for all programs in the college based on course times, size, and special classroom requirements.

Most CHE classes are taught in one of the new science and engineering buildings (SERC, SEC, Shelby).

3. Laboratory facilities including those containing computers (describe available hardware and software) and the associated tools and equipment that support instruction. Include those facilities used by students in the program even if they are not dedicated to the program and state the times they are available to students. Complete Appendix C containing a listing of the major pieces of equipment used by the program in support of instruction.
B. Computing Resources
Describe any computing resources (workstations, servers, storage, networks including software) in addition to those described in the laboratories in Part A, which are used by the students in the program. Include a discussion of the accessibility of university-wide computing resources available to all students via various locations such as student housing, library, student union, off-campus, etc. State the hours the various computing facilities are open to students. Assess the adequacy of these facilities to support the scholarly and professional activities of the students and faculty in the program.

CoE Computer Labs & Specialty Areas

Open Computer Labs:

<table>
<thead>
<tr>
<th>Location</th>
<th>Capacity</th>
<th>Hours of Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Houser Hall 120</td>
<td>70</td>
<td>Monday-Sunday 8am-10:45pm</td>
</tr>
<tr>
<td>Hardaway 256</td>
<td>30</td>
<td>Monday-Sunday 8am-10:45pm</td>
</tr>
</tbody>
</table>

Specialty Areas:

<table>
<thead>
<tr>
<th>Location</th>
<th>Capacity</th>
<th>Hours of Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>3D Printing Lab</td>
<td>14</td>
<td>Monday-Friday 8am-6pm</td>
</tr>
<tr>
<td>Ideal Lab</td>
<td>30</td>
<td>Monday-Friday 8am-6pm</td>
</tr>
</tbody>
</table>

The College of Engineering (CoE) has open lab times for all engineering students. These labs provide students with computer access for homework, projects and internet access. Engineering specialty areas consist of a state of the art 3D printing lab and Ideal lab that introduces engineering and arts & sciences students to cross functional team’s environments.

C. Guidance
Describe how students in the program are provided appropriate guidance regarding the use of the tools, equipment, computing resources, and laboratories.

Student take on line safety courses relative to laboratory safety. Graduate Teaching Assistants, staff (Mr. James Hill), and faculty provide guidance relative to the use an operation of tools and equipment in the laboratory. Guidance and instruction on the use of
computing resources is provided beginning in CHE 125 and continues in ENGR 103 and well as other courses where specific software and programs are used as detailed in the course syllabi. CHE 320, our summer lab, has extensive hands-on training on the use of tools for the large-scale Unit Operations equipment.

D. Maintenance and Upgrading of Facilities

Describe the policies and procedures for maintaining and upgrading the tools, equipment, computing resources, and laboratories used by students and faculty in the program.

The Departmental policy for upgrading tools and equipment used in the laboratories is to provide a safe environment and encourages learning consistent with the program educational objectives and the student outcomes. Plans for new experiments and the need for upgrading equipment and laboratories are discussed during the annual planning retreat and continually improved prior to allocation of funds. The plans are typically driven by the faculty, and when required request and proposals are submitted to the Dean of the College for funds beyond those available to the Department. Typically the Departments are on a 3-5 year College rotation for significant upgrades to laboratories.

Computing resources have been typically upgraded by the College. New technology and the move to laptops have created opportunities for upgrades away from desktop computing laboratories. These needs are reviewed annually by the department faculty members and College technician support is provided for these upgrades. Plans are being developed for additional wireless access to software. Computing labs as described above have been available and upgrades on a regular basis. New construction will require additional designation of rooms for computing that might be shared across the College. The Rogers Library has a significant number of desktop computers and the existing wireless network allows students to access software used in courses (i.e. Polymath and CHEM CAD).

E. Library Services

Describe and evaluate the capability of the library (or libraries) to serve the program including the adequacy of the library’s technical collection relative to the needs of the program and the faculty, the adequacy of the process by which faculty may request the library to order books or subscriptions, the library’s systems for locating and obtaining electronic information, and any other library services relevant to the needs of the program.

Engineering, technology, and science materials are located in the Rodgers Library for Science and Engineering, a stand-alone facility located near engineering buildings and research facilities. The library was constructed in 1990. The Library offers excellent access to engineering and related information, with few limitations. When materials are not owned locally, interlibrary loan and document delivery systems are used to acquire materials from other libraries and various commercial vendors. Excellent telecommunications and computer facilities, at the national and local levels, enable the library to find and obtain external materials rapidly and
with ease. The library promotes use of the Internet for information searching and delivery of documents to faculty and student desktops.

During the academic year, the library is open 24/5 on weekdays. On weekends, library hours are reduced. During the summer, the library is open seven days a week with some evening hours. Reference service is provided by librarians and paraprofessional staff during the day from 10:00 a.m. to 4:00 p.m. and, during evening hours, from 6:00 p.m. to 8:00 p.m., at the beginning of the week. The book stacks are open all hours of library operation.

Engineering students and faculty receive a full range of reference services. The library provides, on an individual basis, assistance with using resources, computers, and facilities. In addition, librarians conduct in-depth research of information resources upon request. Specialized instruction related to the library is offered in classroom settings on request. Three full-time librarians are assigned to the Science and Engineering Library.

The library's Web site provides access to local holdings, subscriptions, and licensed content using a sophisticated discovery system called Scout. Web-based catalogs of the University of Alabama at Birmingham, Auburn University, Jacksonville State University, the University of South Alabama, and other out-of-state university libraries can be searched as well.

The library subscribes to major science and engineering databases, including Compendex and the Web of Science. Specialized digital libraries from ASME, AIAA, ACM, ASCE, and IEEE are used to probe for additional content. The library also subscribes to other science databases which support engineering instruction and research: INSPEC (physics), MathSciNet (mathematics), GeoRef (geology), and Scifinder Scholar (chemistry). Users access databases of the United States Patent and Trademark Office from the USPTO's Web site. Standards from ANSI, ASHRAE, and other standards organizations are accessed using SAI Global’s Standards Infobase. In addition, Expanded Academic Index, a general purpose database, supports undergraduate students.

The library has extensive collections of technical reports from federal agencies and engineering professional societies. Technical reports from EPA, NASA and other federal agencies are available locally on microfiche and online. Local microfiche libraries published by SAE, SME, and SPE are available as well. A separate map library on campus provides U.S.G.S. topographic maps and a variety of other maps for use by engineering faculty and students.

The library supports the computing and computational needs of engineering students by offering specialized academic software such AutoCAD and SolidWorks. Abundant networked PC and MAC desktop computers and laptops are available. The library also has smart boards, large-screen monitors, and white boards which promote sharing and collaboration among students.

Engineering materials are selected for the library by the joint effort of the engineering faculty and the library faculty. The library has a designated librarian as contact person for each
engineering department. Engineering faculty routinely recommend items for purchase by the library. Librarians take the process a step further by making specific selections after consulting tools such as Gobi, a major book vendor, publishers’ catalogs, and society and commercial Web sites. Publication packages from societies such as ACM, AIAA, ASCE, IEEE, ASME, and SAE are ongoing subscriptions. In addition, individual engineering students often request specific titles for their studies and research.

F. Overall Comments on Facilities
Describe how the program ensures the facilities, tools, and equipment used in the program are safe for their intended purposes (See the 2012-2013 APPM Section II.G.6.b.(1)).

Safety is an attitude and commitment shared by the faculty and staff of the Department. Safety training is required prior to participation in instructional laboratories of the Department. Graduate Teaching Assistants, staff (Mr. James Hill), and faculty provide guidance relative to the safe use and operation of tools and equipment in the laboratory. Hard hat and safety glasses and goggles are used appropriately in the Unit Operations laboratories. Safety is part of the instruction in chemistry laboratories in the curriculum of the program.

Instruction in safety is required prior to use of equipment in the College machine shop.

The University has new initiatives for safety that included online safety training. All students working in research labs are required to pass these classes. The Department Head has attended workshops in an effort to understand new initiatives by the Council Chemical Research. Annual assessment of safety instruction in the laboratories has become a priority of the new Department Head.

As discussed elsewhere, we have changed our program to include safety as a required course (CHE 482). It is expected that change will initiate an enhanced awareness of safety. Also the equivalent of one hour of safety topics will dispersed throughout the lectures in our freshman CHE 125 course.
CRITERION 8. INSTITUTIONAL SUPPORT

A. Leadership

Describe the leadership of the program and discuss its adequacy to ensure the quality and continuity of the program and how the leadership is involved in decisions that affect the program.

The program is lead, academically and scholarly, by the Head of the Department of Chemical and Biological Engineering. This individual is entitled to half-time release from teaching during the academic year and half-time support during the three months of summer for this service. This individual is responsible for the administration of the BS, as well as the MS, and PhD programs in the Department. This individual is responsible for the administration of the departmental budget and provides supervision for secretarial, clerical, and other professional and non-professional staff of the department.

The current Department Head joined UA in January 2013. Prior to joining UA the current Department Head was a professor in the Department of Chemical Engineering at the University of South Carolina and the Director of the National Science Foundation’s Center for Fuel Cells. Prior to January 2013 and since the previous report, the Department Head position was filled with either a faculty member from the Department or through joint appointments of heads from other departments in the College. The process through which the departmental leadership is accessed (to be adequate to ensure quality and continuity of the program) involves annual evaluations of the Department Head by the Dean of the College.

The Department Head reports directly to the Dean of the College of Engineering. The Dean interacts with the Department Head at regularly scheduled weekly meetings. In addition, the Dean regularly interacts with all departments through the Dean’s Advisory Council (DAC). This group, composed of the Dean and Associate Deans and seven Department Heads, meets weekly to discuss issues related to both programs in the College and the College as a whole. Decisions, at the college level, that affect the quality and continuity of the program are made by the Dean.

Decisions, at the departmental level, that affect the continuity and quality of the program are made through a consensus process: (1) recommendations from departmental committees and advisory board committees are voted upon at departmental and advisory board meetings, (2) those votes are considered by the Department Head, and when appropriate and necessary in consultation with the Dean of the College and other parts of the College administration, (3) the decision is made by the Department Head, and (4) the path for implementation of the decision is communicated to all parties. For matters of curriculum, the process and recommendations are typically initiated by the Curriculum Advisory Committee (CAC) of the Department, as described elsewhere in this document.
B. Program Budget and Financial Support

1. Describe the process used to establish the program’s budget and provide evidence of continuity of institutional support for the program. Include the sources of financial support including both permanent (recurring) and temporary (one-time) funds.

All full-time faculty and staff salaries are paid by the University and are not included in the description of departmental funding sources below. The Department has six primary recurring sources of funding, described below. In addition, the College has and will provide temporary (one-time) funds to the Department depending on needs and initiatives. The six sources are:

a. **State operating budget** – this budget is designed for basic operating expenses that the department encounters during the fiscal year. The College distributes this budget annually based on a long-standing formula that is based on enrollment and productivity. The Department received approximately $25,000 in the past year from this budget. This amount has increased according to university budget during the current self-study report period.

b. **Graduate Teaching Assistant budget** – this budget provides the funding for graduate teaching assistants (GTAs) in the program and includes tuition and health insurance. As with the state operating budget, the College distributes this funding annually. The Department receives funds for at least 11 graduate students annually. This budget is supplemented by the Department with research overhead and gift funds to achieve regionally competitive graduate student stipends that are equal to the standardized departmental stipend that is budgeted in research grants and contracts.

c. **Lab Fee (equipment) budget** – this budget provides funding for basic hardware used within the Department. It comes from lab fees ($10 per credit hour) that students in the college pay for their courses and is distributed by the College on an annual basis. The Department normally receives approximately $12,000 annually from this budget.

d. **Academic year release money** – this money comes from departmental faculty with active research contracts and grants. Part of their contract/grant includes funding for the faculty member during the academic year. The portion of their salary paid by the contract/grant is then returned to the Department. The Department generated approximately $27,000 in the past year in academic year release money.

e. **Research overhead** – this money comes from the grants and contracts in operation within the Department. Ten percent of the overhead charged to all contracts/grants is returned to the Department, and another ten percent is returned to the individual faculty member engaged in the contract/grant. The Department and its faculty received a total of about $56,000 in the past year from research overhead.

f. **Gift funds** - this is money received in charitable gifts to the Department. The Department received about $98,000 in gifts annually over the past six years.
2. Describe how teaching is supported by the institution in terms of graders, teaching assistants, teaching workshops, etc.

Teaching is supported financially by the institution through the College in the form of budgets for GTAs which are supplemented by the Department described above. The Graduate School provides a two day training course for teaching assistants prior to the first day of fall classes. After this Graduate School course, the Department Head conducts a training seminar on procedures for effective grading. The College allows the Department to set a departmental policy which specifies that, as part of their graduate education, all graduate students who receive stipends will support of the teaching mission of the department through grading and laboratory supervision for every semester except their last. This distribution of grading and teaching assistant responsibilities across the graduate student population effectively decreases the hours devoted to teaching in any one semester by approximately half (to 10 h/week), increases the time for the student to perform research in any one semester, and provides a better learning environment by balancing time requirements for the graduate student to effectively communicate with undergraduate students. Note that the goal of the department is to teach PhD and MS students how to communicate and this teaching support is part of that goal, regardless of their long-term plans to pursue an academic career.

The College and the Department have shared expenses for undergraduate student graders to supplement the grading Department’s expenditures for several large enrollment courses. This occurs on a course by course and semester by semester basis. These undergraduate graders receive instruction on grading from the professor of record and thorough the seminar on procedures for effective grading. The Department also funds faculty attendance at teaching workshops.

3. To the extent not described above, describe how resources are provided to acquire, maintain, and upgrade the infrastructures, facilities, and equipment used in the program.

The funding sources identified above are sufficient for the operation of the BS CHE program. Laboratory supplies are purchased with lab fee funds or with funds from gifts. Funds for repairs or acquisition of equipment greater than $10,000 are typically shared with the College.

4. Assess the adequacy of the resources described in this section with respect to the students in the program being able to attain the student outcomes.

The six sources of funding identified above are sufficient to ensure that students in our undergraduate program are able to attain the identified student outcomes. Specifically the budgets in items a-c are adequate for attainment and items d-f are used to enhance the educational experience. For example, the funds in items d-f are used to supplement student expenditures for travel to conferences of the regional and national student chapters of the AIChE. The Department also supplements student expenditures for annual travel of the Society for Biomedical Engineering to Centennial Medical Center in Nashville, Tennessee,
where the students interact with alumni in the medical profession who use Di Vinci type robots to aid surgical procedures.

C. Staffing
Describe the adequacy of the staff (administrative, instructional, and technical) and institutional services provided to the program. Discuss methods used to retain and train staff.

The College funds two administrative staff positions in the Department of Chemical and Biological Engineering: a departmental administrative assistant (Mrs. Inge Archer) and an academic support secretary (Mrs. Susan Noble). They are responsible for usual tasks associated with processing the appropriate budget and requisition forms for departmental operations, classroom scheduling, course support, and purchasing. Instructional staff, other than tenure track faculty, are not used regularly. Occasionally an adjunct is hired to meet teaching duties of faculty on sabbatical or with heavy research course buyout. The College provides staff technicians through a work request system for addressing various educational and research needs, such as fixing software and hardware problems for all departmental and college computers, repairing lab equipment, moving and reinstalling equipment and furniture, and performing minor facility repairs. Mr. James Hill has primary responsibilities with the Department and provides general maintenance and support in the Unit Operations laboratory. All of these support staff are adequate for the maintenance of our BS CHE program.

To train staff, the University provides extensive training workshops on health and safety issues, purchasing and bid procedures, use of student records management systems, maintenance of course inventories, contract and grant accounting, use of MS Office and many other software packages, prevention of sexual harassment, child welfare, etc. Safety training and control of chemicals has seen new initiatives by the University this last year and it is expected that the Department will develop additional plans for safety certification. The Department staff members and faculty, when appropriate classes are offered, are strongly encouraged to attend these workshops, and any costs of training are covered by the Department. Graduate students are trained as described above for the teaching mission. Safety training monitored by the University is required annually according to the instrumentation and type of chemicals in the specific laboratory.

To retain staff, the University offers staff members locally competitive salaries and excellent benefits including one sick day per month, health insurance, generous vacation allowance, membership in the Alabama Teacher Retirement System (mandatory employee contribution of 7.5 percent of earnings with pension benefit of 2.0125 percent of average annual earnings of the three best years per year of service), optional participation in 403.b plans, discounted athletic event tickets, and one-half coverage of UA tuition for UA employee spouse and children. Furthermore, it is the policy of the current and past department heads to maintain a pleasant workplace and a family friendly environment.
D. Faculty Hiring and Retention

1. Describe the process for hiring of new faculty.

Faculty recruitment is a departmental activity. It is initiated after the Dean of the College informs the Head of approval for a position. The process involves the establishment of a search committee, consisting of multiple faculty members within the department. This search committee drafts an advertisement, recruits nationally, and provides an initial screening of the applicants. Once a short list of candidates is identified, the search committee presents this information to the departmental faculty as a whole. Each faculty member has the prerogative to view the entire applicant pool. Discussions of the short list and pool lead to a shorter list for which telephone interviews are conducted. The Dean is informed of the progress by the Head at regular intervals.

Upon the Dean’s approval and that of the Office of Academic Affairs, after the telephone interviews, candidates are then brought to campus for interviews. The committee and the Department Head arrange for the interviews to include faculty from outside the department (an outside the College) with expertise that may be useful for collaborations.

Once the interviews are complete, the faculty makes their recommendations to the Department Head who then consults with the Dean regarding hiring. Assuming the identified candidate is acceptable and upon approval by the Dean and the Office of Academic Affairs, he/she is then contacted and an offer is negotiated by the Department Head. The offer will include information regarding salary, the tenure process and start-up benefits provided to the candidate. The letter is signed by the Dean.

2. Describe strategies used to retain current qualified faculty.

The institution is committed to the success and retention of its faculty. A complete description of benefits provided to faculty members can be found on the Human Resources web site at http://hr.ua.edu. In the Department the strategies include discussions with the Dean for negotiation of counter offers for faculty considering moving to other institutions and these counter offers may include adjustments to salary, additional expenditures for research equipment and support (i.e., a second start-up package).

For all faculty members there is an effort to provide an environment conducive to scholarly and professional development. This includes adequate office and research laboratories and sufficient support of the educational responsibilities of the faculty. These include:

- Teaching loads that are significantly lower than what is defined in the Faculty Handbook. The Faculty Handbook defines the standard teaching load as a 4-and-4 load (four courses per semester). The Department offer new faculty a 1-and 0 teaching load the first two semesters and a 1-and-1 teaching load until tenure is achieved. For a research-active tenured faculty member, a 1- and -1 load has been the norm for the last years. The Department will reconsider this load as enrollments increase in the next few years. The maximum teaching load has been 3-and-3 for non-research active-faculty.
The offer of graduate research assistants to new faculty members and the offer of bridge funding through a loan by the Department to facilitate continuity of research programs for research active faculty.

Support for the instruction of their courses. Graduate teaching assistants are used in all courses and undergraduate graders are hired by the Department to assure that all large classes are sufficiently staffed.

An automatic ten percent raise for each promotion. Both promotion from Assistant to Associate and promotion from Associate to Full Professor give the faculty member a ten percent raise.

A retirement system that matches 403b contributions up to five percent and also includes the mandatory Alabama Teacher Retirement System pension plan described under the Staffing section above.

Health insurance through Blue Cross/Blue Shield of Alabama and other benefits described under the Staffing section above, except that faculty do not receive sick days but are paid for rather extensive periods of illness.

E. Support of Faculty Professional Development

Describe the adequacy of support for faculty professional development and how activities such as sabbaticals, travel, workshops, seminars, etc., are planned and supported.

As a research institution, it is expected that all faculty in the program are research-active. Given this, we expect our faculty to be actively engaged in their research community—this includes travel for conference/workshop presentations, publications in archival journals, direction of graduate students, and leadership within the research community. This research activity does not exclude the goals of developing and maintaining excellence in teaching. Thus, travel and attendance at teaching workshops are also encouraged and supported. As with the departmental staff, the College and University provide faculty members with extensive training on health and laboratory safety, prevention of sexual harassment, child welfare, etc.

Faculty members are eligible for sabbatical every seven years. For example, Dr. Steven Ritchie took a sabbatical leave for the 2012-2013 academic year and Dr. Christopher Brazel took a sabbatical in the 2011-2012 academic year. While the number of sabbaticals taken or awarded has not been large in the Department, there is a renewed emphasis by the new Head to use these as opportunities to rekindle or enhance in the research activities of the tenured faculty in the Department.

Department gift funds are used to promote travel by faculty who do not have sufficient overhead funds. The UA Office for Research generously funds faculty travel to funding agencies, particularly for untenured faculty members. Most faculty members take multiple trips each year. Additional trips are funded by either departmental funds or contract and grant or overhead funds. In addition, EPSCoR and College and University travel funds are available for travel to NSF and DOE laboratories for the purpose of proposal generation. All new faculty members are promised departmental funding for travel. Departmental funding for faculty and student travel is negotiated with the Department Head on a case-by-case basis. The majority of travel requests are fully- or partially-funded by the Department.
PROGRAM CRITERIA
Describe how the program satisfies any applicable program criteria. If already covered elsewhere in the self-study report, provide appropriate references.

Excerpted from: Criteria for Accrediting Engineering Programs, 2013 - 2014
Lead Society: American Institute of Chemical Engineers

1. Curriculum

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.

The Chemical and Biological Engineering program curriculum provides a thorough grounding in the basic sciences in that it requires 16 hours of chemistry, 8 hours of physics, and 3 hours of basic biology with an additional 3 hours of a biology elective that is satisfied using either CHE 445 “Introduction to Biochemical Engineering”, or CH 461 “Biochemistry I”. Design, analysis and control of chemical, physical, and/or biological processes and the hazards associated with these processes are treated throughout the curriculum via core chemical engineering courses as detailed in section 5 of this document.
APPENDIX A. COURSE SYLLABI

Course syllabi are provided for all courses offered during the 2012-2013 academic year. These courses are outlined in the table below:

<table>
<thead>
<tr>
<th>100-level</th>
<th>200-level</th>
<th>300-level</th>
<th>400-level</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHE 125</td>
<td>CHE 254</td>
<td>CHE 304</td>
<td>CHE 412</td>
</tr>
<tr>
<td></td>
<td>CHE 255</td>
<td>CHE 305</td>
<td>CHE 418</td>
</tr>
<tr>
<td>BSC 114</td>
<td></td>
<td>CHE 306</td>
<td>CHE 440</td>
</tr>
<tr>
<td>CH 102</td>
<td>CH 231</td>
<td>CHE 319</td>
<td>CHE 445</td>
</tr>
<tr>
<td>ENGR 103</td>
<td>CH 232</td>
<td>CHE 320</td>
<td>CHE 481</td>
</tr>
<tr>
<td>ENGR 111</td>
<td>CH 237</td>
<td>CHE 324</td>
<td>CHE 482</td>
</tr>
<tr>
<td>ENGR 131</td>
<td>MATH 227</td>
<td>CHE 354</td>
<td>CHE 493</td>
</tr>
<tr>
<td>ENGR 151</td>
<td>MATH 238</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATH 125</td>
<td>MTE 271</td>
<td>ECE 320</td>
<td></td>
</tr>
<tr>
<td>MATH 126</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PH 105</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PH 106</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: With respect to the ENGR courses (common first year engineering courses), ENGR 131/141/151 (three 1-hour credit courses) that were offered in 2012-2013 are being replaced by ENGR 103 (one 3-hour credit course) effective Fall 2013.
CHE 125 – Introduction to Chemical Engineering

1. **Course Number/Name:** CHE 125 – Introduction to Chemical Engineering

2. **Credits/Contact Hours:** 1 credit hour

3. **Instructor:** Christopher Brazel

4. **Textbook:** No book is used.
   a. **Supplemental Materials:** The only requirement is the purchase of a TurningPoint response device for interactive presentations during class.

5. **Specific Course Information**
   a. **Catalog Description:** An introduction to the chemical engineering profession, its history, and its career-enabling potential. The course contains selected topics, plant visits and alumni seminars covering the full range of career opportunities from emerging areas (nanotechnology, biochemical, multifunctional materials) to those found in the more traditional positions within the chemical, petrochemical and petroleum industries.

   b. **Prerequisites:** None

   c. **Course Role:** CHE 125 is a required course for all chemical engineering majors.

6. **Specific Course Goals**
   a. **Specific Outcomes of Instruction:**
      - This course is designed to introduce freshman-level chemical engineering students to the basic concepts of the core chemical engineering courses: material and energy balances, thermodynamics, fluid dynamics, separations, unit operations, transport phenomena, heat transfer, reaction engineering and process control. Students should understand basic concepts related to the core ChE curriculum.
      - This course provides information about the curriculum requirements and opportunities that students can explore both within and outside the ChE major (including co-op, internships, participating in student organizations, and undergraduate research). Students should understand the curriculum requirements of ChE at UA.
      - ChE 125 is designed to inform students of the types of problems that Chemical engineers solve and aid in selection of a major in the freshman year.

   b. **Student Outcomes Addressed by the Course:** ChE 125 maps to the following outcomes:
10. Understand the impact of engineering solutions in a global, environmental, and societal context
11. Recognize the need for, and to engage in, life-long learning
12. Appreciate how their profession interacts with contemporary issues
   It includes a survey to assess the students’ ability to understand contemporary issues.

7. **Course Topics**
   - ChBE-related career paths
   - Continuous processing
   - Opportunities beyond the classroom: co-op, internships, professional societies, etc.
   - Introduction to Material & Energy balances
   - Introduction to Thermodynamics
   - The ChBE Curriculum: required courses, advising, electives
   - Introduction to Fluid Dynamics and Transport Phenomena
   - Introduction to Separation Processes and Unit Operations
   - Introduction to Heat Transfer
   - Introduction to Reaction Engineering and Biochemical Engineering
   - Introduction to Process and Quality Control in Processing
CHE 254 Chemical Engineering Calculations

1. **Course Number/Name:** CHE 254 – Chemical Engineering Calculations

2. **Credits/Contact Hours:** 4 credit hours

3. **Instructor:** Jason E. Bara

   a. **Supplemental Materials:** None

5. **Specific Course Information**
   a. **Catalog Description:** Study of physical and chemical processes and chemical reactions; material and energy balance calculations for single and multi-phase reacting systems; simultaneous energy and material balances.
   d. **Prerequisites:** CH 101/117 and MATH 125/145
   e. **Course Role:** CHE 254 is a required course for all chemical engineering majors.

6. **Specific Course Goals**
   a. **Specific Outcomes of Instruction:**
      - This course will prepare students to formulate and solve material and energy balances on chemical process systems. It lays the foundation for subsequent courses including thermodynamics (255) and it prepares students in applying the learned concepts in such courses as fluid flow (304), separations (305), heat transfer (306), reactor design (354), transport phenomena (324), the capstone design sequence (481, 482), process dynamics and control (493) and basic (319) and unit operations (320) laboratories. In fact, most of the technical problems encountered after graduation will begin with the application of the fundamental principles learned in this course. More specifically, this course will emphasize the following:
        o Break down a process into its components
        o Establish relationships between known and unknown process variables
        o Assemble the information needed to solve for the unknowns
        o Obtain the solution using appropriate computational methods
      - By the end of the course, students will be able to:
        o Make basic engineering calculations
        o Determine mass and energy quantities within specific processes
        o Analyze complex reacting and multiphase/multicomponent systems
        o Perform a number of calculations rooted in physical chemistry and thermodynamics
o Apply computer applications to problems that have multiple solutions

b. Student Outcomes Addressed by the Course:
   This course imparts knowledge on:
   - Outcome 8(a) - Analyze and control physical, chemical, and biological processes as demonstrated by a working knowledge of material balances applied to chemical processes
   - Outcome 8(b) - Analyze and control physical, chemical, and biological processes as demonstrated by a working knowledge of energy balances applied to chemical processes

7. Course Topics
   - Learning/teaching types, MBTI, Elements of Teaming/Cooperative Learning
   - Units and dimensions
   - Mathematical analysis of process data
   - Basic process variables
   - Fundamentals of material balances
   - Applications of material balance concepts to reactive systems
   - Single phase systems – ideal and real gases
   - Multiphase/multicomponent systems – equilibrium processes
   - General energy balances for open and closed systems
   - Non-steady state material balances
   - Hour exams/final exam
CHE 255 – Chemical Engineering Thermodynamics

1. **Course Number/Name:** CHE 255 – Chemical Engineering Thermodynamics

2. **Credits/Contact Hours:** 4 credit hours

3. **Instructor:** Tonya M. Klein

   a. **Supplemental Materials:** None

5. **Specific Course Information**
   a. **Catalog Description:** Chemical calculations using the first and second laws of thermodynamics, including chemical and phase equilibria, multiphase reacting systems, steady-state and non-steady-state material and energy balances. Computer proficiency is required for a passing grade in this course.
   b. **Prerequisites:** CHE 254, MATH 126
   c. **Course Role:** CHE 255 is a required course for all chemical engineering majors.

6. **Specific Course Goals**
   a. **Specific Outcomes of Instruction:** This course is designed to introduce chemical engineering students to the basic principles and logical structure of thermodynamics, to provide them with a basis for the application of thermodynamic principles to real systems, and to allow them to develop a detailed understanding of the application of thermodynamic principles for the analysis of phase and reaction equilibria.
   b. **Student Outcomes Addressed by the Course:** CHE 255 addresses student learning outcome 8(c): Analyze and control physical, chemical, and biological processes as demonstrated by a working knowledge of thermodynamics.

7. **Course Topics**
   - Basic definitions for energy, work, heat, and state functions
   - First Law applied to single component, single phase systems
   - Equations of State for pure substances
   - Latent heat and heats of reaction
   - First Law applied to reacting and multiphase systems
   - Entropy and the 2nd law including cyclic processes
   - Proper interrelation, residual properties, and generalized correlations
   - Solution thermodynamics (fugacity, activity, excess Gibbs free energy)
- Solution models
- Vapor-Liquid Equilibrium, Vapor-Liquid-Liquid and Liquid-Liquid Equilibrium
- Reaction Equilibrium
- Multiple Reaction Equilibrium
- Multiphase Reactions
CHE 304 - Fluid Flow Operations

1. **Course Number/Name:** CHE 304 – Fluid Flow Operations

2. **Credits/Contact Hours:** 3 credit hours

3. **Instructor:** C. Heath Turner

   
   a. **Supplemental Materials:**

5. **Specific Course Information**
   
   a. **Catalog Description:** Equations of momentum and energy transport and their applications to the analysis of fluid process behavior, filtration, fluidization and metering of fluids.
   
   b. **Prerequisites:** CHE 254 (co-requisite), MA 126/146, minimum grade of C-
   
   c. **Course Role:** CHE 304 is a required course for all chemical engineering majors.

6. **Specific Course Goals**
   
   a. **Specific Outcomes of Instruction:** Upon completion of this course, students will be able to:
      - apply the mechanical energy balance to macroscopic flow problems
      - understand physical properties related to dimensionless groups
      - identify and calculate frictional losses in flow systems
      - describe how a pump operates
      - use a pump curve to size a pump for a given flow scheme
      - describe different types of flow meters, and the principles on which each is based
      - appreciate the complexity of flow of compressible fluids, and distinguish when compressible fluids can and cannot be approximated using incompressible flow equations
      - define shear stress, shear rate, and absolute viscosity and identify common classes of fluids (e.g. Newtonian, Bingham plastic, pseudoplastic, dilatant)
• use the extended Bernoulli equation and macroscopic energy balance to evaluate frictional factor and pressure drop and size common fluid flow devices (e.g. pumps, piping, valves)

b. **Student Outcomes Addressed by the Course:** This course meets program outcome 7:

7. Use the techniques, skills, and modern engineering tools necessary for engineering practice.

7. **Course Topics**

- Pressure Forces and Measurement
- Viscosity and Turbulence
- Steady-State and Unsteady-State Mass Balances
- The Energy Balance and Work
- Bernoulli’s Equation and Mechanical Energy Balance
- The Momentum Balance and Shell Momentum Balance
- Laminar and Turbulent Flow, Fluid Friction and Piping
- Compressible Flow
- Fluid Flow Around Objects
- Pumps, Compressors, Engines, Turbines, and Measuring Devices
- The Navier-Stokes Equations & Continuity
- Boundary Layer Flow and Dimensional Analysis
CHE 305 – Separation Processes

1. **Course Number/Name:** CHE 305 – Separation Processes

2. **Credits/Contact Hours:** 3 credit hours

3. **Instructor:** Dr. Alan M. Lane

   
   **a. Supplemental Materials:**

5. **Specific Course Information**
   
   **a. Catalog Description:** Unified approach to the basic calculations and fundamental concepts involved in the design of equilibrium-stage separations processes and continuous contacting equipment. Computer proficiency is required for a passing grade in this course.

   **b. Prerequisites:** CHE 255

   **c. Course Role:** CHE 305 is a required course for all chemical engineering majors.

6. **Specific Course Goals**

   **a. Specific Outcomes of Instruction:** This course is designed to provide Chemical Engineering students with design and analysis skills applied to separations processes. Material balances, energy balances and equilibrium relationships are applied to equilibrium-staged and continuous contacting equipment. It incorporates teamwork and cooperative learning methods, and as a core “C” course, emphasizes computational methods involving spreadsheets and the ChemCAD process simulator.

   **b. Student Outcomes Addressed by the Course:** This course meets program outcome 8(f):

   8(f) Analyze and control physical, chemical, and biological processes as demonstrated by a working knowledge of separations.
7. Course Topics

- Global view of separation processes
- Phase equilibrium (review)
- Single equilibrium stages (vapor-liquid, gas-liquid, liquid-liquid)
- Absorption and Stripping (graphic, algebraic and rate-based methods, tray and packed column design)
- Distillation (graphic, algebraic and rate-based methods, process simulation with ChemCAD)
- Extraction (graphical methods)
- Multicomponent distillation
- Advanced topics
- Hour exams
CHE 306 – Heat Transfer Operations

1. **Course Number/Name:** CHE 306 – Heat Transfer Operations

2. **Credits/Contact Hours:** 3 credit hours

3. **Instructor:** Christopher Brazel

   

5. **Specific Course Information**
   
a. **Catalog Description:** Study of heat transfer and its application in the design of specific processes and process equipment.

   b. **Prerequisites:** CHE 255; Co-requisite: CHE 304. Prerequisite topics: working knowledge of thermodynamics and basic fluid flow

   c. **Course Role:** CHE 306 is a required course for all chemical engineering majors.

6. **Specific Course Goals**
   
a. **Specific Outcomes of Instruction:**
      
      - Students should be able to identify the type(s) of heat transfer involved in processes.
      - They should be able to identify heat transfer rates in steady state processes involving combinations of conduction, convection and radiation, and be able to solve problems in multiple geometries.
      - Students should be able to work elementary problems of 2-dimensional heat conduction.
      - Students should understand the time-dependent heat transfer and analysis involving the Biot number.
      - Students should be able to identify the proper correlations for convection problems for external and internal flow, forced and free convection, and those that involve phase change, and apply Newton’s Law of Cooling to solve relevant problems.
      - They should be able to apply the Stefan-Boltzmann equation to solve radiation problems.
They should understand the concept of thermal resistance in composite materials and be able to evaluate the overall heat transfer coefficient for heat exchangers.

Students should be familiar with common heat transfer equipment, and be able to solve both design and retrofit problems.

a. **Student Outcomes Addressed by the Course:** ChE 306 maps to the following program outcome:

5. Identify, formulate, and solve engineering problems

   It includes a rubric-based evaluation of student abilities to solve problems.

7. **Course Topics**

   - Overview of heat transfer operations in the chemical process industries
   - Heat transfer by conduction
   - 1-dimensional steady-state in Cartesian, cylindrical and spherical geometries
   - Composite materials and overall heat transfer coefficients
   - 2-dimensional steady state heat transfer
   - Unsteady-state
   - Heat transfer by convection
   - Boundary layers and thermal entry lengths
   - Forced Convection
   - Free Convection
   - Boiling and Condensation
   - Analysis and design of heat exchangers
   - Concentric pipe heat exchangers, shell-and-tube heat exchangers
   - Extended-surface heat exchangers, heat transfer in agitated vessels
   - Analogy between heat and momentum transfer
   - Heat transfer by thermal radiation
   - Evaporators and unit operations involving heat transfer
CHE 319 - Basic Chemical Engineering Laboratory

1. **Course Number/Name:** CHE 319 – Basic Chemical Engineering Laboratory

2. **Credits/Contact Hours:** 2 credit hours

3. **Instructor:** Dr. Margaret Liu

   - **Supplemental Materials:** None

5. **Specific Course Information**
   - **Catalog Description:** Basic chemical engineering measurements and calculations: temperature, pressure, thermal transport rates, fluid flow rates and energy losses, material properties, and specifications.
   - **Prerequisites:** CHE 255 “Chemical Engineering Thermodynamics”
   - **Course Role:** CHE 319 is a required course for all chemical engineering majors.

6. **Specific Course Goals**
   - **Specific Outcomes of Instruction:**
     - Design a meaningful experiment given a general problem statement
     - Perform laboratory experiments safely and efficiently
     - Analyze data using appropriate equations and statistical treatment
     - Write reports in an effective technical style
     - Work in a multidisciplinary team
   - **Student Outcomes Addressed by the Course:** ABET accreditation requires that all Chemical Engineering graduates possess specific attributes. As assessed in this course, students will possess:
     - 2(a) The ability to design and conduct experiments (rubric based grading)
     - 2(b) A working knowledge of modern experimental techniques (rubric based grading)
     - 6(a) Communicate effectively in writing

7. **Course Topics**
   - Teamwork
   - Technical writing
   - Laboratory safety
   - Basic process measurements
   - Transport processes
   - Basic statistics and experimental design
CHE 320 - Operations Laboratory

1. **Course Number/Name:** CHE 320 – Operations Laboratory

2. **Credits/Contact Hours:** 4 credit hours

3. **Instructor:** Dr. David Arnold, Dr. Alan Lane, Dr. Eric Carlson

4. **Textbook:** The students are allowed to use all their sophomore and junior level texts and are encouraged to use the Science and Engineering Library.
   
   a. **Supplemental Materials:** None

5. **Specific Course Information**
   
   a. **Catalog Description:** Operations of chemical engineering. Course includes problems and reports based on performance tests. Writing proficiency within this discipline is required for a passing grade in this course.
   
   b. **Prerequisites:** CHE 305, CHE 306, CHE 319
   
   c. **Course Role:** CHE 320 is a required course for all chemical engineering majors.

6. **Specific Course Goals**
   
   a. **Specific Outcomes of Instruction:**
      
      • Design and conduct experiments
      • Analyze and interpret data
      • Operating large CPI equipment
      • Trouble shooting CPI equipment
      • Technical presentations
      • Technical writing

   b. **Student Outcomes Addressed by the Course:** This course meets program outcomes:
      
      2(a) Operate in a laboratory environment and specifically be able to design and conduct experiments
      2(b) Operate in a laboratory environment and specifically be able to analyze and interpret experimental data
      4. Function on multi-disciplinary teams
      6(a). Communicate effectively in writing
      6(b). Communicate effectively verbally

7. **Course Topics**
   
   NOTE: NEW EXPERIMENTS ARE ADDED EVERY SUMMER
   
   • Distillation (one week)
• Evaporation (one week)
• Pneumatic transport (one week)
• Heat transfer (one week)
• Chemical reactions (one week)
CHE 324 – Transport Phenomena

1. **Course Number/Name:** CHE 324 – Transport Phenomena

2. **Credits/Contact Hours:** 3 credit hours

3. **Instructor:** Dr. Eric Carlson

4. **Textbook:** No text, but many course notes.

   a. **Supplemental Materials:** Problem sets from Braided Logix, Inc (at http://bama.braidedlogix.com)

5. **Specific Course Information**

   a. **Catalog Description:** Development of the conservation equations for mass, momentum and energy with application to steady-state and transient chemical processes. Computer proficiency is required for a passing grade in this course.

   b. **Prerequisites:** CHE 255, MATH 238

   c. **Course Role:** CHE 324 is a required course for all chemical engineering majors.

6. **Specific Course Goals**

   a. **Specific Outcomes of Instruction:**
      - This course introduces the fundamental principles of fluid flow, heat, and mass transfer with scripting.
      - There are three main objectives for this course. The first is to gain scripting proficiency in the numerical Python programming framework. The second is to gain an understanding of the similarities between mathematical descriptions of heat, mass, and momentum processes, an appreciation of the interdependence of these processes, and to gain insights about the spatial variation of transport properties in various spatial geometries. The third objective is to bestow upon the students the ability to give qualitative descriptions of more complicated transport phenomena problems. This will be achieved by using computational methods. The software that is used allows the student to solve more complicated, real-world problems that couple fluid flow with mass or energy transport.

   b. **Student Outcomes Addressed by the Course:** This course meets program outcome 8(d):

      8(d). Analyze and control physical, chemical, and biological processes as demonstrated by a working knowledge of transport phenomena.
7. **Course Topics**

- Python software installation and usage, scripting overview, functions
- Function plotting, min/max, inverses, integration, differentiation
- Polynomial/spline fitting of tables, linear systems, numerical ODE solution
- Fick’s, Fourier’s, and Darcy’s Laws, unit conversions
- One-Dimensional, steady-state transport with no sources
- Quasi-one dimensional systems with complex spatial and nonlinear dependencies
- Convective heat transfer, heat transfer with sources
- General one-dimensional boundary value problems, Q-transform, shooting methods
- Spatial behavior in heat exchangers
- General PDE’s for fluid flow in various geometries
- Univariate laminar flow for various geometries
- Turbulence, turbulent pipe flow, pipe networks
- Unsteady-state conductive heat transfer
- Convective-diffusive transport, combined momentum, energy, and mass transfer
- Data modeling and general curve fitting with Python, engineering diagnostics
CHE 354 - Chemical Reactor Design

1. **Course Number/Name:** CHE 354 - Chemical Reactor Design

2. **Credits/Contact Hours:** 3 credit hours

3. **Instructor:** Dr. Ryan Hartman

   
   a. **Supplemental Materials:** None

5. **Specific Course Information**
   
   a. **Catalog Description:** Reaction rate equations and comparisons with experimental data; use of rate information for the design of chemical reactors.
   
   b. **Prerequisites:** ChE 255 and MA 238
   
   c. **Course Role:** CHE 354 is a required course for all chemical engineering majors.

6. **Specific Course Goals**
   
   a. **Specific Outcomes of Instruction:**
      1) Impart an understanding of chemical kinetics and its application to reaction engineering.
      2) Develop an understanding of the design of chemical reactors.
      3) Use kinetic and reactor concepts to design chemical reactors
   
   b. **Student Outcomes Addressed by the Course:** This course meets program outcome 8(e):
      8(e). Analyze and control physical, chemical, and biological processes as demonstrated by a working knowledge of reaction engineering.

7. **Course Topics**
   
   - Mole balances
   - Conversion and reactor staging
   - Rate laws and stoichiometry
   - Isothermal reactor design
   - Analysis of rate data
   - Multiple reactions
   - Enzyme kinetics, inhibition, bioreactors
   - Steady-state non-isothermal reactor design
   - Heat effects
   - Catalysis
CHE 412/512 – Polymer Materials Engineering

1. **Course Number/Name:** CHE 412 – Polymer Materials Engineering

2. **Credits/Contact Hours:** 3 credit hours

3. **Instructor:** Dr. Chris Brazel

4. **Textbook:** “Fundamental Principles of Polymeric Materials” by Stephen L. Rosen
   a. **Supplemental Materials:** None

5. **Specific Course Information**
   a. **Catalog Description:** Introduction to the manufacture, processing and applications of organic polymeric materials. This course covers the chemistry of polymer manufacture, the molecular structures of polymers, and the structure-property relationships for thermoplastic and thermosetting polymers.
   b. **Prerequisites:** CH 102, Junior standing
   c. **Course Role:** CHE 412 is an elective course for all chemical engineering majors.

6. **Specific Course Goals**
   a. **Specific Outcomes of Instruction:** Introduce fundamentals of polymer chemical synthesis, thermal and mechanical properties and characterization methods to advanced students in chemical engineering.
   b. **Student Outcomes Addressed by the Course:** N/A – Elective Course

7. **Course Topics**
   - Molecular Bonding and Organic Functional Groups
   - Polymer Molecular Weights and Analysis
   - Polymer Synthesis- Condensation and Free Radical
   - Polymerization Reactors
   - Polymer Morphology
   - Thermal Behavior and Treatment of Polymers
   - Polymer Modification
   - Polymer Solution Thermodynamics
   - Polymer Processing Methods
   - Physical Characterization of Polymers
   - Non-Newtonian Polymer Fluid Dynamics
   - Time-Temperature Superposition
   - Product Profile Presentations by Students
   - Current Research Topics
CHE 418/518 – Tissue Engineering

1. **Course Number/Name:** CHE 418/518 – Tissue Engineering

2. **Credits/Contact Hours:** 3 credit hours

3. **Instructor:** Dr. Yuping Bao

   
   a. **Supplemental Materials:** None

5. **Specific Course Information**
   
   a. **Catalog Description:** Tissue Engineering is an emerging dynamic, experimental science in which engineering and biological science principles are used to develop techniques for improving or restoring the structure and function of tissues and organs.

   b. **Prerequisites:** None

   c. **Course Role:** CHE 418 is a selected elective for CHE majors.

6. **Specific Course Goals**

   a. **Specific Outcomes of Instruction:** At the conclusion of the course, students will be able to:
      
      - Provide evaluations for tissue damage and tissue-related diseases.
      - Design or engineer a process for tissue engineering challenges.
      - Choose appropriate characterization and sterilization techniques for tissue scaffolds.

   b. **Student Outcomes Addressed by the Course:** N/A – Elective Course

7. **Course Topics**

   - The fundamentals of human tissues: cell, extracellular matrix, and signaling
   - Tissue scaffold design and characterization
   - Stem-cell technology
   - Tissue practice and specific case studies: skin, bone, cartilage and nerve tissue engineering

115
CHE 440/540– Health and Safety in the Chemical Process Industry

1. **Course Number/Name:** CHE 440/540 – Health and Safety in the Chemical Process Industry

2. **Credits/Contact Hours:** 3 credit hours

3. **Instructor:** Dr. David Arnold

4. **Textbook:** Chemical Process Safety: Fundamentals with Applications, Crowl and Louvar (Prentice Hall)
   
a. **Supplemental Materials:** None

5. **Specific Course Information**
   
a. **Catalog Description:** Historical, legislative, and technical aspects of safety, health, and ethical issues. Students develop skills to assess and mitigate health and safety problems in the chemical process industry, as well as knowledge of how to design to prevent such problems.

   b. **Prerequisites:** CH 102 and junior standing

   c. **Course Role:** CHE 440 is a selected elective for CHE majors.

6. **Specific Course Goals**
   
a. **Specific Outcomes of Instruction:** This course is designed to introduce students to the basic concepts of personal safety, industrial hygiene and loss prevention in the chemical process industry.

   b. **Student Outcomes Addressed by the Course:** N/A – Elective Course

7. **Course Topics**
   - Personal safety
   - Industrial hygiene
   - Process Safety
   - Hazard analysis
   - Accident investigation
   - Professional ethics
   - Case studies
1. **Course Number/Name:** CHE 445/545 – Introduction to Biochemical Engineering

2. **Credits/Contact Hours:** 3 credit hours

3. **Instructor:** Dr. Yuping Bao

   
a. **Supplemental Materials:**
   - *Encyclopedia of Bioprocess Technology: Fermentation, Biocatalysis, and Bioseparation Ref.* TP 248.3 .F57 1999 Volumes 1-5

5. **Specific Course Information**
   
a. **Catalog Description:** Study of biological processes, application of chemical engineering skills to areas including enzyme kinetics, fermentation, cell growth and metabolic processes.

   b. **Prerequisites:** CH 231

   c. **Course Role:** CHE 445 is a selected elective for CHE majors.

6. **Specific Course Goals**
   
a. **Specific Outcomes of Instruction:** This course is designed to build on the chemical and biological engineering principles taught in the sophomore and junior years, providing insight into the biochemical processes and the biotechnology industry. This course will expand upon undergraduate classes to introduce complex biosystems and bioprocesses and develop an approach to engineering analysis of them.

   b. **Student Outcomes Addressed by the Course:** N/A – Elective Course

7. **Course Topics**
   - Biochemicals: structures and function
   - Cell classification and processes
   - Enzyme kinetics
   - Bioenergetics and metabolism
   - Cell growth kinetics/oxygen transfer
   - Bioreactor design
   - Fermentation
• Separation, purification, and analytical methods
• Applications, analytical techniques, special topics
• Transport across cell membranes
• Scale-up of bioprocesses
• Current/Recent Topics
• Exams
CHE 481 - Chemical Process Design I

1. **Course Number/Name:** CHE 481 - Chemical Process Design I

2. **Credits/Contact Hours:** 3 credit hours

3. **Instructor:** Dr. David Arnold

   a. **Supplemental Materials:** None

5. **Specific Course Information**
   a. **Catalog Description:** Technical and economic design of chemical processes and plants.
   b. **Prerequisites:** CHE 255
   c. **Course Role:** CHE 481 is a required course for all chemical engineering majors.

6. **Specific Course Goals**
   a. **Specific Outcomes of Instruction:** This course is designed to introduce chemical engineering students to the basic principles and logical structure of chemical process design. Students are provided with a basis for estimation of fixed capital investment and operating cost of CPI plants. This course allows students to develop the ability to make rational design decisions based on economics and optimum unit operation design.
   b. **Student Outcomes Addressed by the Course:** This course meets program outcomes 3 and 4:
      3. Design physical, chemical, and biological processes to meet desired needs within realistic economic, health, and safety constraints.
      4. Function on multi-disciplinary teams.

7. **Course Topics**
   - Chemical Process Diagrams (2 hrs)
   - Est. of Capital Costs (3 hrs)
   - Est. of Manufacturing Costs (2 hrs)
   - Engineering Economic Analysis (3 hrs)
   - Cash Flow Diagrams (2 hrs)
   - Profitability Analysis (3 hrs)
   - Process Flow Diagram(PFD) (2 hrs)
   - Process Conditions (1 hr)
- Suitability of Process Design (1 hr)
- Synthesis of the PFD (1 hr)
- Process Simulators (1 hr)
- ChemCAD (CC5) (1 hr)
- Process Optimization (3 hrs)
- Process Control (2 hrs)
- Process Troubleshooting (2 hrs)
CHE 482 - Chemical Process Design II

8. Course Number/Name: CHE 482 - Chemical Process Design II

9. Credits/Contact Hours: 3 credit hours

10. Instructor: Dr. David Arnold


   a. Supplemental Materials: None

12. Specific Course Information

   a. Catalog Description: Optimal design of chemical processes and plants. Writing proficiency is required for a passing grade in this class.

   b. Prerequisites: CHE 481, senior standing

   c. Course Role: CHE 482 is a required course for all chemical engineering majors.

13. Specific Course Goals

   a. Specific Outcomes of Instruction: This course is the capstone chemical process design experience for senior-level chemical engineering students. Usually two design projects are completed during the semester. The first project begins at the process concept stage and proceeds through the market analysis, process selection, flowsheet design, material and energy balance calculations, raw material and energy requirement determinations, equipment design, capital investment estimation, operating cost estimation, after-tax cash flow determination and profitability analysis stages. Environmental and safety issues are considered. Once the design and economic analysis template is created, process economic optimization is conducted. Students work in teams of three. Extensive use is made of process simulation and individual-unit design software. Students meet with the instructor at least twice each week during the assigned class periods to discuss progress, to iron out problems, and to obtain input from the instructor and other classmates. Informal meetings with the instructor outside of regular class meeting times are also encouraged. Written progress reports in memorandum form are required periodically, and each group at project completion makes a final oral presentation. A comprehensive written final report is required. The second project generally follows the same format, and it is usually the AICHE National Student Design Project with no input from the instructor or from members of other groups until the final report is submitted and the project oral presentation is delivered.
b. **Student Outcomes Addressed by the Course:** This course meets program outcomes 9, 10(a), 10(c) and 11:
9. Understand and exercise professional ethical responsibility.
10(a). Understand the impact of engineering solutions in a global context.
10(c). Understand the impact of engineering solutions in a societal context.
11. Recognize the need for, and to engage in, life-long learning.

14. **Course Topics**
This course is taken in the last semester of the senior year and builds on essentially all the other chemical engineering courses taken previously by the students. No formal lectures are scheduled, but as the need arises, the instructor to the entire class in a lecture format presents discussions on pertinent topics. Acceptable technical writing skills are required for a passing grade. The final grade is based on the performance on both design projects.
CHE 493 - Process Dynamics and Controls

1. Course Number/Name: CHE 493 – Process Dynamics and Controls

2. Credits/Contact Hours: 3 credit hours

3. Instructor: Prof. C. Heath Turner

   - Supplemental Materials: None

5. Specific Course Information
   - Catalog Description: Development of model equations that describe the unsteady-state behavior of chemical processes; automatic control design and analysis emphasizing time-domain methods; introduction to digital computer control.
   - Prerequisites: CHE 304 (minimum grade C-), MATH 238 (minimum grade C-)
   - Course Role: CHE 493 is a required course for all chemical engineering majors.

6. Specific Course Goals
   - Specific Outcomes of Instruction: The course provides a framework for analyzing process dynamics relevant to chemical engineers and for developing strategies for controlling these processes within design specifications. Dynamic models for open-loop (uncontrolled) processes are formulated and solved. These models may evolve from either the conservation laws (mass, energy, momentum balances) or empiricism. Both analytical and numerical methods are used to solve the model equations. The models and mathematical methods used for open-loop processes are applied to the analysis of closed-loop (controlled) processes. Both linear and nonlinear processes are addressed.
   - Student Outcomes Addressed by the Course: This course meets program outcome 8(g):
     8(g). Analyze and control physical, chemical, and biological processes as demonstrated by a working knowledge of process dynamics and control.

7. Course Topics
   - Process modeling
   - Dynamic system behavior
   - PID feedback control
   - PID control tuning
- Frequency-response analysis

1. **Course Number/Name:** MTE 271: Engineering Materials: Structure and Properties

2. **Credits/Contact Hours:** 3 credit hours

3. **Instructors:** Professor Gregory Thompson, Professor Mark Weaver

   a. **Supplemental Materials:** None

5. **Specific Course Information**
   a. **Catalog Description:** Basic structure of ceramics, alloys, composites, metals and polymers. Relationships between the structure of materials and their mechanical, electrical, magnetic, thermal and chemical properties.

   b. **Prerequisites:** CH 101 (undergrad) with a minimum grade of C- or CH 117 (undergrad) with a minimum grade of C

   c. **Course Role:** Requirement of all MTE and ME undergraduate majors. A selected elective for ChBE.

6. **Specific Course Goals**
   a. **Specific Outcomes of Instruction:** Upon completion of this course, the engineering student will be able to:
      - Understand the basic classes of materials and their relevant structures, properties and applications.
      - Understand how engineering structure, from multiple length scales, influences properties.
      - Understand how a materials' structure can be engineered and exploited.

   b. **Student Outcomes Addressed by the Course:**

7. **Course Topics**
   - Atomic bonding
   - Crystal structures and descriptions via Miller Indices
   - Crystalline defects
   - Diffusion
   - Phase equilibrium, phase transformations and microstructure development
   - Mechanical properties
   - Electrical properties
- Optical properties
- Thermal properties
- Magnetic properties
- Corrosion
- Classes of metals, ceramics, polymers and composites and their applications
ECE 320 – Fundamentals of Electrical Engineering

1. **Course Number/Name:** ECE 320 – Fundamentals of Electrical Engineering

2. **Credits/Contact Hours:** 4 credit hours

3. **Instructor:** Dawen Li

   
   a. **Supplemental Materials:** None

5. **Specific Course Information**
   
   a. **Catalog Description:** Introduction to circuit analysis, methods, resistive circuits, AC circuits, first order transients, AC power, operational amplifiers, and machines. Not open to electrical engineering majors or to students who have earned credit in ECE 225.
   
   b. **Prerequisites:** PH 106. Corequisite: MATH 238

   c. **Course Role:** Selected elective for CHE majors

6. **Specific Course Goals**
   
   a. **Specific Outcomes of Instruction:** This course is designed to teach engineering students who are not ECE majors the fundamental concepts and methods of time-domain and steady-state circuit analysis. Operational amplifiers and electric machines are also introduced. At the end of this course, students are expected to be able to demonstrate:
      1. An ability to apply knowledge of mathematics, science, and engineering. (Outcome A)
      2. An ability to appreciate the electrical engineering terminology connected with functioning on multi-disciplinary teams. (Outcome D)
      3. An ability to identify, formulate, and solve engineering problems. (Outcome E)
      4. Knowledge of contemporary issues. (Outcome J)
      5. An ability to use the techniques necessary for engineering practice. (Outcome K)

   b. **Student Outcomes Addressed by the Course:** The course supports instruction for Student Outcomes A, D, E, J, and K as required by ABET Criterion 3 and ABET Program Criteria. The relationships are indicated in the Course Learning Objectives. The course does not include direct assessment for Student Outcomes.
7. Course Topics

- Fundamentals of Electric Circuits (5 hrs)
  a. Systems of Units, Charge, Current, Voltage, Energy
  b. Kirchhoff's Voltage and Current Laws
  c. Ideal Independent Voltage and Current Sources
  d. Resistance and Ohm's Law, Voltage and Current Dividers

- Resistive Network Analysis (9 hrs)
  e. Nodal Analysis, Loop and Mesh Analysis
  f. Thévenin and Norton Equivalent Circuits
  g. Source Transformations, Superposition
  h. Maximum Power Transfer, Wheatstone Bridges

- Time-Varying Voltages and Currents, Transient Analysis (5 hrs)
  i. Capacitors, Inductors, Transient Response of First-Order Circuits

- Steady-State AC Analysis (5 hrs)
  j. Sinusoidal Current and Voltage
  k. Phasors and Impedance
  l. Steady-State Circuit Analysis

- Frequency Response (3 hrs)
  m. Sinusoidal Frequency Response
  n. Low-pass, Band-pass, and High-pass Filters
  o. Decibel (dB) Plots

- Steady-State AC Power (6 hrs)
  p. Instantaneous and Average Power, Complex Power
  q. Power Factor, Maximum Power Transfer
  r. Three-Phase Systems and Power

- Operational Amplifiers (3 hrs)
  s. Ideal Op-Amp Characteristics
  t. Inverting, Non-inverting, Summing, Differential, and Buffer Amplifiers
  u. Integration and Differentiation

- Principles of Electromechanics (3 hrs)
  v. Magnetic Fields and Circuits, Magnetic Materials and B-H Curves
  w. Ideal and Real Transformers
  x. Electromechanical Energy Conversion

- Introduction to Electric Machines (3 hrs)
  y. Three-Phase, Single-Phase, and DC Motors
  z. Motor Speed-Torque Characteristics

- Examinations (3 hrs)

- Comprehensive final examination (2.5 hrs)
ENGR 103 – Engineering Foundations

Note: This course is new as of Fall 2013. It is a three-hour course that replaces ENGR 131, ENGR 141 and ENGR 151 (three one-hour courses). It is required of all majors in the College of Engineering.

1. Course Number/Name: ENGR 103 – Engineering Foundations

2. Credits/Contact Hours: 3 credit hours: 3 lectures per week

3. Instructor: Rick Stogner, Bridgett Monk, Steve Cooper

4. Textbook: To be determined – course will offered for the first time in Fall 2013

   a. Supplemental Materials: None

5. Specific Course Information

   a. Catalog Description: Introductory course for student in all engineering disciplines that provides the basic skills required for engineering with an emphasis on problem solving, sketching, teaming, oral and written technical communication, and the design process.

   b. Prerequisites: Students must be enrolled in Math 125 (Calculus I) or higher

   c. Course Role: Required for all majors in the College of Engineering

6. Specific Course Goals

   a. Specific Outcomes of Instruction:

      Students who complete this course should be able to:

      o Solve problems
      o Interpret data
      o Demonstrate mastery of the fundamentals
      o Hand-sketched diagrams and components within the context of the three objectives identified above
      o Demonstrate an understand of lettering conventions, orthographic projections, isometrics and sections
      o Utilize spreadsheets to properly input, solve and analyze engineering problems
      o Explain the “engineering science” courses in their curriculum for this and next 2 semesters

   b. Student Outcomes Addressed by the Course: This course meets program outcome 1(c):

      1(c). Be able to apply knowledge of engineering
7. Course Topics

- Problem Solving
  - Solve open-ended and engineering problems using estimation, approximation and a problem solving process
  - Use basic scientific and mathematical principles for trigonometry, length, time & mass to solve problems
  - Formulate problems from abstract, incomplete or over specified statements into recognized forms for solution
  - Document work in a manner that allows the reader to understand the givens, assumptions, procedure and results

- Interpretation of data
  - Graphically represent data generated from engineering experiments and equations
  - Interpret, analyze and interpolate engineering data presented graphically or as tables
  - Utilize basic statistical functions to generate and analyze engineering data
  - Select and interpret mathematical models to describe physical and engineering data and graphs

- Demonstrate mastery of the fundamentals
  - Apply the rules for unit conversions, dimensions and significant digits to engineering problems
  - Solve triangle problems with trigonometric functions, the laws of sines and cosines and Pythagorean Theorem
  - Work with component/polar vectors using consistent/appropriate units. Add, Subtract, Dot & Cross Product
  - Formulate and solve SLE’s from problems like those encountered in statics or DC circuit analysis
  - Define and apply Newton’s 3 laws to simple, commonly observed phenomena
  - Approximate integration and differentiation graphically
  - Explain constants of integration
ENGR 111 – Engineering the Future

1. **Course Number/Name:** ENGR 111 – Engineering the Future

2. **Credits/Contact Hours:** 1 credit hour: 1 lecture per week

3. **Instructor:** Sandy Wood and Bridgett Monk

4. **Textbook:**
   - Studying Engineering, A Roadmap to a Rewarding Career, 3rd Edition
   - Raymond B. Landis; Discovery Press, Los Angeles CA.

   a. **Supplemental Materials:** None

5. **Specific Course Information**
   a. **Catalog Description:** An introduction to the discipline of engineering and what the future of the field will involve. Focus is on developing and understanding of the discipline, the contributions that the discipline will make to society in the future, and career opportunities for students in the field.

   b. **Prerequisites:** Must be enrolled in Math 112 or higher

   c. **Course Role:** Selective Elective – either this course or a “discipline-specific” introductory course are required of all students in the College of Engineering

6. **Specific Course Goals**
   a. **Specific Outcomes of Instruction:**
      - An understanding of the field of engineering
      - An understanding of how to succeed at a major research university
      - An understanding of whether or not engineering is the right career choice for you

   b. **Student Outcomes Addressed by the Course:** This course meets program outcome 1(c):
      1(c): Be able to apply knowledge of engineering

7. **Course Topics**
   - What is engineering? Engineering’s great accomplishments
   - Engineering’s great failures
   - Engineering’s Grand Challenges
   - Change – “Shift Happens” and “The World is Flat, Hot and Crowded”
   - Engineering as a profession – ethics and academic integrity
   - Engineering skills for the future – contemporary issues
   - Scarce resources
• Creativity
• Innovation
ENGR 131 – Engineering Concepts and Design I

1. Course Number/Name: ENGR 131 – Engineering Concepts and Design I

2. Credits/Contact Hours: 1 credit hour: 1 lecture per week

3. Instructor: Rick Stogner and Bridgett Monk

4. Textbook:
   - Thinking Like An Engineer: An Active Learning Approach
   - Stephan, et. al. / Pearson
   - 2010
   
   a. Supplemental Materials: None

5. Specific Course Information
   
   a. Catalog Description: Introductory course for students in all engineering disciplines that provides the basic skills required for engineering with an emphasis on problem solving, teaming, oral and written communication, and the design project.
   
   b. Prerequisites: Must be enrolled in Math 125 or higher
   
   c. Course Role: Required for all majors in the College of Engineering

6. Specific Course Goals
   
   a. Specific Outcomes of Instruction:
      - Solve open-ended and engineering problems using estimation, approximation and a problem solving process
      - Apply the rules for unit conversions, dimensions and significant digits to engineering problems
      - Graphically represent data generated from engineering experiments and equations
      - Interpret, analyze and interpolate engineering data presented graphically or as tables
      - Utilize basic statistical functions to generate and analyze engineering data
      - Apply basic scientific and mathematical principles for trigonometry, length, time & mass to solve engineering problems
      - Utilize spreadsheets to properly input, solve and analyze engineering problems
      - Select and interpret mathematical models to describe physical and engineering data and graphs
   
   b. Student Outcomes Addressed by the Course: This course meets program outcome 1(c):
1(c). Be able to apply knowledge of engineering

7. Course Topics
   - Estimation, Units, Significant Figures
   - Excel (units/dimensions/unit conversions)
   - Universal Units, Force/Mass/Weight
   - Excel (graphing)
   - Length/Area/Volume, Optimization
   - Trig refresher, vectors and applications
   - Time: amplitude/period/frequency/phase angle
   - Time: velocity, speed, acceleration
ENGR 141 – Engineering Concepts and Design II

1. **Course Number/Name:** ENGR 131 – Engineering Concepts and Design II

2. **Credits/Contact Hours:** 1 credit hour: 1 lecture per week

3. **Instructor:** Rick Stogner and Steve Cooper

4. **Textbook:**
   - No textbook is required, a drawing kit is required
   - Students should bring their laptop and/or calculator to class daily
   
   a. **Supplemental Materials:** None

5. **Specific Course Information**

   a. **Catalog Description:** A second course for students in all engineering disciplines that reinforces the basic skills required for engineering with an emphasis on design, problem solving, teaming and technical communication.

   b. **Prerequisites:** ENGR 131

   c. **Course Role:** Required for all majors in the College of Engineering

6. **Specific Course Goals**

   a. **Specific Outcomes of Instruction:**
      - Use units appropriately in all calculations and results
      - Solve triangle problems with trigonometric functions, the law of sines and cosines and the Pythagorean Theorem
      - Work with component vectors and polar vectors with consistent and appropriate units – addition, subtraction, dot product, cross product
      - Formulate and solve SLE’s from problems like those encountered in statics or DC circuit analysis
      - Define and apply Newton’s three laws to simple, commonly observed phenomena
      - Approximate integration and differentiation graphically and explain the constants of integration

   b. **Student Outcomes Addressed by the Course:** This course meets program outcome 1(c):
      
      1(c). Be able to apply knowledge of engineering

7. **Course Topics**

   - Vectors, Newton, Functions, Units, Triangles, SLE, Mass != Force
   - Classic mechanics – Statics Sum forces = 0, free body diagrams, what is a force?
   - Classic mechanics – Statics Sum of M = 0, what is a torque or moment, FBDs
• Centroids – how do you apply distributed loads
• Tower cranes – why is statics relevant
• Classic mechanics – Dynamics sum $F = mA$, projectile without drag in Excel
• Mechanics of materials
ENGR 151 – Fundamental Engineering Graphics

1. **Course Number/Name:** ENGR 151 – Fundamental Engineering Graphics

2. **Credits/Contact Hours:** 1 credit hour: 1 lecture per week

3. **Instructor:** Bryan Graham

4. **Textbook:**
   - Engineering Graphics: Tools for the Mind
   - Graham, 978-1-58503-412-3
   - 2007

   a. **Supplemental Materials:** None

5. **Specific Course Information**

   a. **Catalog Description:** An introduction to the fundamental principles of graphic and visual communication. Focus is on the ability to use sketching as an effective communication tool within the field of engineering.

   b. **Prerequisites:** Must be enrolled in Math 112 or higher

   c. **Course Role:** Required for all majors in the College of Engineering

6. **Specific Course Goals**

   a. **Specific Outcomes of Instruction:**
      - Hand-sketich diagrams and components within the context of the three objectives identified above
      - Demonstrate an understand of lettering conventions, orthographic projections, isometrics and sections

   b. **Student Outcomes Addressed by the Course:** This course meets program outcome 1(c):

      1(c). Be able to apply knowledge of engineering

7. **Course Topics**

   - Lettering
   - Sketching
   - Orthographic Projections
   - Isometrics
   - Sections
CH 101–General Chemistry I

1. Course Number/Name: CH 101–General Chemistry I

2. Credits/Contact Hours: 4 credit hours / 6 contact hours

3. Course Coordinator: Dr. Patrick Frantom


   a. Supplemental Materials: None

5. Specific Course Information

   a. Catalog Description: The objective of this course is to introduce students to the basic facts and principles of chemistry. Some of the topics included are: chemical formulas, reaction stoichiometry, atomic structure, chemical periodicity, molecular structure, covalent bonding theories, molecular orbitals, gas laws, and kinetic molecular theory.

   b. Prerequisites: Minimum grade of C- in: MATH 100 or MATH 112 or MATH 113 or MATH 115 or MATH 121 or MATH 125 or MATH 126 or MATH 145 or MATH 146. Or 24 ACT math sub-score. Or 560 SAT math sub-score.

   c. Course Role: Required CHE science course

6. Specific Course Goals

   a. Specific Outcomes of Instruction:

      - Describe experiments that support Atomic Theory, Quantum Theory, and Kinetic Molecular Theory.
      - Identify common elements/compounds and types of chemical reactions such as combustion, acid/base, redox, precipitation, and gas-evolving reactions.
      - Apply the Mole Concept to chemical problems such as stoichiometry, balancing chemical equations, and determination of limiting reagents and reaction yields.
      - Utilize the periodic table to determine atomic and molecular weights and predict atomic properties such as subatomic composition, atomic radius, electronegativity, ionic charge, and electron configuration.
      - Utilize scientific equations to convert between common scientific units and solve chemical problems dealing with thermochemistry, properties of gases, and the quantum nature of matter.
      - Predict the three-dimensional shapes of molecules based on chemical bonding theories such as Lewis, VSEPR, and valence bond theory.
Apply the modern scientific method to discriminate between hypotheses, laws, and theories.

a. **Student Outcomes Addressed by the Course:** This course meets program outcome 1(b)(i):
1(b)(i). Have a thorough grounding in the basic sciences including chemistry

7. **Course Topics**
- Matter, measurement and problem solving
- Atoms and elements
- Molecules, compounds and chemical equations
- Reactions in aqueous solution
- The quantum-mechanical model of the atom
- Periodic properties of the elements
- Chemical bonding I: Lewis Theory
- Chemical bonding II: molecular shapes, VB and MO theories
- Gases
- Thermochemistry
CH 102–General Chemistry II

1. **Course Number/Name:** CH 102 – General Chemistry II

2. **Credits/Contact Hours:** 4 credit hours / 6 contact hours

3. **Instructor:** Dr. Martin Bakker


   a. **Supplemental Materials:** None

5. **Specific Course Information**

   a. **Catalog Description:** The objective of this course is to introduce students to the basic facts and principles of chemistry. Some of the topics included: intermolecular forces, colligative properties, kinetics, chemical thermodynamics, acid-base chemistry, equilibria, and nuclear chemistry. Application of the scientific method will be illustrated by examples drawn from the historical development of the various topics. With respect to the lab, students will make observations, analyze data, and use the scientific method to allow for complete integration of the laboratory topics with the lecture ones. This approach will help foster greater understanding of the covered topics in CH 102.

   b. **Prerequisites:** CH 101 or CH 117

   c. **Course Role:** Required CHE science course

6. **Specific Course Goals**

   a. **Specific Outcomes of Instruction:**
      - Identify important intermolecular forces for a given molecule.
      - Calculate physical property changes of solutions based on colligative properties.
      - Determine the rate law for a chemical reaction.
      - Use Le Châtelier’s Principle to determine the effect of a concentration change on a chemical equilibrium.
      - Classify a salt solution as acidic, basic, or neutral.
      - Calculate the pH of a buffer solution.
      - Determine how a temperature change will affect a chemical equilibrium.
      - Calculate the energy released in a nuclear reaction

   b. **Student Outcomes Addressed by the Course:** This course meets program outcome 1(b)(i):
1(b)(i). Have a thorough grounding in the basic sciences including chemistry

7. **Course Topics**
   - Intermolecular forces
   - Solutions
   - Kinetics
   - Equilibrium
   - Acids and bases
   - Electrochemistry and nuclear chemistry
CH 231–Elementary Organic Chemistry I

1. Course Number/Name: CH 231 – Elementary Organic Chemistry I

2. Credits/Contact Hours: 3 credit hours / 3 contact hours

3. Instructor: Dr. Silas Blackstock

   a. Supplemental Materials: None

5. Specific Course Information
   a. Catalog Description: The objective of this course is coverage of organic molecule structure, including nomenclature, 3-D geometry and stereochemistry, conformational structure and dynamics, and isomerism; functional groups of organic structures and their reactivity patterns; organic reactions and reaction mechanisms, including electron pushing mechanisms; organic molecule synthesis; and IR spectroscopy of organic molecules.
   b. Prerequisites: CH 102 or CH 118
   c. Course Role: Required CHE science course

6. Specific Course Goals
   a. Specific Outcomes of Instruction:
      - Name organic molecules
      - Write the structure, including 3-D geometry, of organic molecules
      - Understand the bonding at all atoms in organic structures and be able to dissect a structure into orbital components for the electrons present
      - Name and recognize organic functional groups
      - Be familiar with the conformational properties of alkanes, including chair cyclohexanes
      - Be familiar with the terminology and relationships of organic isomers, including stereoisomers, and be familiar with the stereochemistry of molecular structures
      - Be familiar with the reactions of alkanes, alkenes, alkynes, alkyl halides, alcohols, and ethers and be able to predict reaction outcomes and needed ingredients for chemical transformations of these classes of organic molecules
      - Provide detailed mechanisms for the organic reactions covered, including electron redistributions in each step of a transformation
      - Deduce sequences of organic reactions to synthesize a target organic structure from another organic structure
• Predict the IR spectrum of an organic structure as well as predict the organic structure from IR data

b. Student Outcomes Addressed by the Course: This course meets program outcome 1(b)(i):
1(b)(i). Have a thorough grounding in the basic sciences including chemistry

7. Course Topics
• Bonding in molecules and molecular shapes
• Alkanes and Cycloalkanes
• Stereochemistry and Chirality
• Acids and Bases
• Alkenes: Bonding, Nomenclature, Properties
• Alkenes: Reactions
• Alkynes
• Alkylhalides
• Nucleophilic Substitution and beta-Elimination Reactions
• Alcohols
• Ethers, Epoxides, and Sulfides
• Infrared Spectroscopy
CH 232–Elementary Organic Chemistry II

1. **Course Number/Name:** CH 232 – Elementary Organic Chemistry II

2. **Credits/Contact Hours:** 3 credit hours / 3 contact hours

3. **Instructor:** Dr. Marco Bonizzoni

   
   a. **Supplemental Materials:** None

5. **Specific Course Information**
   
   a. **Catalog Description:** This course is a continuation of CH 231
   
   b. **Prerequisites:** CH 231
   
   c. **Course Role:** Required CHE science course

6. **Specific Course Goals**
   
   a. **Specific Outcomes of Instruction:**
      
      - Determine structures of organic molecules using NMR and IR spectroscopy
      - Understand the properties of such functional groups as conjugated p-systems, aromatic compounds, amines, and carbonyl compounds
      - Predict simple reactivity of the mentioned organic compounds
      - Write detailed mechanisms for important reaction classes, among which are electrophilic aromatic substitutions and carbonyl nucleophilic addition reactions
      - Devise syntheses of organic compounds including any and all the reactions proposed in this course

   b. **Student Outcomes Addressed by the Course:** This course meets program outcome 1(b)(i):
      
      1(b)(i). Have a thorough grounding in the basic sciences including chemistry

7. **Course Topics**
   
   - CH 13: Nuclear magnetic resonance
   - CH 15: Organometallic compounds
   - CH 16: Aldehydes and ketones
   - CH 17: Carboxylic acids
   - CH 18: Carboxylate derivatives
   - CH 19: Enolates and enamines
• CH 20: Dienes and conjugated systems
• CH 21: Benzene and aromaticity
• CH 22: Reactions of aromatic systems
• CH 23: Amines
• CH 24: Catalytic C-bond formation
CH 237–Elementary Organic Chemistry Laboratory

1. **Course Number/Name:** CH 237 – Elementary Organic Chemistry Laboratory

2. **Credits/Contact Hours:** 2 credit hours / 6 contact hours

3. **Instructor:** Dr. Anthony Arduengo

4. **Textbook:** *Operational Organic Chemistry*; John Lehman; Prentiss Hall; (ISBN 978-0136000921)
   
   a. **Supplemental Materials:** None

5. **Specific Course Information**
   
   a. **Catalog Description:** A one-hour lecture and five-hour laboratory. Designed for chemistry majors and chemistry minors to take concurrently with CH 232. You will have the chance to see where the science of chemistry meets the art of chemical laboratory work.
   
   b. **Prerequisites:** CH 231 or CH 232
   
   c. **Course Role:** Required CHE science course

6. **Specific Course Goals**
   
   a. **Specific Outcomes of Instruction:**
      
      - Predict the correct products for a given reaction
      - Choose appropriate reaction conditions for any desired organic transformation
      - Be competent in designing, setting-up, and executing a given organic reaction
      - Display a general understanding of spectroscopic techniques and how they are utilized in organic chemistry
      - Exhibit a general understanding of reaction mechanisms.

   b. **Student Outcomes Addressed by the Course:** This course meets program outcome 1(b)(i):
      
      1(b)(i). Have a thorough grounding in the basic sciences including chemistry

7. **Course Topics**
   
   - Separation of components of Panacetin
   - Stereochemistry of the addition of Br₂ to *trans*-cinnamic acid
   - Synthesis of banana oil
   - Dehydration of methylecyclohexanols
   - TLC analysis of drug mixtures
- Synthesis of triphenylmethanol and the trityl carbocation
- Synthesis of trityl carbocation
MATH 125 - Calculus I

1. **Course Number/Name:** MATH 125 – Calculus I

2. **Credits/Contact Hours:** 4 credit hours / 4 contact hours

3. **Instructor:** Dr. Weihua Geng

4. **Textbook:** *Essential Calculus: Early Transcendentals (2\textsuperscript{nd} Ed)*; James Stewart; Cengage Learning; (ISBN 978-1133112280)

   a. **Supplemental Materials:** None

5. **Specific Course Information**

   a. **Catalog Description:** First course in the three part basic calculus sequence for students majoring in mathematics, science, or engineering. Topics include limits, continuity, differentiation, applications of differentiation, and integration. Applications of the derivative are covered in detail, including approximations of errors using differentials, maxima and minima problems, curve sketching, optimization problems, and Newton's Method. Topics on integration include Riemann sums, of definite integrals, integration by substitution, and integrals involving logarithmic, exponential, trigonometric, inverse trigonometric, and hyperbolic functions.

   b. **Prerequisites:** A grade of C- or higher in MATH 112 and MATH 113 (or MATH 115) or a mathematics placement score in the 440-600 range

   c. **Course Role:** Required CHE mathematics course

6. **Specific Course Goals**

   a. **Specific Outcomes of Instruction:**
   - Students will develop a basic understanding of the concepts of limits, rates of change, linear approximation, and Riemann sums, and be able to apply them.
   - Students will be able to compute limits of simple functions.
   - Students will be able to calculate (and simplify) derivatives involving rational, exponential, trigonometric, and inverse trigonometric functions.
   - Students will be able to apply derivatives to various applications including optimization problems, linear approximation, and curve sketching.
   - Students will be able to calculate (and simplify) integrals using some basic techniques of integration, including substitution and the Fundamental Theorem of Calculus.
   - Students will be able to find the area of certain types of planar regions using integration.
b. Student Outcomes Addressed by the Course: This course meets program outcome 1(a):
1(a). Be able to apply knowledge of mathematics

7. Course Topics
- Functions and Limits (sections 1.3-1.6)
- Derivatives (sections 2.1 – 2.8)
- Inverse Functions: Exponential, Logarithmic, and Inverse Trigonometric Functions (sections 3.1-3.6)
- Applications of Differentiation (sections 4.1 – 4.7)
- Integrals (sections 5.1 – 5.5, 7.1)
MATH 126 - Calculus II

1. **Course Number/Name:** MATH 126 – Calculus II

2. **Credits/Contact Hours:** 4 credit hours / 4 contact hours

3. **Instructor:** Dr. Martyn Dixon

   a. **Supplemental Materials:** None

5. **Specific Course Information**
   a. **Catalog Description:** The second course in the three part basic calculus sequence for students majoring in mathematics, science or engineering. Topics include vectors and the geometry of space, applications of integration, integration techniques, L'Hospital's Rule, improper integrals, infinite series, conic sections, plane curves, parametric equations, and polar coordinates.
   b. **Prerequisites:** A grade of C- or higher in MATH 125 or MATH 131 or MATH 145
   c. **Course Role:** Required CHE mathematics course

6. **Specific Course Goals**
   a. **Specific Outcomes of Instruction:**
      - Students will develop a basic understanding of two- and three-dimensional vectors, the geometry of the plane and space, and be able to apply these concepts when working applied problems.
      - Students will learn various techniques of integration including integration by parts, trigonometric substitution, and partial fractions decomposition.
      - Students will acquire basic skills needed to apply integration techniques to solve a wide range of integration problems.
      - Students will develop a basic understanding of infinite series and their applications.
      - Students will learn how to use parametric equations and polar coordinates.
   b. **Student Outcomes Addressed by the Course:** This course meets program outcome 1(a):
      1(a). Be able to apply knowledge of mathematics

7. **Course Topics**
   - Chap 10: Vectors and the Geometry of Space (cover sections 10.1 –10.5)
• Chap 3: Indeterminate Forms and L'Hospital's Rule (cover section 3.7)
• Chap 6: Techniques of Integration
• Chap 7: Applications of Integration (cover sections 7.2, 7.3, 7.4, and 7.6)
• Chap 8: Series
• Chap 9: Parametric Equations and Polar Coordinates (9.5 optional)
MATH 227 - Calculus III

1. Course Number/Name: MATH 227 – Calculus III

2. Credits/Contact Hours: 4 credit hours / 4 contact hours

3. Instructor: Dr. Roger Sidje

   a. Supplemental Materials: None

5. Specific Course Information
   a. Catalog Description: This course covers the last third of the basic calculus sequence. Topics include analytic geometry in space, vector-valued functions and motion in space, functions of two or more variables and their partial derivatives, applications of partial differentiation (including Lagrangian multipliers), quadric and cylindrical surfaces, and multiple integrations (including Jacobian) and applications, line integrals, Green's Theorem, curl and divergence, surface integrals, and Stokes’ Theorem.
   b. Prerequisites: A grade of C- or higher in MATH 126 or MATH 132 or MATH 146
   c. Course Role: Required CHE mathematics course

6. Specific Course Goals
   a. Specific Outcomes of Instruction:
      - Students will demonstrate a basic understanding of the multi-dimensional aspects of calculus and its applications.
      - Students will learn to work with parametric representations of curves and surfaces and be able to do standard calculations using them.
      - Students will be able to do routine calculations of partial derivatives.
      - Students will be able to apply partial derivatives to various applied problems such as working with Lagrange multipliers.
      - Students will be able to solve multiple integration problems and their applications.
      - Students will learn the basics of vector analysis and be able to apply Green’s, Stokes’, and the divergence theorems.
   b. Student Outcomes Addressed by the Course: This course meets program outcome 1(a):
      1(a). Be able to apply knowledge of mathematics
7. **Course Topics**

- Chap 10: Vectors and the Geometry of Space (Review 10.1 – 10.5 and cover 10.6 – 10.9)
- Chap 11: Partial Derivatives (cover 11.1 – 11.8)
- Chap 12: Multiple Integrals (cover 12.1 – 12.8)
- Chap 13: Vector Calculus (cover 13.1 – 13.9)
MATH 238–Applied Differential Equations

1. Course Number/Name: MATH 238 –Applied Differential Equations

2. Credits/Contact Hours: 3 credit hours / 3 contact hours

3. Instructor: Dr. Lawrence Roberts

   
   a. Supplemental Materials: None

5. Specific Course Information

   a. Catalog Description: Introduction to analytic methods for solving differential equations. Topics include the qualitative, and analytic solution of first order equations, applications to population models and motion problems; techniques for solving second order linear differential equations with constant coefficients, including the use of undetermined coefficients and variation of parameters; the Laplace transform and its use in solving initial value problems with discontinuous forcing functions; an introduction to systems of ordinary differential equations, and the use of simple numerical techniques such as Euler’s method.

   b. Prerequisites: A grade of C- or higher in MATH 126 or MATH 146; MATH 227 or MATH 247 (co-requisite)

   c. Course Role: Required CHE mathematics course

6. Specific Course Goals

   a. Specific Outcomes of Instruction:
      
      • Recognize and classify ordinary differential equations in terms of their order, whether they are linear or nonlinear, and whether they are homogeneous or inhomogeneous, and explain what it means to solve a differential equation.
      • Use ordinary differential equations to model simple physical, chemical, and biological phenomena.
      • Solve simple first order equations using separation of variables and integrating factors.
      • Solve linear second-order ordinary differential equations with inhomogeneous terms.
      • Solve ordinary differential equations indirectly by using Laplace transforms.
      • Apply basic numerical techniques to understand linear initial value problems
b. **Student Outcomes Addressed by the Course:** This course meets program outcome 1(a):
1(a). Be able to apply knowledge of mathematics

7. **Course Topics**
   - Introduction, (§1.1-1.4),
   - First-order Differential Equations, (§2.1, 2.2, 2.3, 2.6).
   - Mathematical Models, parts of sections (§3.1 – 3.5).
   - Linear Second-order Equations (§4.1 – 4.6, 4.7-4.10 time permitting).
   - Introduction to Systems, (§5.1 – 5.2).
   - Laplace Transforms, (§7.1-7.8).
PH 105–General Physics with Calculus I

1. **Course Number/Name:** PH 105 – General Physics with Calculus I

2. **Credits/Contact Hours:** 4 credit hours / 5 contact hours

3. **Instructor:** Dr. J. W. Harrell

4. **Textbook:** *Fundamentals of Physics*; David Halliday; Wiley; (ISBN 978-0471105589)
   
   a. **Supplemental Materials:** None

5. **Specific Course Information**
   
   a. **Catalog Description:** This is the first part of the introductory calculus-based classical physics course which includes classical mechanics, waves, and thermodynamics. The lab is integrated into the lecture, so there is no separate lab section. Degree credit can only be awarded for one of the following: PH 101, PH 105, or PH 125.

   b. **Prerequisites:** MATH 125 or MATH 145

   c. **Course Role:** Required CHE science course

6. **Specific Course Goals**

   a. **Specific Outcomes of Instruction:**
      
      General Learning Outcomes:
      
      - Recognize and identify key concepts in physics that will provide a broad perspective on phenomena observed in our surrounding. [knowledge, evaluation, analysis]
      - Understand the scientific method and critically evaluate scientific information. [analysis, knowledge, comprehension, evaluation]
      - Recognize the role of physics in the other natural sciences, engineering, and technology and on the human condition. [knowledge, comprehension, evaluation]
      - Develop skills in working together in team activities. [receiving, responding, organizing]

      Course-specific Learning Outcomes:
      
      - Conceptual understanding:
        
        - Answer conceptual questions which require a solid understanding of kinematics and Newton's laws of motion. [knowledge, comprehension, evaluation]
        - Apply the concepts of kinematics to relevant problems. [analysis, knowledge, comprehension, evaluation, application]
o Apply the concepts of Newton's laws of motion to relevant problems.
  [analysis, knowledge, comprehension, evaluation, application]

o Apply the concepts of conservation of momentum and energy to relevant problems. [analysis, knowledge, comprehension, evaluation, application]

- Application of basic laws of physics: Apply the laws of physics to formulate a solution to a problem using elementary differential and integral calculus. [analysis, knowledge, comprehension, evaluation, application]
- Analysis of mechanical systems: Analyze objects subject to forces and predict their behavior. [analysis, knowledge, comprehension, evaluation, application]
- Knowledge of thermodynamics: Solve problems which require knowledge of temperature and heat transfer. [analysis, knowledge, comprehension, evaluation, application]
- Laboratory skills: Be able to make basic mechanical measurements, analyze and interpret data, and identify and evaluate potential sources of error. [knowledge, comprehension, application, analysis, synthesis, evaluation]

b. **Student Outcomes Addressed by the Course:** This course meets program outcome 1(b)(ii):
   1(b)(ii). Have a thorough grounding in the basic sciences including physics

7. **Course Topics**
   - Motion in One, Two, and Three Dimensions
   - Forces and Newton's Three Laws
   - Work, Kinetic and Potential Energy
   - Conservation of Energy
   - Center of Mass and Conservation of Momentum
   - Rotation, Rolling, Torque, and Angular Momentum
   - Gravitation
   - Oscillations and Waves
   - Laws of Thermodynamics and Kinetic Theory of Gases
PH 106–General Physics with Calculus II

1. **Course Number/Name:** PH 106 – General Physics with Calculus II

2. **Credits/Contact Hours:** 4 credit hours / 5 contact hours

3. **Instructor:** Dr. Claudia Mewes

   
   a. **Supplemental Materials:** None

5. **Specific Course Information**
   
   a. **Catalog Description:** PH 106 continues our calculus-based introduction to physics, and is aimed at students who desire (or require) a detailed working physics background, particularly calculations and problem solving. Laboratory experiments will augment lecture- and discussion-based learning, and introduce students to key experimental techniques and analysis. The course will stress a conceptual and mathematical understanding of everyday phenomena and recent technologies in terms of their basic underlying physical principles.

   b. **Prerequisites:** Both (Math 126 or MATH 146) and (PH 101 or PH 105 or PH 125)

   c. **Course Role:** Required CHE science course

6. **Specific Course Goals**
   
   a. **Specific Outcomes of Instruction:**
      
      General Learning Outcomes:
      
      - Scientific method: You should be able to recognize and explain the scientific method, and evaluate scientific information.
      - Effective teamwork: You should be able to collaborate and perform effectively in team activities.

      Course-specific Learning Outcomes:
      
      - Conceptual understanding:
        - Be able to answer conceptual questions which require a solid understanding of electrical and magnetic forces
        - Be able to apply the concepts of electric fields and electric potential to relevant problems
        - Be able to apply the concepts of magnetic fields to relevant problems
      - Application of basics laws of physics: be able to apply the laws of physics to formulate a solution to a problem
      - Analysis of electric circuits: be able to analyze electric circuits and predict their function.
Knowledge of optics: be able to solve problems which require the knowledge of ray optics and optical image formation.

b. Student Outcomes Addressed by the Course: This course meets program outcome 1(b)(ii):
1(b)(ii). Have a thorough grounding in the basic sciences including physics

7. Course Topics
- Electric forces, energy, and capacitance
- Current and resistance; dc circuits
- Magnetism
- Electromagnetic induction and ac circuits
- Electromagnetic waves & the nature of light
- Reflection and Refraction
- Mirrors and Lenses
- Wave optics
BSC 114–Principles of Biology I

1. Course Number/Name: BSC 114 – Principles of Biology I

2. Credits/Contact Hours: 3 credit hours / 3 contact hours

3. Instructor: Dr. Julie Olson

4. Textbook: *Campbell Biology (9th Ed)*; Reece, Urry, Cain, Wasserman, Minorsky and Jackson; Benjamin Cummings; (ISBN 978-0321558237)
   
   a. Supplemental Materials: None

5. Specific Course Information
   
   a. Catalog Description: BSC114 is designed as an introduction to biology at the college-freshman level for biology majors, biology minors, and pre-health professions students. Topics covered include the basic principles and terminology of cell chemistry, cell biology, genetics, and evolution.

   b. Prerequisites: None

   c. Course Role: Required CHE science course

6. Specific Course Goals
   
   a. Specific Outcomes of Instruction:
      
      - Identify the chemicals of life and how they interact at the cellular level.
      - Relate the structure and function of cellular organelles.
      - Understand the mechanisms of metabolic processes and the interrelationship of cells and molecules in the production of energy necessary for life.
      - Solve genetic crosses, analyze gene interactions and interpret phenotypes.
      - Know how molecules are synthesized and utilized for inheritance and cell function and are used in modern molecular technologies that are changing medicine and agriculture.
      - Understand how genetics underlies speciation and evolution of life and predicts population structure.
      - Recognize and identify key concepts in science to provide a broad perspective on the human condition
      - Be able to critically discriminate between reliable and less reliable information when making decisions
      - Understand the scientific method and critically evaluate scientific information as related to real world problems
      - Be knowledgeable of research methods used in cellular, molecular, and evolutionary biology
      - Have developed skills in working together in teams
b. **Student Outcomes Addressed by the Course:** This course meets program outcome 1(b)(iii):
1(b)(iii). Have a thorough grounding in the basic sciences including biology

7. **Course Topics**
   - Chapters 1-25
Faculty Vitae
David W. Arnold, Department of Chemical Engineering, Professor

1. Name: David W. Arnold
2. Education:
   B.S., Chemical Engineering, University of Alabama, 1971
   M.S., Chemical Engineering, Georgia Institute of Technology, 1976
   Ph. D., Chemical Engineering, Purdue University, 1980
3. Academic Experience:
   - The University of Alabama:
     o Associate Professor of Chemical Engineering 1980
     o Professor of Chemical Engineering 1999
4. Non-Academic Experience:
   - The U. S. Army Missile Command, Huntsville, Alabama, Summer, 1985, Faculty Research Participantship, purification of high energy materials.
   - The Bartlesville Energy Technology Center, Bartlesville, Oklahoma, Summer, 1983, Faculty Research Participantship, high pressure VLE measurements.
5. Certifications or Professional Registrations: None
6. Current Membership in Professional Organizations: AIChE (elected a member on 05/15/87)
7. Honors and Awards: None
8. Service Activities:
   - Faculty Senate; Fall 1998 - Present.
   - Faculty Senate Alternate; Fall 1996 - Spring 1997.
   - Chair, Campus Master Plan Committee; Fall 200-Present.
   - Campus Master Plan Committee; Fall 1998-Spring 2000.
9. Important Publications:
   - Final Report “Minimizing the Derate of adding Post Combustion Capture to Pulverized Coal Units” EPRI------December, 2012------Eric Altman, Josh Slaten, Scott Piltzer, David W. Arnold
10. Recent Professional Development Activities:

- 1998-99 Attended 1 week NSF-Sponsored Faculty Workshop on Novel Process Science and Engineering held at Rowan University July 26-30, 1998. This workshop focused on faculty development in the area of undergraduate teaching.


- Attended the 3 day advanced ChemCADIII course on engineering design in Houston, TX from October 8 to 10, 1997 at The Chemstations, Inc. international headquarters. The instructor was Ben Horwitz, a well-known author in the field of chemical engineering process simulators.

- 1996-97 Attended 2 week NSF workshop at SMU on engineering design, entitled “Enhancement of Faculty Design Capabilities”, from July 28-August 10, 1996.

- Attended a 2 day workshop entitled “Effective Teaching: A Workshop” on this campus on February 24-25, 1997. The instructor was Richard Felder, a well-known educator in the field of chemical engineering.

- 1994-95 I attended The NSF workshop on "Advanced Separation Processes". This excellent 8 day workshop featured several talks by vice-presidents for research for manufacturers of advanced separation equipment, a visit to industry, and a full day in the laboratory working "hands-on" with the latest separations equipment available to the process industry. This workshop was held at Manhattan College from July 25 to August 3, 1994.
Faculty Vitae
Yuping Bao, Department of Chemical Engineering, Assistant Professor

1. Name: Yuping Bao
2. Education:
   - B.S., Chemistry, East China University of Science & Technology, Shanghai, China, 1998
   - M.S., Physics, Tongji University, 2001
   - Ph.D., Materials Science & Engineering, University of Washington, Seattle, WA, Ph. D., Dual degree in Nanotechnology concentrated on Bioengineering, 2006
3. Academic Experience:
   - The University of Alabama:
     o Reichhold-Shumaker Assistant Professor of Chemical Engineering 2008-2013
     o Adjunct Professor, Department of Biological Sciences, 2009 – present
4. Non-Academic Experience:
5. Certifications or Professional Registrations: None
6. Current Membership in Professional Organizations:
   Sigma Xi, the Honor Scientific Research Society, American Association for Cancer Research, American Chemical Society, and Materials Research Society.
7. Honors and Awards:
   - NSF CAREER award, 2012
   - Ralph E. Powe Junior Faculty Enhancement Award, 2010
   - 50th Magnetism and Magnetic Materials International Conferences Student Travel Award, 2005
   - Argonne National Lab Nanoscience Summer School Fellowship, 2003
   - University Initiatives Fund Graduate Fellowship in Nanotechnology at University of Washington, 2003
   - Joint Institute for Nanoscience Graduate Fellowship at University of Washington, 2002
8. Service Activities:
   - Manuscript Reviewer for over 30 different research journals and publications
   - Proposal Review for NSF, DoD, and several other organizations
   - Editor, Materials Research Society Proceeding
   - Department and University-level committees
9. Selected Publications and Presentations:
   a. Publications (37 total):
Yaolin Xu, Soubantika Palchoudhury, Yin Qin, Yuping Bao, “Phase transfer of iron oxide nanoparticles with tunable hydrodynamic size and functionality.” 27, 8990–8997 (2011). Note: Highlighted in Nature


b. Presentations (30 conference talks):

- Yuping Bao, “Platinum-iron oxide dual component nanoparticles for biomedical applications’, Chemistry Departmental Seminar, University of California, Santa Cruz, April 7th 2010.

10. Recent Professional Development Activities:

- UA 3rd Active & Collaborative Learning Conference, 2010
- NSF grant writing workshop, 10/2008, 10/2009
- UA Junior investigator program, 2008/2009
Faculty Vitae
Jason E. Bara, Department of Chemical Engineering, Assistant Professor

1. **Name:** Jason E. Bara

2. **Education:**
   - B.S. Chemical Engineering, Virginia Commonwealth University, 2002
   - Ph. D. Chemical Engineering, University of Colorado at Boulder, 2007

3. **Academic Experience:**
   - The University of Alabama, Reichhold-Shumaker Assistant Professor, 2010-present, full time
   - University of Colorado at Boulder, Senior Research Associate, Dept. of Chemical & Biological Engineering & Dept. of Chemistry & Biochemistry, 1/2009-9/2009, full time
   - University of Colorado at Boulder, Research Associate, Dept. of Chemical & Biological Engineering & Dept. of Chemistry & Biochemistry, 6/2007 – 1/2009, full time

4. **Non-Academic Experience:**
   - ION Engineering, Founder & VP of Engineering for clean-tech start-up commercializing advanced gas treating processes for the electric power, oil & gas and biofuels industries, 2008-2010, full time
   - ChemEngine, President & Lead Consultant, managed operations of chemical engineering consulting firm, led numerous short and long-term chemical engineering-based research projects for small to multinational companies in the Mid-Atlantic region, 8/2000 – 8/2002, full time

5. **Certifications or Professional Registrations:** N/A

6. **Current Membership in Professional Organizations:** AIChE, ACS, NAMS (North American Membrane Society), ASEE

7. **Honors and Awards:** UA Chemical & Biological Engineering Most Outstanding Faculty Member (2012, 2013)

8. **Service Activities:**
   - Session chair at AIChE Annual Meeting – 2012 (2), 2011 (5), 2010 (1)
   - Session chair at NAMS Annual Meeting – 2012 (1)
     Session chair at 18th Symposium on Thermophysical Properties – 2012 (1)

9. **Selected Publications and Presentations**
   - **Publications (46 total, 1318 citations):**


### b. Presentations (17 invited, 36 at professional meetings):

- Properties of N-Functionalized Imidazoles and Comparisons to Imidazolium-based Ionic Liquids. 18$^{th}$ Symposium on Thermophysical Properties, Boulder, CO 6/26/2012
- Shannon, M. S.; Tedstone, J. M.; Danielsen, S. P. O.; **Bara, J. E.** Gas Solubility and Selectivity Correlation to Free Volume in Ionic Liquids. IUPAC World Polymer Congress, 6/26/2012

### 10. Recent Professional Development Activities: N/A
Faculty Vitae
Christopher S. Brazel, Department of Chemical Engineering, Associate Professor

1. Name: Christopher S. Brazel

2. Education:
   - B.S., Chemical Engineering, Texas A&M University, 1992
   - M.S., Chemical Engineering, Purdue University, 1994
   - Ph.D., Chemical Engineering, Purdue University, 1997

3. Academic Experience:
   - The University of Alabama:
     - Reichhold-Shumaker Assistant Professor of Chemical Engineering 1999-2005
     - Associate Professor of Chemical and Biological Engineering, 2005 - present
     - Adjunct Professor, Department of Biological Sciences, 2009 - present
     - ChBE honors program coordinator, 2003-, ChBE undergrad coordinator, 2012-

4. Non-Academic Experience:
   - Southwest Research Institute, San Antonio, Texas
     - Research Engineer, Encapsulation and Process Research, 1997-1999

5. Certifications or Professional Registrations:
   - PE License, State of Alabama, Number 25714

6. Current Membership in Professional Organizations:
   - Member of American Institute for Chemical Engineers, Materials Research Society,
   - American Chemical Society, American Society for Engineering Education

7. Honors and Awards:
   - Fulbright Distinguished Scholar/Researcher, United Kingdom, 2008-2009
   - Univ of Alabama National Alumni Association, Outstanding Commitment to Teaching Award, 2008
   - UA College of Engineering Outstanding Professor, 2007 and 2011
   - UA ChBE Department Outstanding Professor, 2010
   - Inducted into UA Anderson (Honor) Society as Faculty Member, 2010

8. Service Activities:
   - Manuscript Reviewer for over 50 different research journals and publications
   - Proposal Review for NSF, CREES, DoD, and several other organizations
   - Editorial Board, Journal of Pharmaceutics
   - Advisor, student AIChE chapter 2001-2005
   - Founding Advisor, student organization Society of Engineers in Medicine, 2010-
   - Founding Chair, ChBE Honors program, 2003-
   - Several Department and College-level committees (searches, programs, etc.)
   - Internal Program Review Committee, Biological Sciences, 2011-2012

9. Important Publications and Presentations
   a. Publications (83 total, including 2 books; 24 in last 5 years; H-index: 21, >1800 citations):


b. Presentations (137 conference talks, 57 in last 5 years; 33 invited seminars and lectures):


10. **Recent Professional Development Activities:** Learning new educational tools for classroom teaching through UA’s Faculty Resource Center- Blackboard Learn, E-Learning, and TurningPoint Clicker Technology
Faculty Vitae

Eric S. Carlson, Department of Chemical Engineering, Associate Professor

1. **Name:** Eric S. Carlson

2. **Education:**
   - B.S. Petroleum Engineering, University of Wyoming, 1981
   - M.S. Petroleum Engineering, University of Wyoming, 1984
   - Ph.D. Petroleum Engineering, University of Wyoming, 1986

3. **Academic Experience:**
   - The University of Alabama:
     - Associate Professor of Chemical Engineering: August 1996 – Present
     - Assistant Professor of Petroleum Engineering: June 1990 - August 1996
     - University of Maryland European Division - Lecturer: Jan. 1987 - Mar. 1988

4. **Non-Academic Experience:**
   - National Energy Technology Laboratory, Morgantown, WV and Pittsburgh, PA:
     - Part-Time Faculty Research Associate: August 2001 – August 2004
     - Part-Time Faculty Research Associate: October 1991- October 1993
     - Marathon Oil Company – Intern Summer 1981 and Summer 1982

5. **Certifications or Professional Registrations:**
   - EIT, Wyoming 1981

6. **Current Membership in Professional Organizations:**
   - Society of Petroleum Engineers, Interpore

7. **Honors and Awards ($6 Million in contracts):**
   - Carbon-Dioxide-Enhanced Oil Production from the Citronelle Oil Field in the Rodessa Formation; Subcontractor on Proposal sent to USDOE; UA Carlson Amount $375,000 ($75,000/year for 5 years) from UAB/DOE ($187,500 UA In-Kind, roughly .2 FTE/year cost share); performance period 1/07-10/13

8. **Service Activities:**
   - Manuscript Reviewer for over 10 different research journals and publications
   - Proposal Reviewer for USDOE
   - Numerous department and college committees
   - Troubleshoot on numerous platforms and newsgroups for scientific computing

9. **Important Publications and Presentations**
   a. **Publications (32 total, including 1 books):**


b. Presentations (72 Conference and Program Review presentations):


10. Recent Professional Development Activities: Development of numerous open source software projects and open source courses
Faculty Vitae
Arunava Gupta, Department of Chemical Engineering, Professor

1. Name: Arunava Gupta

2. Education:
   - M.Sc., Chemistry, Indian Institute of Technology, Kanpur, India, 1976
   - M.A., Chemistry, Columbia University, New York, 1977
   - Ph.D., Chemical Physics, Stanford University, California, 1980

3. Academic Experience:
   - MINT Professor, Departments of Chemistry and Chemical & Biological Engineering, University of Alabama, 2004-present
   - Visiting Professor, University of Caen, France, 1994-1994

4. Non-Academic Experience:
   - Research Staff Member and Manager, IBM T. J. Watson Research Center, N.Y., 1985-2003
   - Research Chemist, Senior Research Chemist, Allied Corporation, New Jersey, 1980-1984

5. Certifications or Professional Registrations: None

6. Current Membership in Professional Organizations:

7. Honors and Awards:
   - Elected American Association for the Advancement of Science (AAAS) Fellow (2011)
   - Humboldt Research Award (2010)
   - Elected APS Fellow (1998)

8. Service Activities:
   - Faculty mentor for REU and High School Programs at the University of Alabama (2004 - 2012)

9. Important Publications (selected from a total of over 300 peer-reviewed publications):


10. Recent Professional Development Activities:

- Co-organizer of MRS Symposium “Advanced Materials for Half Metallic and Organic Spintronics” at the 2009 MRS Fall Meeting, Boston, MA.

- Co-organizer of DMP focused session on “Complex Oxides” at the 2008 APS March Meeting, New Orleans, LA.
Faculty Vitae

Ryan L. Hartman, Department of Chemical and Biological Engineering, Assistant Professor and Reichhold-Shumaker Fellow

1. Name: Ryan L. Hartman
2. Education:
   - B.S., Chemical Engineering, Michigan Technological University, 2001
   - M.S., Chemical Engineering, University of Michigan, 2003
   - Ph.D., Chemical Engineering, University of Michigan, 2006
3. Academic Experience:
   - Assistant Professor and Reichhold-Shumaker Fellow, Department of Chemical and Biological Engineering, The University of Alabama, Tuscaloosa, AL, 2010– present
   - Adjunct Professor, Tri-Campus Materials Science Program, The University of Alabama System, 2011– present
   - ChBE seminar coordinator, Department of Chemical and Biological Engineering, The University of Alabama, Tuscaloosa, AL, 2012-2013
   - Postdoctoral Associate, Department of Chemical Engineering, Massachusetts Institute of Technology, Cambridge, MA, 2008-2010
4. Non-Academic Experience:
   - Oilfield Chemical Steering Committee Chair, Oilfield Chemical Products, Schlumberger Limited, Sugar Land, TX, 2006-2007
   - Chemical Engineer III, Oilfield Chemical Products, Schlumberger Limited, Sugar Land, TX, 2005-2007
   - Engineering Intern, Oilfield Chemical Products, Schlumberger Limited, Sugar Land, TX, 2002, 2003-2004
   - Summer Chemical Engineering Intern, Vitamins Manufacturing, BASF Corporation, Wyandotte, MI, 2000
5. Certifications or Professional Registrations:
6. Current Membership in Professional Organizations:
   - American Association for the Advancement of Science (Member), 2011-present
   - American Chemical Society (Member), 2011-present
   - Sigma Xi, The Scientific Research Society (Full Member), 2009-present
   - American Society for Engineering Education (Member), 2008-present
   - American Institute of Chemical Engineers (Senior Member), 1999-present
   - Tau Beta Pi, Engineering Honors Society (Member), 2001-present
   - Society of Petroleum Engineers (Member), 2001-2005; 2011-present
   - International Society of Pharmaceutical Engineers (Member), 2001-2005
7. Honors and Awards:
   - AIChE Recognition as a Senior Member, 2012
   - Chemical Engineering Distinguished Lecture Series, Auburn University, 2011
   - Article highlighted in Chemistry World, 2011
   - Article highlighted in Conveying News, 2011
   - Research work cited in AngewandteChemie International News, 2010
   - Schlumberger Inventor Award, 2007
Schlumberger Rewards of Excellence for Innovation, 2007
Research Partnership to Secure Energy for America Fellow, 2003-2004
Summa Cum Laude undergraduate honors, 2001

8. Service Activities:
- Chair, *Microreaction Engineering II Session*, AIChE Annual Meeting 2012
- Co-Chair, *Microreaction Engineering I Session*, AIChE Annual Meeting 2011 & 2012
- Judge, Undergraduate Student Poster Session, AIChE Annual Meeting 2010 & 2011
- NSF Panel Reviewer, 2011-2012
- US DOE Graduate Fellowship Program Reviewer 2012
- ChBE department seminar coordinator, 2012-2013
- Environmental Health and Safety, University Laboratory Safety Committee, 2012-2013
- Department head search committee member, 2012
- Department faculty search committee member, 2011-2012

9. Important Publications and Presentations
a. Publications (83 total, including 2 books; 24 in last 5 years; H-index: 21, >1800 citations):

b. Presentations (137 conference talks, 57 in last 5 years; 33 invited seminars and lectures):

10. Recent Professional Development Activities: ASEE Chemical Engineering Summer School, 2012
Faculty Vitae
Yonghyun (John) Kim, Department of Chemical Engineering, Assistant Professor

1. **Name:** Yonghyun (John) Kim

2. **Education:**
   - Ph.D. Chemical and Biochemical Engineering, University of Maryland, Baltimore County (UMBC), 2008
   - B.S. Chemical Engineering, Lafayette College, 2002
   - B.A. Biochemistry, Lafayette College, 2002

3. **Academic Experience:**
   - Samsung Biomedical Research Institute, Post-doctoral Fellow, 2008-2011, Full-time

4. **Non-Academic Experience:** None

5. **Certifications or Professional Registrations:** None

6. **Current Membership in Professional Organizations:**
   - American Institute of Chemical Engineers (AIChE), American Chemical Society (ACS), American Society for Engineering Education (ASEE)

7. **Honors and Awards:**

8. **Service Activities:** None

9. **Important Publications and Presentations**
   - Klionsky DJ, et al. (2012) Guidelines for the use and interpretation of assays for monitoring autophagy, Autophagy, 8(4):445-544. (one of 1270 authors)
human neural stem cells with rabbit carboxyl esterase can target brain metastasis from breast cancer, Cancer Lett, 311(2):152-159.


**Recent Professional Development Activities:** Joined the University of Alabama, Chemical and Biological Engineering in 2012.
Faculty Vitae
Tonya M. Klein, Department of Chemical Engineering, Associate Professor

1. Name: Tonya M. Klein
2. Education:
   - B.S., Chemical Engineering, The University of Florida, 1994
   - Ph.D., Chemical Engineering, North Carolina State University, 1999
3. Academic Experience:
   The University of Alabama:
   - Assistant Professor of Chemical and Biological Engineering, 1999 - 2005
   - Reichhold-Shumaker Assistant Professor of Chemical Engineering 2001-2005
   - Associate Professor of Chemical and Biological Engineering, 2005 - present
   - ChBE Chair Curriculum and ABET committee, 2010-present
4. Non-Academic Experience: None
5. Certifications or Professional Registrations: None
6. Current Membership in Professional Organizations:
   - American Vacuum Society, American Society for Engineering Education
7. Honors and Awards:
   - CAREER Award 2003
   - Reichhold-Shumaker Professorship 2001-2005
   - GAAN Fellow 1995-1999
   - AIChE Southeast Regional Fellow 1994-1997
   - Tau Beta Pi
   - Florida Academic Scholar 1989-1994
8. Service Activities:
   - ABET curriculum committee (2001-present); Chair (2010-present)
   - Research Advisory Committee (2009-2011)
   - Pre-Engineering Task Force (2008-2009)
   - Chair Faculty Search Committee (2009-2012)
9. Important Publications and Presentations
   a. Publications:
• JS Burgess, CK Acharya, J Lizarazo, N Yancey, B Flowers, G Kwon, T Klein, M Weaver, AM Lane, CH Turner, S Street "Boron Doped Carbon Formed at 1000 degrees C and one Atmosphere"; CARBON 46 (2008) 1711-1717.

b. Presentations:
• N. Li, K. Li, and T.M. Klein, “Remote plasma assisted atomic layer deposition of HfNxCy thin films” 32nd Symposium on Applied Surface Analysis, Orlando, FL, March 7th-10th, 2010.
• Y.-H.A. Wang, N. Li, T.M. Klein and A. Gupta “Epitaxial Growth of Thick NiFe2O4, LiFe5O8 and BaTiO3 Films using Chemical Vapor Deposition for Microwave Device Applications” 55th Annual Conference on Magnetism and Magnetic Materials, November 14th-18th, 2010 Atlanta, GA.
• K. Li, S. Li, N. Li, T.M. Klein and D.A. Dixon “Tetrakis(ethylmethy lamido) Hafnium Adsorption and Reaction on Hydrogen-terminated Si(100) Surfaces” poster at the Southeastern Regional Meeting of the American Chemical Society, New Orleans, LA, November 30th-December 04, 2010.
• K. Li, N. Li, and T.M. Klein, “In situ ATR and transmission FTIR spectroscopy of tetrakis(dimethylamido) hafnium (IV) decomposition and adsorption dynamics on H-Si(100)” AVS 56th International Symposium & Exhibition, San Jose, CA, November 9-13, 2009.

Faculty Vitae
Alan M. Lane, Department of Chemical Engineering, Professor

1. **Name:** Alan M. Lane

2. **Education:**
   - Ph.D., Chemical Engineering, University of Massachusetts, 1984
   - B.S., Chemical Engineering, University of Washington, 1977
   - B.S., Chemistry, University of Washington, 1977

3. **Academic Experience:**
   The University of Alabama:
   - Assistant Professor 1986-1993
   - Associate Professor 1993-2000
   - Professor and Graduate Program Director 2000-present

4. **Non-Academic Experience:**
   - Argonne National Laboratory, Argonne, Il, Summer, 2000, Visiting Scientist, catalytic combustion of fuel cell exhaust.
   - The University of Wales, Bangor, Wales, Fall, 1995, Visiting Scientist, dispersion quality of magnetic colloids.
   - Qingdao Institute of Chemical Technology, Qingdao, PRC, Summer, 1993, Visiting Scientist, computer modeling of chemical reactors.
   - Union Carbide Corporation, South Charleston, West Virginia, 1984-1986, Research Engineer, novel polymerization processes with Ziegler-Natta and free-radical catalysts.

5. **Certifications or Professional Registrations:** None

6. **Current Membership in Professional Organizations:**
   - American Institute of Chemical Engineers

7. **Honors and Awards:**
   - 1988/1989 Lilly Teaching Scholar - a competitive award for new faculty already established in research based on a teaching project proposal. I set up a College of Engineering committee on effective teaching.
   - 1989 Dow Outstanding Young Faculty Award (SE Section) - a competitive award given by the American Society for Engineering Education for overall excellence.
   - 1989 Outstanding Section Campus Representative Award, American Society for Engineering Education, Southeastern Section.
   - 1989/1990 AIChE Outstanding Professor Award - voted best professor in the Department of Chemical Engineering by the students.
   - 1990 College of Engineering Outstanding Instructional Award - based on a paper published in Chemical Engineering Education.
- 1991/1992 Reichhold-Shumaker Professor of Chemical Engineering - an endowed research award based on an interdepartmental research proposal.
- 1992 Most Outstanding Advisor for a Professional Group by the Coordinating Council for Student Organizations, for work as AIChE student chapter advisor.
- 1993/1994 Nominated for Amoco Outstanding Undergraduate Teaching Award with certificate of recognition - one of several finalists nominated by engineering students.
- 1996 Best Paper Award of the Molding Methods and Materials Division of the AFS-sponsored Castings Congress.
- 2000 Best Paper Award of the Steel Division of the AFS-sponsored Castings Congress.

8. Service Activities:
- Regular reviewer for journals and funding agencies.
- Panel reviewer for NSF SBIR program.
- Department and College Tenure and Promotion Committee
- Department Graduate Program Director

9. Important Publications and Presentations
a. Publications (72 total):
   - W. Li and A. M. Lane, “Resolving the HUPD and HOPD by DEMS to determine the ECSA of Pt electrodes in PEM fuel cells,” Electrochemistry Comm. 13, 913–916 (2011).

b. Presentations:
   - M. Lane, “So Where Is My Fuel Cell Car?” UAB American Chemical Society Student Chapter, 9/26/06.

10. Recent Professional Development Activities: None
Faculty Vitae
Xiaoguang (Margaret) Liu, Dept. of Chemical & Biological Engineering, Assistant Professor

1. **Name:** Xiaoguang (Margaret) Liu
2. **Education:**
   - B.S., Major in Chemical Engineering, Minor in Computer Science and Engineering, Shandong University, 1997
   - M.S., Biochemical Engineering, Tianjin University, 2000
   - Ph.D, Chemical and Biomolecular Engineering, Ohio State University, 2005
3. **Academic Experience:**
   - University of Alabama, Assistant Professor, Department of Chemical and Biological Engineering, 2012–present
   - University of Alabama, Adjunct Assistant Professor, Department of Biological Science, 2012 – present
4. **Non-Academic Experience:**
   - Life Technologies (Invitrogen), Staff Scientist (Sr. Scientist), Project and R&D Lead, Cell Culture and Cell Line, PD-Direct Department, 2007 – 2011
   - EMD Pharmaceuticals Inc. (MerkKGaA), Scientist, Cell Culture Process Development, 2005 – 2006
5. **Certifications or Professional Registrations:** None
6. **Current Membership in Professional Organizations:**
   - Member, American Chemistry Society
   - Member, American Institute of Chemical Engineering
   - Member, Society of Women Engineering (SWE)
7. **Honors and Awards:**
   - Life Technologies Bronze Award, Life Technologies, Frederick, MD, 2011
   - R&D and NPI Excellent Award, Life Technologies, Frederick, MD, 2010
   - R&D Excellence Award, Life Technologies, Frederick, MD, 2010
   - R&D Excellence Award, Life Technologies, Frederick, MD, 2010
   - New Idea Award, Life Technologies (Invitrogen), Frederick, MD, 2008
   - R&D Excellence Award, Life Technologies (Invitrogen), Frederick, MD, 2008
   - Customer Excellence Award, Life Technologies (Invitrogen), Frederick, MD, 2008
   - Alumni Grants for Graduate Research and Scholarship, Ohio State University, Columbus, OH, 2005
   - Outstanding Graduate Student, Ohio State University, Columbus, OH, 2005
   - CPBR Research Fellowship, Ohio State University, Columbus, OH, 2003-2004
   - Graduate Fellowship, Ohio State University, Columbus, OH, 2001-2002
8. **Service Activities:**
   - Review >10 journal papers for multiple journals each year
   - Chair AIChE oral presentation section
   - AHA proposal review panel
9. **Important Publications and Presentations**
   a. **Publications:**

183
• Dong, W., Yang, S.T., and Liu, X. Butyric acid production from sugarcane bagasse hydrolysate by *Clostridium tyrobutyricum* immobilized in a fibrous-bed bioreactor. Bioresource Technology. 129, 553-560 (2013).

b. Presentations:

10. **Recent Professional Development Activities:**
• Recruit and mentor graduate student
• Mentor REU undergraduate researchers
• Recruit Summer Intern
Faculty Vitae
Stephen M.C. Ritchie, Department of Chemical & Biological Engineering, Associate Professor

1. Name: Stephen M.C. Ritchie

2. Education:
   - B.S., Chemical Engineering, University of Toledo, 1995
   - Ph.D., Chemical Engineering, University of Kentucky, 2001
   - Post-doctoral Scholar, University of Kentucky, 2001

3. Academic Experience:
The University of Alabama:
   - Assistant Professor of Chemical Engineering, 2001-2007
   - Reichhold-Shumaker Assistant Professor of Chemical Engineering, 2003-2007
   - Associate Professor of Chemical Engineering, 2007-present
   - Graduate Coordinator, Chemical & Biological Engineering, 2008-2010

4. Non-Academic Experience:
   - Intern, UOP LLC, Des Plaines, IL, 2000
   - NASA Faculty Fellow, Marshall Space Flight Center, Huntsville, AL, 2002-2003
   - Visiting Scientist, Sepro Membranes, Inc., Oceanside, CA, 2012-present

5. Certifications or Professional Registrations: None

6. Current Membership in Professional Organizations:
   - North American Membrane Society
   - American Institute of Chemical Engineers
   - American Chemical Society

7. Honors and Awards:
   - NSF-IGERT Scholar at University of Kentucky, 1998 – 2001
   - Dr. Leon Y. Sadler III Outstanding Faculty Award, April 2004
   - AIChE Outstanding Faculty Award, 2008 and 2009

8. Service Activities:
   - Co-Chair, North American Membrane Society, 2012 Annual Meeting, New Orleans, LA, June 2012
   - Board of Directors, North American Membrane Society (June 2007 – July 2010)
   - Co-Chair, North American Membrane Society, 2006 Annual Meeting, Chicago, IL, May 12-17, 2006
   - Fundraising Chair, Engineering Conferences International, “Advanced Membrane Technology II,” May 2004, Irsee, Germany
   - AIChE 2G Area Vice Chair, November 2009 – Present
   - AIChE 2G Area Chair, November 2003 – November 2009
   - Session Chair or Co-Chair, AIChE and NAMS Meetings (~40 sessions), 2002 – 2012
   - Co-Advisor, Omega Chi Epsilon (Fall 2001 – Spring 2005)
   - Advisor, American Institute of Chemical Engineers (Fall 2006 – Present)

9. Important Publications and Presentations
   a. Publications (35 total, including 3 book chapters, 24 journal publications, and 3 patents):

b. Presentations (~75 conference presentations, posters, and invited seminars and lectures):

10. Recent Professional Development Activities: None
Faculty Vitae

C. Heath Turner, Dept. of Chemical & Biological Engineering, Associate Professor

1. Name: C. Heath Turner
2. Education:
   - B.S., Chemical Engineering, Auburn University, 1996
   - M.S., Chemical Engineering, North Carolina State University, 1999
   - Ph.D., Chemical Engineering, North Carolina State University, 2002
3. Academic Experience:
   - University of Alabama, Interim Department Head, Chemical and Biological Engineering, 2010-2011
   - UA-UAH-UAB Tri-Campus Material Science Faculty Member, 2011-current
   - University of Alabama, Graduate Coordinator, Chemical and Biological Engineering, 2010
   - Associate Professor, University of Alabama, 2009-current
   - Naval Research Lab Summer Faculty Fellow, Chemistry Division, Summer 2007
   - NASA Summer Faculty Fellow, Atmospheric Sciences, Summer 2005
   - University of Alabama, Reichhold-Shumaker Assistant Professor, 2005-2009
   - University of Alabama, Assistant Professor, 2003-2009
   - North Carolina State University, Research Assistant, 1997-2002
4. Non-Academic Experience:
   - Monsanto, Decatur, AL. Co-op position in the acrylic fiber R&D department, performing various engineering tasks. 1994.
5. Certifications or Professional Registrations: FE exam passed
6. Current Membership in Professional Organizations:
7. Honors and Awards:
   a. AICHE Most Outstanding Faculty Member (2011), Omega Chi Epsilon Most Outstanding Faculty Member (2013), NSF CAREER Award (2008), Simmons Endowed Excellence Award (2007)
8. Service Activities:
   - Manuscript reviewer for approximate 50 different journals, Proposal Reviewer for Swiss National Science Foundation Irish Research Council for Science, Engineering and Technology (IRCSET), Hong Kong Research Grants Council (RGC), Canada Foundation for Innovation, Department of Homeland Security (DHS) scholarship and fellowship panelist, National Defense Science and Engineering Graduate (NDSEG) Fellowships, NSF proposal reviewer panelist (CTS/CBET,
EEC/REU/RET, CH, and SBIR Phase I & II) – approximately 30 panel reviews, Department of Energy (DOE) ad-hoc proposal reviewer, U.S. Civilian Research and Development Foundation (CRDF), Louisiana Board of Regents proposal reviewer, Mississippi NSF EPSCoR proposal reviewer, American Chemical Society Petroleum Research Fund (ACS-PRF), Research Corporation for Science Advancement

- UA Research Advisory Committee, UA Faculty Senator, UA Graduate Council, UA Technology and Learning Committee, UA CAREER award workshop leader, UA College of Engineering Strategic Planning Committee, UA College of Engineering Information Technology Services Review Committee, UA College of Engineering ABET Committee, UA College of Engineering Academic Misconduct Monitor, UA College of Engineering Retention, Promotion, and Tenure Committee, UA MINT Center Nanoscale Theory Faculty Search Committee, UA MTE Department Faculty Search Committee, UA Goldwater Scholarship Selection Committee, Chair of the UA ChBE Department Head Search Committee, UA Environmental Institute Director Search Committee, UA ChBE Retention, Promotion, and Tenure Committee (Chair), UA ChBE Emerging Scholars Program Coordinator, UA ChBE Undergraduate Research Coordinator, UA ChBE 100th Anniversary Committee (recruited Sen. Shelby as speaker), UA ChBE Graduate Program Coordinator (2010), UA ChBE Department Webmaster, UA ChBE Junior Faculty Mentor, UA ChBE Equipment and Computer Committee, UA ChBE Faculty Search Committee, UA ChBE Alumni Relations Committee, UA Graduate Parent Support (GPS) member, AICHE Area 1a Programming Committee, Chair for multiple sessions at AIChe Annual Meetings, Catalysis and Reaction Engineering poster session judge at AIChe Annual Meeting, Adsorption section poster session judge at AIChe Annual Meeting, Panelist at the SWE Region D Conference, Faculty Advisor, Omega Chi Epsilon at UA, University Fellows Experience Mentor at UA

9. Important Publications and Presentations


10. Recent Professional Development Activities: DoD Material Science Workshops
Faculty Vitae
John W. Van Zee, Dept. of Chemical & Biological Engineering, Professor

1. **Name:** John W. Van Zee

2. **Education:**
   - Ph. D., Chemical Engineering, Texas A&M University (1984)
   - M. S., Chemical Engineering, Texas A&M University (1982)
   - B. S., Chemical Engineering, University of California-Berkeley (1975)

3. **Academic Experience:**
   - Professor and Department Head, Dept. of Chemical Engineering, The University of Alabama (January 2013-present)
   - Director, NSF I/UCRC for Fuel Cells, University of South Carolina (Mar 2002-January 2013)
   - Professor, Dept. of Chemical Engineering, University of South Carolina (Jun 2000-January 2013)
   - Visiting Scholar, Dept. of Chemical Engineering, University of Virginia (Mar-Dec 1997)
   - Associate Professor, Dept. of Chemical Engineering, University of South Carolina (Aug 1989-Jun 2000)
   - Graduate Director, Dept. of Chemical Engineering, University of South Carolina (Aug 1987 - Sept 1994)
   - Assistant Professor, Dept. of Chemical Engineering, University of South Carolina (Jul 1984 - Aug 1989)
   - Research Assistant, Dept. of Chemical Engineering, Texas A & M University (Sep 1981 - Jul 1984)
   - Instructor, Dept. of Chemical Engineering, Texas A & M University (Sept 1979 - Aug 1981)
   - Teaching Assistant, Dept. of Chemical Engineering, Texas A & M University (Jan-Sept 1979)

4. **Non-Academic Experience:**
   - Co-founder, Battery Design Company (Sept 1999-present)
   - Chemical Engineer, Dow Chemical Company (Jun-Sept 1981)
   - Director of Engineering, Chiapas Relief & Encouragement Organization (Jun 1976 - Dec 1978)
   - Field Engineer, Chiapas Relief & Encouragement Organization (Oct 1975 - Jun 1976)

5. **Certifications or Professional Registrations:** None

6. **Current Membership in Professional Organizations:**
   - Omega Chi Epsilon (TAMU)
   - Tau Beta Pi
   - American Institute of Chemical Engineers (AIChE)
   - Electrochemical Society. American Chemical Society (ACS)
   - National Association of Corrosion Engineers (NACE)
   - American Society of Engineering Educators (ASEE)
7. **Honors and Awards:**
- Samuel Litman, Outstanding Engineering Professor, University of South Carolina, 1997
- Omega Chi Epsilon, Outstanding Teacher of the Year, University of South Carolina, Chemical Engineering, 1990
- Mortarboard Excellence in Teaching Award, 1990, University of South Carolina
- NASA - ASEE Summer Faculty Fellowship Recipient, 1988
- Navy - ASEE Summer Faculty Research Program, 1988
- Distinguished Graduate Student Award, Doctoral Level, presented by the Graduate College and the Association of Former Students, Texas A&M University, 1984

8. **Service Activities:**
- Associate Editor, International Journal Hydrogen Energy (01/04-present)

9. **Important Publications:**


10. **Recent Professional Development Activities:**
- Attendance at the Council of Chemical Research Meeting where safety was and instructional challenges were reviewed, May 2013.
Faculty Vitae
Hung-Ta Wang, Department of Chemical Engineering, Assistant Professor

1. Name: Hung-Ta Wang
2. Education:
   - B.S., Chemical Engineering, National Cheng-Kung University, 1995-1999
   - M.S., Chemical Engineering, National Cheng-Kung University, 1999-2001
   - Ph.D., Chemical Engineering, University of Florida, 2004-2008
3. Academic Experience:
   - University of California, Berkeley, Postdoc, Department of Chemistry, 2008-2011
   - University of Alabama, Assistant Professor, Department of Chemical and Biological Engineering, 2011-present
4. Non-Academic Experience:
   - Mandatory Officer (1st Lieutenant), Army, Taiwan, 2001-2003
   - Front-end Process Integration Engineer, Fab-6, Taiwan Semiconductor Manufacturing Company (TSMC), Taiwan, 2003-2004
   - NanoInkInc., Intern, 2008
5. Certifications or Professional Registrations: None
6. Current Membership in Professional Organizations:
   - Member of American Institute for Chemical Engineers, Materials Research Society, Electrochemical Society, American Society for Engineering Education
7. Honors and Awards:
   - Electrochemical Society Student Travel Award, 206th ECS conference, Oct. 2005
   - Electrochemical Society Student Travel Award, 211th ECS conference, May 2007
   - Electrochemical Society Student Travel Award, 212th ECS conference, Oct. 2007
   - 2012 R&D 100 Award: Multinozzle Emitter Array (MEA), along with Pan Mao, Peidong Yang, and Daojing Wang
8. Service Activities:
   - Manuscript Reviewer for several research journals
   - 2013 AIChE Annual meeting chair
9. Important Publications and Presentations
   a. Publications (selected from 51 papers, 1 book chapter, and 6 patents):

b. Presentations (selected from 10 conference talks; 4 invited seminars):
- Graduate seminar, "Holey silicon as an efficient thermoelectric materials,” Department of Chemical Engineering, Carnegie Mellon University, March 1, 2011.
- Graduate seminar, "Holey silicon as an efficient thermoelectric materials,” School of Material Science and Engineering, Nanyang Technological University, on November 16, 2010.

10. Recent Professional Development Activities:
- Attending ASEE: Chemical Engineering Division 2012 Summer School, learning new educational tools for classroom teaching through UA’s Faculty Resource Center, including Blackboard Learn, Creating Video and multimedia Assignments
APPENDIX C. EQUIPMENT
### TUSCALOOSA FACILITIES

<table>
<thead>
<tr>
<th>UV-1650 UV-Visible Spectrophotometer</th>
<th>Microfuge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stirred Tank Reactor Series</td>
<td>Spray Dryer</td>
</tr>
<tr>
<td>Isotemp Oven</td>
<td>Multi-Tube Heat Exchanger</td>
</tr>
</tbody>
</table>
Packed Column
Pipe Flow System
Gas Absorption Column
Infrared Gas Analyzer
Gas Chromatograph
Water Bath Setup for Heat Transfer Experiments
<table>
<thead>
<tr>
<th>Chemical Safety Hood</th>
<th>Chemical Safety Hood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balance</td>
<td>Balance</td>
</tr>
<tr>
<td>Tray Drier</td>
<td>Flammable Materials Cabinet</td>
</tr>
<tr>
<td>Image 1</td>
<td>Image 2</td>
</tr>
<tr>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>Micropipettes</td>
<td>Double-Plate Heat Exchanger</td>
</tr>
<tr>
<td>Image 3</td>
<td>Image 4</td>
</tr>
<tr>
<td>Tube Furnace</td>
<td>Armfield Stirred Tank Reactor</td>
</tr>
<tr>
<td>Image 5</td>
<td></td>
</tr>
<tr>
<td>Distillation Column</td>
<td></td>
</tr>
</tbody>
</table>
# DENMARK FACILITIES

<table>
<thead>
<tr>
<th>Distillation Column Control</th>
<th>High Temp Short Time Pasteurizer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Control - 2 Tank Level Control</td>
<td>Flow in Packed Columns</td>
</tr>
<tr>
<td>Drying in a Tunnel</td>
<td>Falling Film Evaporation</td>
</tr>
</tbody>
</table>
Falling Film Evaporation

Ultrafiltration

Pump Systems

Fermentation

Solid/Liquid Extraction

Spray Drying
APPENDIX D. INSTITUTIONAL SUMMARY
1. The Institution:
   Institution name and address: The University of Alabama
   Box 870100
   Tuscaloosa, AL 35487-0100
   www.ua.edu
   Chief Executive Officer: Dr. Judith L. Bonner, President
   Self-Study Submitted by: John W. Van Zee, Ph.D.

   Current Accreditations: The University of Alabama is accredited by the
   Commission on Colleges of the Southern Association of Colleges and Schools (SACS) to award bachelors, masters,
   educational specialist, and doctoral degrees. The most recent reaffirmation of accreditation by SACS was in 2010.
   The University’s accreditation now runs through 2015.

2. Type of Control:
   The University of Alabama is a State institution. The University of Alabama (together with The University of
   Alabama at Birmingham and The University of Alabama in Huntsville) is one of three institutions that comprise
   The University of Alabama System. The System is governed by The Board of Trustees of The University of
   Alabama as stipulated by the Alabama Constitution. The purpose of the Board of Trustees is to ensure the
   effective leadership, management, and control of the System institutions in order to provide for a definitive, orderly form
   of governance and to secure and maintain responsive, progressive, and superior institutions of higher education. The
   Board of Trustees created the present multi-campus structure in 1969 and each of the component institutions has a unique
   mission that is consistent with the broader mission of the System.

   The Board of Trustees is a self-nominating Board of fifteen elected and two ex-officio members. The Constitution
   of the State of Alabama provides that the Board is composed of three members from the congressional district in which the
   Tuscaloosa campus is located and two members from each of the remaining six congressional districts. The Governor and the
   State Superintendent of Education are ex-officio members of the Board. Those members who are not ex-officio are elected by the
   Board, subject to confirmation by the State Senate and may serve up to three consecutive six-year terms. The primary functions of
   the Board are to determine the major policies of the System. These include reviewing existing policy; defining
   the mission, role, and scope of each campus; and assuming ultimate responsibility to the public and political bodies of Alabama.
   Rules, policies, and procedures are promulgated to ensure that, through The University of Alabama System Office, the necessary flow of information
   for such accountability takes place.

   The Board of Trustees executes its governance responsibilities through a chancellor, who serves as the chief executive officer of the System. A president heads each campus with responsibility for campus administration and reports directly to the Chancellor, and through the Chancellor to the Board of Trustees. The Board of Trustees and the Chancellor delegate certain administrative functions and maintain such offices as deemed appropriate to meet the administrative needs of the System. The Chancellor also provides linkage between the System and various components of state and federal governments, as well as other educational groups and organizations.
3. Educational Unit:
The College of Engineering is one of 11 instructional colleges comprising The University of Alabama. The College of Engineering currently enrolls approximately 3,600 undergraduates and 400 graduate students. This represents approximately 12% of the total enrollment at the University of Alabama. There were approximately 117 engineering faculty in AY2012-13, representing approximately 10% of the University faculty. The College is organized administratively into seven departments as follows:

- **Aerospace Engineering and Mechanics,** Head: Dr. John Baker
- **Chemical and Biological Engineering,** Head: Dr. John Van Zee
- **Civil, Construction and Environmental Engineering,** Head, Dr. Kenneth Fridley
- **Computer Science,** Head: Dr. David Cordes
- **Electrical and Computer Engineering,** Head: Dr. Timothy Haskew
- **Mechanical Engineering,** Head: Dr. Clark Midkiff
- **Metallurgical and Materials Engineering,** Head: Dr. Viola Acoff

The seven department heads report to the Dean of the College of Engineering. The Office of the Dean is organized as follows:

- **Dean:** Dr. Charles Karr
- **Associate Dean for Academic Programs:** Dr. Kevin Whitaker
  - Director of Engineering Student Services: Mr. Gregory Singleton
  - Coordinator of Engineering Student Recruitment: Ms. Lynsey Dill
  - Coordinator of Multicultural Engineering Program: Mr. Greg Singleton (acting)
  - Director of Cooperative Education: Mr. Roy Gregg
  - Director of the Freshman Engineering Program: Dr. David Cordes
- **Associate Dean for Research and Graduate Studies:** Dr. John Wiest
- **Director of External Affairs and Development:** Mr. Allen McClendon
  - Director of the Capstone Engineering Society: Ms. Nancy Holmes
  - Events Coordinator: Ms. Carol Sanders
  - Communications Specialist: Mr. Adam Jones
- **Director of Financial Affairs:** Mr. Mike Rhiney
- **Director of Information Technology and Engineering Services:** Dr. Lawrence Hill

An organization chart showing the university structure is included as Table D3-1 and an organization chart for the College of Engineering is included as Table D3-2.
Table D3-1. The University of Alabama Organizational Chart
Table D3-2. The College of Engineering Organizational Chart
4. Academic Support Units

The College of Engineering experiences a high-level of quality support from numerous academic units across campus. The names and titles of those responsible for the programs are listed below:

- Department of Mathematics, Chair: Dr. Zhijian Wu
- Department of Chemistry, Chair: Dr. Kevin Shaughnessy
- Department of Physics and Astronomy, Chair, Dr. Raymond White
- Department of Biological Sciences, Chair: Dr. Patricia Sobecky
- Department of English, Chair: Dr. Catherine Davies

5. Non-Academic Support Units:

The University of Alabama has a wide-range of non-academic institutional support units and facilities that positively impact programs, professional development, and student life. Many are described in detail on pages 34-36 of The University of Alabama 2012-2013 Undergraduate Catalog. Some of the larger institutional support units directly impacting the quality of instruction in the College of Engineering are the following.

- University Library System, Louis Pitschmann, Dean
  John Sandy, Head, Science and Engineering Library
- University Computer Center, John McGowan, Vice Provost and CIO
- Career Center, Travis Railsback, Executive Director
- Gayle Howell, Senior Consultant, Engr. Satellite
- Center for Academic Success, Holly Hallman, Director
- Office for Disability Services, Judy Thorpe, Director
- Student Health Center, John Maxwell, Chief Administrative Officer
- University Recreation, George Brown, Executive Director
- Women’s Resource Center, Ellen Shaaban-Magana, Director

6. Credit Unit:

The University of Alabama follows the standard definition where one credit hour represents one class hour or three laboratory hours per week. Each semester, inclusive of final exams, is fifteen weeks. The academic year consists of the Fall and Spring semesters for 30 total weeks of instruction. A student is considered full-time if they take 12 or more credit hours per semester.

7. Tables:
### Table D-1. Program Enrollment and Degree Data

Chemical and Biological Engineering

<table>
<thead>
<tr>
<th>Academic Year</th>
<th>Enrollment Year</th>
<th>Total Undergrad</th>
<th>Total Grad</th>
<th>Degrees Awarded</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1st</td>
<td>2nd</td>
<td>3rd</td>
<td>4th</td>
</tr>
<tr>
<td>2012</td>
<td>FT</td>
<td>186</td>
<td>159</td>
<td>123</td>
</tr>
<tr>
<td></td>
<td>PT</td>
<td>2</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>FT</td>
<td>116</td>
<td>133</td>
<td>91</td>
</tr>
<tr>
<td></td>
<td>PT</td>
<td>3</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>FT</td>
<td>139</td>
<td>107</td>
<td>74</td>
</tr>
<tr>
<td></td>
<td>PT</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>2009</td>
<td>FT</td>
<td>120</td>
<td>73</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>PT</td>
<td>2</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>2008</td>
<td>FT</td>
<td>79</td>
<td>61</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>PT</td>
<td>2</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

Give official fall term enrollment figures (head count) for the current and preceding four academic years and undergraduate and graduate degrees conferred during each of those years. The "current" year means the academic year preceding the fall visit.

FT--full time  
PT--part time
Table D-2. Personnel
Chemical and Biological Engineering

Year\(^1\): Fall 2012

<table>
<thead>
<tr>
<th></th>
<th>HEAD COUNT</th>
<th>FTE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FT</td>
<td>PT</td>
</tr>
<tr>
<td>Administrative(^2)</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Faculty (tenure-track)(^3)</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>Other Faculty (excluding student Assistants)</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Student Teaching Assistants(^4)</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Technicians/Specialists</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Office/Clerical Employees</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Others(^4)</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>19</td>
<td>11</td>
</tr>
</tbody>
</table>

Report data for the program being evaluated.

1 Data on this table should be for the fall term immediately preceding the visit. Updated tables for the fall term when the ABET team is visiting are to be prepared and presented to the team when they arrive.

2 Persons holding joint administrative/faculty positions or other combined assignments should be allocated to each category according to the fraction of the appointment assigned to that category.

3 For faculty members, 1 FTE equals what your institution defines as a full-time load.

4 For student teaching assistants, 1 FTE equals 20 hours per week of work (or service). For undergraduate and graduate students, 1 FTE equals 15 semester credit-hours (or 24 quarter credit-hours) per term of institutional course work, meaning all courses — science, humanities and social sciences, etc.

4 Specify any other category considered appropriate, or leave blank.
APPENDIX E. ADVISING INFORMATION
A BASIC GUIDE TO CHEMICAL & BIOLOGICAL ENGINEERING AT UA

The University of Alabama’s Department of Chemical and Biological Engineering offers a BS CHE degree which is accredited by the ABET, Inc. You can learn more about applying to the university by contacting the Admission Office.

Today’s world is full of challenges for those who want to help create better and safer products for the home and for industry, to develop new resources of energy, to fight pollution and preserve our environment and natural resources. Chemical engineers accept these challenges. In fact, we believe a degree in chemical engineering is the best preparation for someone who wants to make a difference in the world today.

You will earn the equivalent of minors in chemistry and math. The University’s core curriculum requires 18 hours of humanities and social sciences for a well-rounded education. Other required courses in engineering prepare you for the Fundamentals of Engineering exam, the first step in professional registration. Technical electives give you a chance to specialize in an area of your interest, such as biology, materials processing or business.

It is a rigorous and demanding curriculum designed to shape students into the kinds of people who understand as much as possible about their world and their roles in it.

Much of the information included in this handout can be found at che.eng.ua.edu – click on undergraduate

-updated October 2012-
The ChBE Flowchart for Courses

Flow Charts are also available for 1. Dual CH/ChE, 2. Pre-Med, 3. Accelerated 7 semesters + 1 summer, 4. BS/MS Scholars Program (see che.eng.ua.edu)
## CHEMICAL AND BIOLOGICAL ENGINEERING CURRICULUM

### FRESHMAN YEAR

<table>
<thead>
<tr>
<th>First Semester</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH 101 General Chemistry I (N)</td>
<td>4</td>
</tr>
<tr>
<td>CHE 125 Introduction to Chemical Engineering</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 111 Engineering the Future</td>
<td>1</td>
</tr>
<tr>
<td>EN 101 English Composition I (FC)</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 131 Engineering Concepts &amp; Design I</td>
<td>1</td>
</tr>
<tr>
<td>MATH 125 Calculus I (MA)</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 151 Fundamental Engineering Graphics</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td><strong>15</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second Semester</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>BSC 114 Principles of Biology I (N)</td>
<td>3</td>
</tr>
<tr>
<td>CH 102 General Chemistry II (N)</td>
<td>4</td>
</tr>
<tr>
<td>EN 102 English Composition II (FC)</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 141 Engineering Concepts &amp; Design II</td>
<td>1</td>
</tr>
<tr>
<td>MATH 126 Calculus II (MA)</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td><strong>15</strong></td>
</tr>
</tbody>
</table>

### SOPHOMORE YEAR

<table>
<thead>
<tr>
<th>First Semester</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CH 231 Elementary Organic Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHE 254 Chemical Engineering Calculations</td>
<td>4</td>
</tr>
<tr>
<td>MATH 227 Calculus III (MA)</td>
<td>4</td>
</tr>
<tr>
<td>PH 105 General Physics with Calculus I (N)</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td><strong>15</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second Semester</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CH 232 Elementary Organic Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>CHE 255 Chemical Engineering Thermodynamics (C)</td>
<td>4</td>
</tr>
<tr>
<td>MATH 238 Applied Differential Equations I (MA)</td>
<td>3</td>
</tr>
<tr>
<td>History (HI) or Social Behavioral Sciences (SB) Elective</td>
<td>3</td>
</tr>
<tr>
<td>Humanities (HU), Literature (L), or fine arts (FA) elective</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>16</strong></td>
</tr>
</tbody>
</table>
JUNIOR YEAR

First Semester
CHE 304 Fluid Flow Operations 3
CHE 306 Heat Transfer Operations 3
CHE 324 Transport Phenomena (C) 3
Engineering elective (see advisor) 3
History (HI) or social and behavioral sciences (SB) elective* 3
\[15\]

Second Semester
CHE 305 Separation Processes (C) 3
CHE 319 Basic Chemical Engineering Laboratory 2
CHE 354 Chemical Reactor Design 3
CH 237 Organic Chemistry Laboratory I 2
Career Elective (see advisor) 3
History (HI) or social and behavioral sciences (SB) electives* 3
\[16\]

SUMMER
CHE 320 Operations Laboratory (W) 4

SENIOR YEAR

First Semester
CHE 481 Chemical Process Design I 3
CHE 493 Process Dynamics and Control 3
PH 106 General Physics with Calculus II (N) 4
Chemical Engr. Elective (see advisor) 3
Humanities (HU), Literature (L), or fine arts (FA) electives 3
\[16\]

Second Semester
CHE 482 Chemical Process Design II (W) 3
Advanced science elective (see advisor) 3
Biochem elective (see advisor) 3
Career elective (see advisor) 3
Humanities (HU), literature (L), or fine arts (FA) elective 3
\[15\]

Total: 127 hours

*Note: EC 110 is a recommended SB course.
*Some undergraduates may qualify to enroll in 500-level courses.
**ELECTIVES: HY/SB and HU/L/FA**

Engineering students must complete 9 hours of History/Social Behavior (HY/SB) electives and 9 hours of Humanities/Languages/Fine Arts (HU/L/FA) electives. Of those 18 hours, 6 must be a depth sequence—i.e., two courses in the same subject (e.g., EC 110-EC 111).

**HY/SB**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
<th>Type</th>
<th>Department</th>
<th>Course Number</th>
<th>Course Title</th>
<th>Hours</th>
<th>Type</th>
<th>Department</th>
<th>Course Number</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAST</td>
<td>Intro to African American Studies</td>
<td>SB</td>
<td>HY</td>
<td>HI</td>
<td>105</td>
<td>Honors Western Civilization to 1648</td>
<td>HI</td>
<td>SB</td>
<td>HI</td>
<td>166</td>
<td>Honors Western Civilization since 1648</td>
</tr>
<tr>
<td>AHE</td>
<td>Freshman Seminar</td>
<td>SB</td>
<td>HY</td>
<td>HI</td>
<td>166</td>
<td>Honors Western Civilization since 1648</td>
<td>HI</td>
<td>SB</td>
<td>HI</td>
<td>203</td>
<td>American Civilization to 1865</td>
</tr>
<tr>
<td>AMS</td>
<td>Freshman Seminar</td>
<td>SB</td>
<td>HY</td>
<td>HI</td>
<td>204</td>
<td>American Civilization since 1865</td>
<td>HI</td>
<td>SB</td>
<td>HI</td>
<td>205</td>
<td>Honors American Civilization to 1865</td>
</tr>
<tr>
<td>AMS</td>
<td>Intro to African American Studies</td>
<td>SB</td>
<td>HY</td>
<td>HI</td>
<td>206</td>
<td>Honors American Civilization since 1865</td>
<td>HI</td>
<td>SB</td>
<td>HI</td>
<td>208</td>
<td>Culture and Human Experience</td>
</tr>
<tr>
<td>ANT</td>
<td>Introduction to Anthropology</td>
<td>SB</td>
<td>IHP</td>
<td>SB</td>
<td>103</td>
<td>Discoveries in Archaeology</td>
<td>SB</td>
<td>MC</td>
<td>SB</td>
<td>101</td>
<td>Mass Communication</td>
</tr>
<tr>
<td>ANT</td>
<td>Introduction to Cultural Anthropology</td>
<td>SB</td>
<td>IHP</td>
<td>SB</td>
<td>155</td>
<td>Honors Freshman Seminar</td>
<td>SB</td>
<td>MC</td>
<td>SB</td>
<td>155</td>
<td>Honors Freshman Seminar</td>
</tr>
<tr>
<td>BUI</td>
<td>Foundation: Possibilities</td>
<td>SB</td>
<td>NEW</td>
<td>SB</td>
<td>102</td>
<td>Social Science I - Cooperation and</td>
<td>SB</td>
<td>NEW</td>
<td>SB</td>
<td>237</td>
<td>Social Science I - Cooperation and</td>
</tr>
<tr>
<td>CJ</td>
<td>Introduction to Criminal Justice</td>
<td>SB</td>
<td>NEW</td>
<td>SB</td>
<td>238</td>
<td>Honors Social Science I</td>
<td>SB</td>
<td>NEW</td>
<td>SB</td>
<td>238</td>
<td>Honors Social Science I</td>
</tr>
<tr>
<td>COM</td>
<td>Principles of Human Communication</td>
<td>SB</td>
<td>NEW</td>
<td>SB</td>
<td>101</td>
<td>Freshman Seminar</td>
<td>SB</td>
<td>NEW</td>
<td>SB</td>
<td>155</td>
<td>Freshman Seminar</td>
</tr>
<tr>
<td>COM</td>
<td>Interpersonal Communication</td>
<td>SB</td>
<td>NUR</td>
<td>SB</td>
<td>220</td>
<td>Principles of Microeconomics</td>
<td>SB</td>
<td>PSC</td>
<td>SB</td>
<td>101</td>
<td>Introduction to American Politics</td>
</tr>
<tr>
<td>CSM</td>
<td>Freshman Seminar</td>
<td>SB</td>
<td>PSC</td>
<td>SB</td>
<td>110</td>
<td>Principles of Microeconomics</td>
<td>SB</td>
<td>PSC</td>
<td>SB</td>
<td>155</td>
<td>Freshman Seminar</td>
</tr>
<tr>
<td>EC</td>
<td>Principles of Microeconomics</td>
<td>SB</td>
<td>PSC</td>
<td>SB</td>
<td>111</td>
<td>Principles of Microeconomics</td>
<td>SB</td>
<td>PSC</td>
<td>SB</td>
<td>155</td>
<td>Freshman Seminar</td>
</tr>
<tr>
<td>EC</td>
<td>Principles of Macroeconomics</td>
<td>SB</td>
<td>PSC</td>
<td>SB</td>
<td>101</td>
<td>Introduction to Psychology</td>
<td>SB</td>
<td>PSC</td>
<td>SB</td>
<td>101</td>
<td>Introduction to Psychology</td>
</tr>
<tr>
<td>ECE</td>
<td>Freshman Seminar</td>
<td>SB</td>
<td>PSC</td>
<td>SB</td>
<td>155</td>
<td>Honors Intro to Psychology</td>
<td>SB</td>
<td>PSC</td>
<td>SB</td>
<td>155</td>
<td>Honors Intro to Psychology</td>
</tr>
<tr>
<td>GES</td>
<td>Impacts of Major Engineering</td>
<td>SB</td>
<td>PSC</td>
<td>SB</td>
<td>225</td>
<td>Creativity</td>
<td>SB</td>
<td>PSC</td>
<td>SB</td>
<td>155</td>
<td>Freshman Seminar</td>
</tr>
<tr>
<td>GY</td>
<td>World Regional Geography</td>
<td>SB</td>
<td>SOC</td>
<td>SB</td>
<td>105</td>
<td>Analysis of Social Problems</td>
<td>SB</td>
<td>SOC</td>
<td>SB</td>
<td>105</td>
<td>Analysis of Social Problems</td>
</tr>
<tr>
<td>GY</td>
<td>Principles of Human Geography</td>
<td>SB</td>
<td>SOC</td>
<td>SB</td>
<td>110</td>
<td>Principles of Human Geography</td>
<td>SB</td>
<td>SOC</td>
<td>SB</td>
<td>201</td>
<td>Principles of Human Geography</td>
</tr>
<tr>
<td>HDL</td>
<td>Life Span Human Development</td>
<td>SB</td>
<td>SOC</td>
<td>SB</td>
<td>155</td>
<td>Freshman Seminar</td>
<td>SB</td>
<td>SOC</td>
<td>SB</td>
<td>201</td>
<td>Freshman Seminar</td>
</tr>
<tr>
<td>HDL</td>
<td>Life Span Human Development</td>
<td>SB</td>
<td>SOC</td>
<td>SB</td>
<td>155</td>
<td>Freshman Seminar</td>
<td>SB</td>
<td>SOC</td>
<td>SB</td>
<td>201</td>
<td>Freshman Seminar</td>
</tr>
<tr>
<td>HHE</td>
<td>Freshman Seminar</td>
<td>SB</td>
<td>SOC</td>
<td>SB</td>
<td>155</td>
<td>Freshman Seminar</td>
<td>SB</td>
<td>SOC</td>
<td>SB</td>
<td>201</td>
<td>Freshman Seminar</td>
</tr>
<tr>
<td>HY</td>
<td>Western Civilization to 1648</td>
<td>SB</td>
<td>SOC</td>
<td>SB</td>
<td>101</td>
<td>Western Civilization to 1648</td>
<td>SB</td>
<td>SOC</td>
<td>SB</td>
<td>101</td>
<td>Western Civilization to 1648</td>
</tr>
<tr>
<td>HY</td>
<td>Western Civilization since 1648</td>
<td>SB</td>
<td>SOC</td>
<td>SB</td>
<td>102</td>
<td>Western Civilization since 1648</td>
<td>SB</td>
<td>SOC</td>
<td>SB</td>
<td>102</td>
<td>Western Civilization since 1648</td>
</tr>
</tbody>
</table>

List accurate as of October 2012. For an updated listing, click the HY/SB link on DegreeWorks or visit [http://registrar.ua.edu/academics/core-curriculum/general-studies/#tab=tab-4](http://registrar.ua.edu/academics/core-curriculum/general-studies/#tab=tab-4).
**Humanities (HU) Literature (L), & Fine Arts (FA)**

**BE VERY CAREFUL WHEN CHOOSING AN ELECTIVE**

*UI 201 IS A HUMANITIES*
*UI 203 IS A HUMANITIES*
*UI 300 IS NOT A HUMANITIES*

Just because they have the same first letter designations does not mean they have the same attributes.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Attribute</th>
<th>Credits</th>
<th>Course Name</th>
<th>Attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAST 249</td>
<td>African American Literature</td>
<td>HU or L</td>
<td>3</td>
<td>American Literature I</td>
<td>HU or L</td>
</tr>
<tr>
<td>AMS 150</td>
<td>Arts and Values</td>
<td>HU</td>
<td>EN 210</td>
<td>American Literature II</td>
<td>HU or L</td>
</tr>
<tr>
<td>AMS 151</td>
<td>World, Nations, Regions</td>
<td>HU</td>
<td>EN 215</td>
<td>Honors English Literature I</td>
<td>HU or L</td>
</tr>
<tr>
<td>AMS 203</td>
<td>Southern Lives</td>
<td>HU</td>
<td>EN 216</td>
<td>Honors English Literature II</td>
<td>HU or L</td>
</tr>
<tr>
<td>AMS 204</td>
<td>Western American Lives</td>
<td>HU</td>
<td>EN 219</td>
<td>Honors American Literature I</td>
<td>HU or L</td>
</tr>
<tr>
<td>AMS 205</td>
<td>Working Lives</td>
<td>HU</td>
<td>EN 220</td>
<td>Honors American Literature II</td>
<td>HU or L</td>
</tr>
<tr>
<td>AMS 231</td>
<td>Contemporary American</td>
<td>HU</td>
<td>EN 249</td>
<td>African American Literature</td>
<td>HU or L</td>
</tr>
<tr>
<td>AMS 232</td>
<td>Contemporary American in</td>
<td>HU</td>
<td>FA 200</td>
<td>Introduction to Fine Arts</td>
<td>FA</td>
</tr>
<tr>
<td>ARH 151</td>
<td>Introduction to the Visual Arts</td>
<td>FA</td>
<td>FR 101</td>
<td>Elementary French I</td>
<td>HU</td>
</tr>
<tr>
<td>ARH 152</td>
<td>Survey of Art I</td>
<td>FA</td>
<td>FR 102</td>
<td>Elementary French II</td>
<td>HU</td>
</tr>
<tr>
<td>ARH 153</td>
<td>Survey of Art II</td>
<td>FA</td>
<td>FR 103</td>
<td>French First Year Review</td>
<td>HU</td>
</tr>
<tr>
<td>ARH 154</td>
<td>Survey of Art III</td>
<td>FA</td>
<td>FR 201</td>
<td>Intermediate French I</td>
<td>HU</td>
</tr>
<tr>
<td>ART 251</td>
<td>Reboot/Remix</td>
<td>FA or</td>
<td>FR 202</td>
<td>Intermediate French II</td>
<td>HU</td>
</tr>
<tr>
<td>BEF 155</td>
<td>Freshman Seminar</td>
<td>HU</td>
<td>GN 101</td>
<td>Elementary German I</td>
<td>HU</td>
</tr>
<tr>
<td>BUI 101</td>
<td>Foundations: Origins</td>
<td>HU</td>
<td>GN 102</td>
<td>Elementary German II</td>
<td>HU</td>
</tr>
<tr>
<td>CHI 101</td>
<td>Elementary Chinese I</td>
<td>HU</td>
<td>GN 103</td>
<td>Accelerated Elementary German I</td>
<td>HU</td>
</tr>
<tr>
<td>CHI 102</td>
<td>Elementary Chinese II</td>
<td>HU</td>
<td>GN 201</td>
<td>Intermediate German I</td>
<td>HU</td>
</tr>
<tr>
<td>CHI 201</td>
<td>Intermediate Chinese I</td>
<td>HU</td>
<td>GN 202</td>
<td>Intermediate German II</td>
<td>HU</td>
</tr>
<tr>
<td>CHI 202</td>
<td>Intermediate Chinese II</td>
<td>HU</td>
<td>GN 260</td>
<td>The Holocaust in Film and Literature</td>
<td>HU</td>
</tr>
<tr>
<td>CIP 200</td>
<td>Introduction to Global Studies</td>
<td>HU</td>
<td>GN 264</td>
<td>German Literature in Translation I</td>
<td>HU or L</td>
</tr>
<tr>
<td>CL 222</td>
<td>Greek and Roman Mythology</td>
<td>HU</td>
<td>GN 265</td>
<td>German Literature in Translation II</td>
<td>HU or L</td>
</tr>
<tr>
<td>COM 100</td>
<td>Rhetoric and Society</td>
<td>HU</td>
<td>GR 101</td>
<td>Beginning Greek I</td>
<td>HU</td>
</tr>
<tr>
<td>COM 121</td>
<td>Honors Critical Decision</td>
<td>HU</td>
<td>GR 102</td>
<td>Beginning Greek II</td>
<td>HU</td>
</tr>
<tr>
<td>COM 122</td>
<td>Critical Decision Making</td>
<td>HU</td>
<td>IT 101</td>
<td>Introductory Italian I</td>
<td>HU</td>
</tr>
<tr>
<td>COM 123</td>
<td>Public Speaking</td>
<td>HU</td>
<td>IT 102</td>
<td>Introductory Italian II</td>
<td>HU</td>
</tr>
<tr>
<td>COM 155</td>
<td>Freshman Seminar</td>
<td>HU</td>
<td>IT 201</td>
<td>Intermediate Italian I</td>
<td>HU</td>
</tr>
<tr>
<td>COM 210</td>
<td>Oral Interpretation of</td>
<td>HU</td>
<td>IT 202</td>
<td>Intermediate Italian II</td>
<td>HU</td>
</tr>
<tr>
<td>EN 155</td>
<td>Freshman Seminar</td>
<td>FA</td>
<td>JA 101</td>
<td>Elementary Japanese I</td>
<td>HU</td>
</tr>
<tr>
<td>EN 205</td>
<td>English Literature I</td>
<td>HU or L</td>
<td>JA 102</td>
<td>Elementary Japanese II</td>
<td>HU</td>
</tr>
<tr>
<td>EN 206</td>
<td>English Literature II</td>
<td>HU or L</td>
<td>JA 201</td>
<td>Intermediate Japanese I</td>
<td>HU</td>
</tr>
<tr>
<td>EN 207</td>
<td>World Literature I</td>
<td>HU or L</td>
<td>JA 202</td>
<td>Intermediate Japanese II</td>
<td>HU</td>
</tr>
<tr>
<td>EN 208</td>
<td>World Literature II</td>
<td>HU or L</td>
<td>JN 209</td>
<td>Introduction to Journalism</td>
<td>HU</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>LA 101</td>
<td>Elementary Latin I</td>
<td>HU</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>LA 102</td>
<td>Elementary Latin II</td>
<td>HU</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Department</td>
<td>Course Code</td>
<td>Course Title</td>
<td>Department</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------------------------------------</td>
<td>------------</td>
<td>-------------</td>
<td>--------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>LA 101</td>
<td>Elementary Latin I</td>
<td>HU</td>
<td>RUS 223</td>
<td>19th Century Russian Literature in Translation</td>
<td>HU or L</td>
</tr>
<tr>
<td>LA 102</td>
<td>Elementary Latin II</td>
<td>HU</td>
<td>RUS 224</td>
<td>Modern Russian Literature in Translation</td>
<td>HU or L</td>
</tr>
<tr>
<td>LA 201</td>
<td>Intermediate Latin Reading I</td>
<td>HU</td>
<td>SP 101</td>
<td>Introductory Spanish I</td>
<td>HU</td>
</tr>
<tr>
<td>LA 202</td>
<td>Intermediate Latin Reading II</td>
<td>HU</td>
<td>SP 102</td>
<td>Introductory Spanish II</td>
<td>HU</td>
</tr>
<tr>
<td>MUS 121</td>
<td>Introduction to Listening</td>
<td>FA</td>
<td>SP 103</td>
<td>Intensive Review Introductory Spanish</td>
<td>HU</td>
</tr>
<tr>
<td>MUS 250</td>
<td>Music in World Cultures</td>
<td>FA</td>
<td>SP 104</td>
<td>Spanish for Engineering</td>
<td>HU</td>
</tr>
<tr>
<td>NEW 155</td>
<td>Freshman Seminar</td>
<td>HU</td>
<td>SP 201</td>
<td>Intermediate Spanish I</td>
<td>HU</td>
</tr>
<tr>
<td>NEW 211</td>
<td>Humanities I: Perspectives</td>
<td>HU or</td>
<td>TCF 112</td>
<td>Motion Picture History and Criticism</td>
<td>HU or</td>
</tr>
<tr>
<td>NEW 212</td>
<td>Humanities I: Creativity</td>
<td>HU or</td>
<td>TH 114</td>
<td>Introduction to Theatre</td>
<td>FA</td>
</tr>
<tr>
<td>NEW 215</td>
<td>Humanities I: Perspectives in</td>
<td>HU</td>
<td>UH 101</td>
<td>Survey: Values and Society</td>
<td>HU</td>
</tr>
<tr>
<td>PHL 100</td>
<td>Introduction to Philosophy</td>
<td>HU</td>
<td>UH 155</td>
<td>Freshman Seminar</td>
<td>HU</td>
</tr>
<tr>
<td>PHL 104</td>
<td>Critical Thinking</td>
<td>HU</td>
<td>UH 201</td>
<td>Classics and Western Culture I</td>
<td>HU</td>
</tr>
<tr>
<td>PHL 191</td>
<td>Honors Introduction to Philosophy</td>
<td>HU</td>
<td>UH 202</td>
<td>Classics and Eastern Culture</td>
<td>HU</td>
</tr>
<tr>
<td>PHL 211</td>
<td>Ancient Philosophy</td>
<td>HU</td>
<td>UH 203</td>
<td>Classic and Western Culture II</td>
<td>HU</td>
</tr>
<tr>
<td>PHL 212</td>
<td>Early Modern Philosophy</td>
<td>HU</td>
<td>UH 210</td>
<td>Honors Fine Arts</td>
<td>FA</td>
</tr>
<tr>
<td>PHL 215</td>
<td>American Philosophy</td>
<td>HU</td>
<td>UH 331</td>
<td>Save First. Poverty in America</td>
<td>HU</td>
</tr>
<tr>
<td>PHL 221</td>
<td>Honors Introduction to Ethics</td>
<td>HU</td>
<td>UH 332</td>
<td>Bridge Builders of Alabama</td>
<td>HU</td>
</tr>
<tr>
<td>PHL 223</td>
<td>Medical Ethics</td>
<td>HU</td>
<td>UH 333</td>
<td>Every Move Counts ChessED Project</td>
<td>HU</td>
</tr>
<tr>
<td>PHL 230</td>
<td>Political Philosophy</td>
<td>HU</td>
<td>UH 334</td>
<td>Documenting Justice I</td>
<td>HU</td>
</tr>
<tr>
<td>PHL 260</td>
<td>Mind and Nature</td>
<td>HU</td>
<td>UH 335</td>
<td>Documenting Justice II</td>
<td>HU</td>
</tr>
<tr>
<td>PHL 291</td>
<td>Aesthetics</td>
<td>HU</td>
<td>UH 350</td>
<td>Black Belt Experience</td>
<td>HU</td>
</tr>
<tr>
<td>PHL 292</td>
<td>Introduction to Ethics</td>
<td>FA</td>
<td>WL 207</td>
<td>World Literature I</td>
<td>HU or L</td>
</tr>
<tr>
<td>REL 100</td>
<td>Introduction to Religious Studies</td>
<td>HU</td>
<td>WL 208</td>
<td>World Literature II</td>
<td>HU or L</td>
</tr>
<tr>
<td>REL 101</td>
<td>Western Approaches to the</td>
<td>HU</td>
<td>WL 223</td>
<td>19th Century Russian Literature in Translation</td>
<td>HU or L</td>
</tr>
<tr>
<td>REL 105</td>
<td>Honors Introduction to Religious</td>
<td>HU</td>
<td>WL 224</td>
<td>20th Century Russian Literature in Translation</td>
<td>HU or L</td>
</tr>
<tr>
<td>REL 110</td>
<td>Introduction to Hebrew Bible</td>
<td>HU</td>
<td>WS 200</td>
<td>Introductory to Women Studies</td>
<td>HU</td>
</tr>
<tr>
<td>REL 112</td>
<td>Introduction to the New Testament</td>
<td>HU</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>REL 220</td>
<td>Survey of Asian Religions</td>
<td>HU</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>REL 224</td>
<td>Introduction to Judaism</td>
<td>HU</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RUS 101</td>
<td>Elementary Russian I</td>
<td>HU</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RUS 102</td>
<td>Elementary Russian II</td>
<td>HU</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RUS 201</td>
<td>Intermediate Russian I</td>
<td>HU</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RUS 202</td>
<td>Intermediate Russian II</td>
<td>HU</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

List accurate as of October 2012. For an updated listing, click the HU/L/FA link on DegreeWorks or visit http://Registrar.ua.edu/Academics/Core-Curriculum/General-Studies/#tab=tab-2.
ELECTIVES: Engineering & Science electives

On the flowchart, there are four electives labeled: Advanced Science (ADV SCI) Elective, Engineering (ENG) Elective, Biochem (BIO) Elective, and Chemical Engineering (CHE) Elective. Each of these is restricted to a choice of at least 2 classes. Other courses may also be approved, but require a petition to the ChBE faculty. Undergraduate research and honors internships/co-op fit under the courses designated "independent study". Up to 6 hours of independent study courses can be applied towards the ChBE degree.

Chemical and Biological Engineering Department Approved List of
Advanced Science Electives, Biochem Electives and Chemical Engineering Electives.

ChBE students must satisfy the 3 hours of Advanced Science, 3 hours of Engineering, 3 hours Biochem AND 3 hours Chemical Engineering electives by completing one of the following courses for each elective. A course may be used as an elective if it appears on the approved list which is current at the time the course is taken. One course cannot count in more than one place on the curriculum flowchart. Note: If you take a class that can fit into more than one elective slot, DegreeWorks will place it in one of the empty slots, and when you take additional electives, DegreeWorks will shift the classes so hours are optimized towards the degree.

**Advanced Science Electives are:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSC 300*</td>
<td>Cell Biology</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>BSC 310*</td>
<td>Microbiology (w/ permission)</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>BSC 315*</td>
<td>Genetics</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>BSC 442*</td>
<td>Genomics (see instructor about waiving pre-reqs)</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>MS 448</td>
<td>Introduction to Oceanography</td>
<td>4 hrs.</td>
</tr>
<tr>
<td>BSC 399, 399</td>
<td>Biology Research (Independent Study with Advisor)</td>
<td>variable hrs.</td>
</tr>
<tr>
<td>CH 223</td>
<td>Chemical Equilibria &amp; Analyses</td>
<td>4 hrs.</td>
</tr>
<tr>
<td>CH 340</td>
<td>Physical Chemistry for Non-ACS</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>CH 341</td>
<td>Physical Chemistry I</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>CH 396, 398, 399</td>
<td>Chemistry Research (Independent Study with Advisor)</td>
<td>variable hrs.</td>
</tr>
<tr>
<td>CH 405</td>
<td>Medicinal Chemistry</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>CH 461*</td>
<td>Biochemistry I</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>CH 462</td>
<td>Biochemistry II</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>CH 424</td>
<td>Instrumental Analysis</td>
<td>4 hrs.</td>
</tr>
<tr>
<td>CH 497, 498, 499</td>
<td>Chemistry Research (Independent Study with Advisor)</td>
<td>variable hrs.</td>
</tr>
<tr>
<td>CHE 412 or 512*</td>
<td>Polymer Materials Engineering</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>CHE 418 or 518*</td>
<td>Tissue Engineering</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>CHE 438 or 538*</td>
<td>Integrated Circuit Fabrication Principles</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>CHE 445 or 545*</td>
<td>Introduction to Biochemical Engineering</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>CHE 491/492</td>
<td>Special Problems (requires pre-approval)</td>
<td>variable hrs.</td>
</tr>
<tr>
<td>CHE 498/499</td>
<td>Honors Special problems (requires pre-approval)</td>
<td>variable hrs.</td>
</tr>
</tbody>
</table>

* Overrides can be given for ChBE students to take 300+ level BSC classes with only BSC 114 as a pre-req.

**Engineering Electives are:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE 320</td>
<td>Fundamentals of Electrical Engineering</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>MTE 271</td>
<td>Engineering Materials</td>
<td>3 hrs.</td>
</tr>
</tbody>
</table>

216
### Chemical Engineering Electives are:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHE 412 or 512*</td>
<td>Polymer Materials Engineering</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>CHE 418 or 518*</td>
<td>Tissue Engineering</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>CHE 438 or 538*</td>
<td>Integrated Circuit Fabrication Principles</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>CHE 440 or 540*</td>
<td>Health and Safety</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>CHE 445 or 545*</td>
<td>Introduction to Biochemical Engineering</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>CHE 491/492</td>
<td>Special Problems (requires pre-approval)</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>CHE 498/499</td>
<td>Honors Special Problems (requires pre-approval)</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>CHE 525</td>
<td>Polymer Processing and Rheology*</td>
<td>3 hrs.</td>
</tr>
</tbody>
</table>

### Biochem Electives are:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH 461°</td>
<td>Biochemistry I</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>CHE 445</td>
<td>Intro to Biochemical engineering</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>CHE 545</td>
<td>Intro to Biochemical Engineering*</td>
<td>3 hrs.</td>
</tr>
</tbody>
</table>

°An override is possible to take CH461 without the pre-requisite CH 223. See the ChBE main office.

*Advanced Undergraduate/Entry-Level Graduate Course: Undergraduates must have senior status (91+hours) and a grade point average of 3.0 or better to be eligible for these courses. Consult the course instructor for advice regarding this option.

---

OTHER ITEMS AVAILABLE ON-LINE (but not included in this packet)

- SCHOLARS PROGRAM (earn your B.S. and M.S. degrees with a combined program)

- FLOW CHARTS FOR:
  1. DUAL CHEMISTRY/CHEMICAL ENGINEERING MAJOR PLAN
  2. PRE-MED SUGGESTED FLOW CHART
     (pushes courses helpful for the MCAT to complete by the junior year)
  3. ACCELERATED CURRICULUM (to complete the degree in 7 semesters plus 1 summer)
     - requires 9 hours of transfer or AP credit (or taking more than 16 hours per semester)
  4. SCHOLARS PROGRAM (B.S./M.S.)
ELECTIVES: CAREER ELECTIVES

The boxes marked CAREER ELECTIVE are for 6 hours of electives that are geared to helping students with their career goals. If a student wishes to take a class that is not on the CAREER ELECTIVES list, they can gain approval to count it as such using the "Career Elective Approval Form" below. Please write a short paragraph about how the particular class(es) will be helpful in meeting your career goals, and have the form signed by any ChBE advisor. If approved, this form will begin a process to have the class show up as satisfying hours towards the Career Electives on DegreeWorks.

ChBE Career Electives Approval Form

Student Name: __________________________

Student CWID Number: __________________

Date: _________________________________

I plan to take the following course(s) to satisfy my Approved Career Electives:

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Please write 1-2 sentences explaining how the above course(s) will be useful for your planned career.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Student’s Signature: __________________________ Date: __________

Advisor’s Signature: __________________________ Date: __________

*Prior to Fall 2012, the ChBE curriculum listed these classes as “Approved” or APP electives. The concept is the same, but DegreeWorks will show a requirement for APP EL instead of CAREER electives. Students at UA following 2010 or earlier Undergraduate Catalogs will need to fill this form out, and drop it by the main ChBE office. If the Approved Elective courses they wish to take are listed on the CAREER electives list, the form doesn’t need to be signed. If the classes are NOT on the CAREER electives list, the form will need approval from a ChBE professor before the classes can be counted towards your degree.
## ChBE CAREER ELECTIVES

(replacing 6 hours of APPROVED (APP) electives from 2010 UG Catalog)

Students must take 6 hours of classes aimed at enhancing their career objectives. It is encouraged that these 6 hours be related to each other in some way, but any combination of these classes (from one or multiple categories) totaling 6 hours is acceptable. Tracks are provided as suggestions that lead to a focus in particular areas. These classes can be used towards a minor or double major at UA.

The courses listed below and on the next page are all pre-approved as CAREER electives; numbers in parentheses are the course credit hours. See the undergraduate catalog for course descriptions, pre- and co-requisites and frequency of offerings. Other classes may be allowed to fill the CAREER electives slots, but requires filling out the "career electives approval" form, signed by an advisor. Course numbers are accurate as of May 2012, but are subject to change.

<table>
<thead>
<tr>
<th>BUSINESS TRACK</th>
<th>CHEMISTRY TRACK</th>
<th>COMPUTER-BASED HONORS (CBH) / UNDERGRADUATE RESEARCH / HONORS CO-OP</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC 210 (4) Intro to Accounting</td>
<td><strong>any chemistry &gt; 200 level, including:</strong></td>
<td>BSC 398, 399&lt;sup&gt;1&lt;/sup&gt; Biology Research</td>
</tr>
<tr>
<td>COM 121 (3) Hons. Critical Decision Making</td>
<td>CH 223 (4) Chemical Equilibria and Analysis</td>
<td>CBH 101, 102&lt;sup&gt;4&lt;/sup&gt; (4) Freshman Seminar</td>
</tr>
<tr>
<td>COM 122 (3) Critical Decision Making</td>
<td>CH 340 (3) Elem. Physical Chemistry</td>
<td>CBH 201&lt;sup&gt;1&lt;/sup&gt; (3) Sophomore Seminar</td>
</tr>
<tr>
<td>COM 123 (3) Public Speaking</td>
<td>CH 341 (3) Physical Chemistry I</td>
<td>CHE 491, 492&lt;sup&gt;1&lt;/sup&gt; ChE UG Research</td>
</tr>
<tr>
<td>COM 352 (3) Business &amp; Prof. Communication</td>
<td>CH 343 (1) Elem. Physical Chem. Lab</td>
<td>CHE 498, 499&lt;sup&gt;1&lt;/sup&gt; Honors Res./Co-op</td>
</tr>
<tr>
<td>EC 110 (3) Principles of Microeconomics</td>
<td>CH 395, 398, 399&lt;sup&gt;1&lt;/sup&gt; Research</td>
<td>CH 396, 398, 399&lt;sup&gt;1&lt;/sup&gt; Chem. Research</td>
</tr>
<tr>
<td>EC 111 (3) Principles of Macroeconomics</td>
<td>CH 405 (3) Medical Chemistry</td>
<td>CH 407, 408, 409&lt;sup&gt;1&lt;/sup&gt; Chem. Research</td>
</tr>
<tr>
<td>EN 319 (3) Technical Writing</td>
<td>CH 413 (4) Inorganic Chemistry</td>
<td>UA 155&lt;sup&gt;1&lt;/sup&gt; Freshman Research and Creative Opportunities (Emerging Scholars)</td>
</tr>
<tr>
<td>FI 302 (3) Business Finance</td>
<td>CH 424 (4) Instrumental Analysis</td>
<td></td>
</tr>
<tr>
<td>GES 418 (3) Engr Management</td>
<td>CH 461 (3) Biochemistry I</td>
<td></td>
</tr>
<tr>
<td>MGT 300 (3) Organizational Theory &amp; Behavior</td>
<td>CH 462 (3) Biochemistry II</td>
<td>MATHEMATICS, ENGR MATH</td>
</tr>
<tr>
<td>MKT 300 (3) Marketing</td>
<td>CH 497, 498, 499&lt;sup&gt;1&lt;/sup&gt; Research</td>
<td>GES 255 (3) Engineering Statistics I</td>
</tr>
<tr>
<td>PHL 200 (3) Intro to Ethics</td>
<td></td>
<td>GES 257 (3) Engineering Statistics II</td>
</tr>
<tr>
<td>PHL 202 (3) Honors Intro to Ethics</td>
<td>COMPUTER SCIENCE</td>
<td>GES 400 (3) Engineering Statistics</td>
</tr>
<tr>
<td>ST 260 (3) Statistical Data Analysis</td>
<td>CS 150 (2) Programming I</td>
<td>GES 451 (3) Matrix and Vector Analysis</td>
</tr>
<tr>
<td></td>
<td>CS 250 (2) Programming II</td>
<td>MA 237 (3) Intro Linear Alg and Matrix Theory</td>
</tr>
<tr>
<td>GEOLOGY TRACK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GEO 101 (4) The Dynamic Earth</td>
<td>CS 350 (2) Programming III (Java)</td>
<td>MA 257 (3) Linear Algebra</td>
</tr>
<tr>
<td>GEO 105 (4) Sustainable Earth</td>
<td>CS 352 (2) Programming III (C++)</td>
<td>MA 300 (3) intro to Scientific Computing</td>
</tr>
<tr>
<td>GEO 210 (4) Mineralogy</td>
<td></td>
<td>MA 301 (3) Discrete Mathematics</td>
</tr>
<tr>
<td>GEO 306 (3) Hydrogeology</td>
<td>GRAD SCH (SCHOLARS PROGRAM)&lt;sup&gt;3&lt;/sup&gt;</td>
<td>MA 343 (3) Applied Differential Equations II</td>
</tr>
<tr>
<td></td>
<td>CHE 512 (3) Polymer Materials Eng.</td>
<td>MA 355 (3) Theory of Probability</td>
</tr>
<tr>
<td>PRE-LAW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 518 (3) Tissue Engineering</td>
<td>CHE 538 (3) Electronic Materials</td>
<td>CHE 451 (3) Mathematical Statistics w/ Applic. I</td>
</tr>
<tr>
<td>LEG 200 (3) Legal Envim. of Business</td>
<td>CHE 540 (3) Health and Safety</td>
<td>CHE 452 (3) Mathematical Statistics w/ Applic. II</td>
</tr>
<tr>
<td>LEG 402 (3) Government and Business</td>
<td>CHE 545 (3) Biochemical Engineering</td>
<td>CHE 485 (3) Intro to Complex Variables</td>
</tr>
<tr>
<td>LEG 405 (3) International Business Law</td>
<td>(for other 500 level classes- use approval form)</td>
<td>ME 349 (3) Engineering Analysis</td>
</tr>
</tbody>
</table>

<sup>1</sup> Note: These 6 hours must be in addition to classes used for H/SB, HU/LFA, ENG, ADV SCI, BIOCHEM and CHE Electives.

Refer to the undergraduate catalog for information about minors in each field.

<sup>2</sup> For Dual CH/ChE BS majors, the Career electives should be Chemistry courses (see Dual CH/ChE Flowsheet).

<sup>3</sup> Undergraduate Research/Independent study classes can count for a maximum of 6 hours towards the BS ChE degree.

<sup>4</sup> Most research classes have variable credit. Negotiate credit hours with your research director.

<sup>5</sup> a maximum of 6 hours of CBH research can be used to fill Career electives, Advanced Science elective (depending on topic), or ChE elective (if CBH project is with a ChBE professor)

<sup>6</sup> For BS/MS Scholars program, approved electives should be graduate level. Apply to the ChBE graduate coordinator.
ChBE CAREER ELECTIVES\(^a\) (continued)
(replacing 6 hours of APPROVED (APP) electives from 2010 UG Catalog)

<table>
<thead>
<tr>
<th>ENVIRONMENTAL ENGINEERING</th>
<th>PHYSICS</th>
<th>FUNDAMENTAL ENGINEERING (FE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 320 (3) Intro to Environmental Engr</td>
<td>any PH &gt; 200-level, including:</td>
<td>AEM 201 (3) Statics</td>
</tr>
<tr>
<td>CE 378 (3) Water Resources Engr</td>
<td>PH 253 (3) Intro to Modern Physics</td>
<td>AEM 205 (3) Honors Statics</td>
</tr>
<tr>
<td>CE 422 (3) Solid and Hazardous Waste Mgmt</td>
<td>PH 255 (1) Modern Physics Lab</td>
<td>AEM 250 (3) Mechanics of Materials I</td>
</tr>
<tr>
<td>CE 424 (3) Water and Wastewater Treatment</td>
<td>PH 301 (3) Mechanics</td>
<td>AEM 264 (3) Dynamics</td>
</tr>
<tr>
<td>CE 425 (3) Air Pollution Engineering</td>
<td>PH 302 (3) Intermediate Mechanics</td>
<td>ECE 225 (3) Electric Circuits</td>
</tr>
<tr>
<td></td>
<td>PH 331 (3) Electricity and Magnetism</td>
<td>ECE 320 (3) Fundamentals of Elec. Engr.</td>
</tr>
</tbody>
</table>

ADDITIONAL CHE ELECTIVES

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CHE 412/512 (3) Polymer Materials Engr</td>
<td>PH 411 (3) Biophysics</td>
<td>MTE 271 (3) Engr Materials: Structure &amp; Props</td>
</tr>
<tr>
<td>CHE 418/518 (3) Tissue Engineering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 438/538 (3) Electronic Materials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 440/540 (3) Health &amp; safety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 445/545 (3) Biochemical Engr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 225, 325, 425(b) (1) CHE Honors Forum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FOREIGN LANGUAGES(^b)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHI 101, 102 (4) Elementary Chinese 1 &amp; 2</td>
<td>BSC 115 (1) Biology I Laboratory</td>
<td>BSC 425 (2) Human Physiology Laboratory</td>
</tr>
<tr>
<td>CHI 201, 202 (3) Intermediate Chinese 1 &amp; 2</td>
<td>BSC 215 (4) Human Anatomy &amp; Physiology I</td>
<td>BSC 435 (4) Immunology</td>
</tr>
<tr>
<td>FR 101, 102, 103 (4) Intro. French 1 &amp; 2</td>
<td>BSC 216 (4) Human Anatomy &amp; Physiology II</td>
<td>BSC 441 (3) Developmental Biology</td>
</tr>
<tr>
<td>FR 201, 202 (3) Intermediate French 1 &amp; 2</td>
<td>BSC 242 (4) Microbiology and Man</td>
<td>BSC 442 (4) Integrated Genomics</td>
</tr>
<tr>
<td>GN 101, 102, 103 (4) Intro German 1 &amp; 2</td>
<td>BSC 300 (3) Cell Biology</td>
<td>BSC 444 (4) General Virology</td>
</tr>
<tr>
<td>GN 301, 302 (3) Intermediate German 1 &amp; 2</td>
<td>BSC 310 (3) Microbiology</td>
<td>BSC 445 (3) Endocrinology</td>
</tr>
<tr>
<td>IHP 105(c) (3) Hon Culture &amp; Human Experience</td>
<td>BSC 312 (2) Microbiology Lab</td>
<td>BSC 451 (3) Molecular Biology</td>
</tr>
<tr>
<td>IHP 155(c) (3) Hon Culture &amp; Human Experience</td>
<td>BSC 315 (3) Genetics</td>
<td>BSC 452 (3) Motor Physiology</td>
</tr>
<tr>
<td>IT 101, 102 (4) Intro Italian 1 &amp; 2</td>
<td>BSC 385 (3) General Ecology</td>
<td>CHE 225, 325, 425(b) (1) CHE Honors Forum</td>
</tr>
<tr>
<td>IT 101, 202 (3) Intermediate Italian 1 &amp; 2</td>
<td>BSC 398, 399(d) Biology Research</td>
<td>CHE 418 (3) Tissue Engineering</td>
</tr>
<tr>
<td>JA 101, 102 (4) Elementary Japanese 1 &amp; 2</td>
<td>BSC 424 (3) Human Physiology</td>
<td>PHL 223 (3) Medical Ethics</td>
</tr>
<tr>
<td>JA 201, 202 (3) Intermediate Japanese 1 &amp; 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP 101, 102, 103 (4) Intro Spanish 1 &amp; 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP 201, 202 (3) Intermediate Spanish 1 &amp; 2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) Note: These 6 hours must be in addition to classes used for HI/SB, HU/L/FA, ENG, ADV SCI, BIOCHEM and CHE Electives. Refer to the undergraduate catalog for information about minors in each field, as well as pre- and co-requisites.\n
\(^b\) Other foreign languages can be approved- use career electives approval form.\n
\(^c\) One of these two classes may count, but not both.\n
\(^d\) BSC 118 can be used to count for 3 hours of BSC 114; the additional hour of lab can be used for Career Electives; however, on DegreeWorks, it will not appear explicitly as a Career elective (instead, the required hours for Career electives will be decreased to 5 if you take BSC 118).\n
\(^e\) Students can take ChE honors forum more than once for credits. Topics and instructors rotate each semester.\n
\(^f\) Undergraduate Research/Independent study classes can count for a maximum of 6 hours towards the BS ChE degree. Most research classes have variable credit. Negotiate credit hours with your research director.
Advising FAQs

1. TRANSFER CREDITS (TAKING CLASSES OFF CAMPUS) and ADVANCED PLACEMENT (AP) CREDITS

You can take classes away from UA: junior colleges and other university classes will often transfer to UA and count towards your major. Check with the Office of Academic Records to make sure the classes will transfer before enrolling. If taking a ChE class abroad or away from UA, check with a ChE professor to determine if the class will transfer. Organic Chemistry can be a little tricky, though. UA offers the organic chemistry sequence as CH 231 (3 hours lecture), CH 232 (3 hours lecture), and CH 237 (2 hours lab). Many other colleges and universities offer the sequence as two 4-hour classes, where the lab is included with the class. So, it is advisable to either take ALL organic chemistry at UA, or all of it off-campus. Consult the undergraduate catalog for further information about transfer credits.

AP credits are accepted for college credit, commensurate with UA guidelines. Common courses in the ChBE curriculum where AP credits can be applied include Math, Chemistry, English, Biology and Physics, as well as History and Foreign Languages. For pre-med students, see the section on the Pre-Med track below for advice on AP Biology credit. For physics, only AP Physics C test scores can be used to replace calculus-based physics (PH 105 and 106). PH 101 and PH 102 are not calculus-based and cannot be used to meet ChBE curriculum requirements.

2. MINORS

Minors are available to ChBE majors as described in the undergraduate catalog. The department offering the minor sets the rules for the minor, so questions should be directed to that department.

Some common minors that ChBE students obtain include (accurate as of May 2012, see undergraduate catalog for updated information):

- Math (6 additional hours: two 300 or 400 level MATH courses)
- Chemistry (8 additional hours): CH223 (Analytical Chem + lab) and physical chem and lab
- Biology (22 hours; BSC classes taken towards the ChE degree are counted toward the minor; ChE 445/545 and CH461 are both usually considered "biologies" and count towards the minor)
- Business (22 total business hours) (several classes can be taken as H/JSB or Career Electives to reduce the total number of additional hours needed above those on the ChBE flowchart)
- Environmental Engineering (23 hours required; administered through Civil Engineering)

In most cases, the electives in the ChBE curriculum can be used to complete some of the requirements for minors. Consult the undergraduate catalog (under the section for the department offering the minor) for further information.

3. CAREER PATHS

The ChE curriculum is designed to prepare students for careers in process engineering, product development, process optimization, or engineering design. With the many electives in the curriculum (Biology-3hrs, ChE-3hrs, Engineering-3hrs, Advanced Science-3hrs, Career Electives-6hrs, and H/JSB and H/JSB/FA-18hrs), students may pursue numerous career paths.

Pre-Med (Medical School, Dental, Optometry) Track

The ChE curriculum offers slots for all of the required classes to enter medical school. Beyond the required courses, pre-med students must take BSC 115, 116 and 117 (or honors equivalents BSC 118/120). Additional advanced biology courses may help prepare students for the MCAT and the rigor of medical school, 3 hours of which may fit into the Advanced Science elective slot. Medical school applications require BSC 114, 115, 116 and 117. The 5 hours of 115-117 can count towards the 6 hours of career electives. Students interested in pre-med should consult the UA’s health professions office in Lloyd Hall (Chris Hutt) early in their college careers. Programs offered by UA ChBE, SEM or AED may help with preparing for medical school. Classes such as BSC 300, 310 and 315, CH 461, and CHE 418 and 445 should be considered in the junior year. Students will generally want to prepare for the MCAT at the end of their junior year at UA, while filling out applications in the summer prior to their senior year. Medical schools start in the fall semester only. For those interested in medical research, PhD or MD/PhD programs offer a career option that leads towards medical R&D as opposed to clinical or hospital practice.
**AP credits can be used for many classes at UA and will count toward your B.S. degree in Chemical Engineering (although the grade will not be included in your UA GPA). HOWEVER, for students planning to apply to a medical school, most medical schools require the following classes be taken ON CAMPUS (i.e., not AP credit): 2 semesters of biology (plus labs); 2 semesters of chemistry (plus labs); 8 hours of organic chemistry (including the lab). One way to do this is take the classes required in the ChBE curriculum, plus BSC 115, 116 & 117. An alternative would be to use AP credit for some of these, but take higher-level CH or BSC classes with labs to satisfy these requirements.

**Pre-Pharmacy Track**
See above for pre-med, and contact the health professions advisor to learn more about the requirements for entering a graduate pharmacy program. (Entrance requirements vary widely.)

**Pre-Law Track**
Some engineers decide to pursue law degrees, often practicing in the area of patent or corporate law or specializing in environmental law. The LSAT is required to enter law school. Consult the undergraduate catalog for information about preparing for a career in legal studies.

**Business and Management Track (including MBA)**
With the electives available in the curriculum, students that wish to prepare for entering an MBA program may want to consider a minor in Business to complement their engineering degree. Courses in economics, finance, management, and accounting will be useful in preparing for a career in business management. Several of these classes can be used for HY/SB or Career electives.

**Traditional Engineering (FE) Track**
Electrical engineering, materials engineering, and statics and dynamics can complement your ChE degree and prepare you for work in a traditional engineering job, where you will interact with engineers with different backgrounds. These classes can also be helpful in passing the Fundamentals of Engineering (FE) exam in your senior year. While this exam is not required for obtaining a degree in the chemical and biological engineering program, it is required if you want to eventually be licensed as a professional engineer (a second exam, the Professional Engineer (PE) exam, is required after several years of work experience beyond the BS degree). The FE and PE are generally important to those who seek careers in consulting or government positions.

**Biotechnology Track**
Students interested in biotechnology-related careers should consider taking BSC classes (as well as CH and ChE electives) related to advanced biology- genetics, molecular biology, biochemistry, biomaterials, biochemical engineering, or other 300 & 400-level electives. While the course catalog shows all of the freshmen BSC classes (114-117) as prerequisites for 300- and 400-level biologies, ChE students may use BSC 114 to count for all 4 courses as prerequisites. 200-level BSC classes are not generally recommended, as these are courses primarily geared toward nursing majors.

**Research and Development Track/Engineering Graduate School**
A graduate degree is the springboard to a career in R&D. While some may enter industrial R&D with a B.S. degree, research is the main theme of a graduate education in chemical and biomedical engineering and other engineering fields. To prepare for graduate school, consider opportunities working in research labs at UA. Many faculty in ChBE, as well as other related departments (such as Chemistry, Biology, Metallurgical and Materials Engineering, etc.), have openings for undergraduate researchers. The research can be done for credit (using ChE 491, 492, 498 or 499), as a part-time job, or as part of a fellowship. Talk with professors to find out about opportunities. REU (Research Experiences for Undergraduates) programs sponsored by the National Science Foundation (NSF) are available during the summer at a number of universities across the US. There are many advertisements that usually come out around January each year, or check nsf.gov and look for REU programs. Advanced math courses beyond differential equations are also helpful in preparing for graduate-level classes. In most cases, students will be required to take the GRE (Graduate Record Exam) during their senior year while applying to graduate school. Unlike other advanced degree programs (law, medicine, business), attending graduate school in chemical and biological engineering (or related fields) will usually include a tuition waiver as well as a monthly stipend to cover living expenses while earning an MS or PhD. Some ChE graduate programs will allow students to start in the spring or summer, though most programs begin with a new class of graduate students in the fall semester. You may also opt to switch majors when entering graduate school- many students earn a BS degree in chemical engineering before entering a biomedical engineering graduate program. Check with the graduate program of schools you wish to apply to on requirements for acceptance.
FAQ’s (continued)

4. CO-OPERATIVE EDUCATION AND INTERNSHIPS

There are opportunities for students to gain valuable industrial or other work experience by participating as a co-op or intern student. Both programs are strong assets to career development and successful job placement upon graduation. In some cases, University credits can be earned through honors special problems courses in conjunction with advanced work projects (see the ChBE honors program coordinator for more information).

Co-operative Education Program
The Cooperative Education program is an alternating study/work program that can begin as early as the summer following your freshman year. Three work periods are generally expected, with the student following an alternating schedule of work/school/work/school, etc. over the spring, summer, and fall semesters. Three work periods generally add one year to the time required to complete the B.S. degree, but the salaries can be used to help with tuition costs, and the experience gained is a strong addition to your resume and is helpful in finding full-time employment upon graduation. The UA Co-Op office coordinates interviews for Co-Op positions. See http://coop.eng.ua.edu/ for more information on the Co-Op program.

Recommended Course Schedule for ChBE Co-Op Students:

Start by labeling the flow chart on page 2 with semesters 1-8 and include a "SL" semester between 6 & 7 to represent summer lab. The table below gives a suggested order of semesters to handle co-ops that start as early as the summer after freshman year to as late as the summer after the junior year. Starting a co-op in the senior year is not recommended.

<table>
<thead>
<tr>
<th>Semester of First Co-op --</th>
<th>Summer after 1st Year</th>
<th>Fall of 2nd Year</th>
<th>Spring of 2nd Year</th>
<th>Summer after 2nd Year</th>
<th>Fall of 3rd Year</th>
<th>Spring of 3rd Year</th>
<th>Summer after 3rd Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semesters at UA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall 1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Spring 1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Summer 1</td>
<td>co-op 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall 2</td>
<td>3</td>
<td>co-op 1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Spring 2</td>
<td>co-op 2</td>
<td>3</td>
<td>co-op 1</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Summer 2</td>
<td>co-op 2</td>
<td>co-op 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall 3</td>
<td>co-op 3</td>
<td>4</td>
<td>co-op 2</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Spring 3</td>
<td>4</td>
<td>co-op 3</td>
<td>4</td>
<td>co-op 2</td>
<td>6</td>
<td>co-op 1</td>
<td>6</td>
</tr>
<tr>
<td>Summer 3</td>
<td>co-op 3</td>
<td>co-op 2</td>
<td></td>
<td></td>
<td></td>
<td>co-op 2</td>
<td></td>
</tr>
<tr>
<td>Fall 4</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>co-op 3</td>
<td>5</td>
<td>co-op 2</td>
<td>7</td>
</tr>
<tr>
<td>Spring 4</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>co-op 3</td>
<td>6</td>
<td>co-op 2</td>
</tr>
<tr>
<td>Summer 4</td>
<td>SL</td>
<td>SL</td>
<td>SL</td>
<td>SL</td>
<td>SL</td>
<td>co-op 3</td>
<td>SL</td>
</tr>
<tr>
<td>Fall 5</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>co-op 3</td>
</tr>
<tr>
<td>Spring 5</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Summer 5</td>
<td>XX</td>
<td>XX</td>
<td>XX</td>
<td>XX</td>
<td>XX</td>
<td>SL</td>
<td>XX</td>
</tr>
</tbody>
</table>

Summers with no entry can be used for classes, but should not be necessary to graduate in the time prescribed.
FAQ's (continued)

Internships
Internships usually involve summer work programs that are arranged by the student with targeted companies. The ChBE department often gets requests for interns, so check with the main ChBE office or UA's Career Center's Satellite Engineering Office in Bevill 1004 to see if there are open positions. REU programs offer an alternative for internships for students interested in pursuing research-related careers. See the section on Research Track/Graduate School for more information on REUs.

5. PROFESSIONAL STUDENT ORGANIZATIONS

Within the ChBE department, the AIChE (American Institute for Chemical Engineers) student chapter hosts industrial speakers, fields intramural sports teams, offers department tours (E-Day), and organizes regular meetings and plant trips, among other activities. AIChE is a great way to find out what chemical engineers do after graduation, network with your peers in the major, and build your resume.

Omega Chi Epsilon is the national honor society for chemical engineering. Eligible students are invited to join in their junior or senior year, with membership based on academics.

Other engineering and science-related organizations that can help with career planning include:

- Society for Engineers in Medicine (SEM)
- Ambassadors to the College of Engineering (ACEs)
- Tau Beta Pi (Engineering Honor Society)
- Society of Women Engineers
- National Society of Black Engineers
- Engineers without Borders (EWB)
- Tri-Beta Biology
- Pre-Med (Alpha Epsilon Delta, AED)
- Pre-Law
- Medical Advising Office (Chris Hutt, located in Lloyd Hall)

6. PROGRAMS

Honors Programs
The University Honors Program, International Honors Program and Computer-Based Honors Program are administered by the Honors College (honors.ua.edu)

ChBE Honors

Within ChBE, an honors program carries the same eligibility requirements as the UHP programs (3.3 GPA at UA). If your GPA is 3.3 or higher, you are automatically in ChBE honors. The requirements to graduate with ChBE honors are:

- maintain overall 3.3 GPA
- complete at least one 1-hour ChBE honors forum class (ChE 225, 325 or 425)
- complete at least one 3-hour experiential (hands-on) course (Co-Op, Internship, Independent research or design)
- complete a minimum of 6 hours of ChE honors courses (495, 499, 5xx classes or any 300+ level or higher course as honors by contract); this can include honors forum hours or research hours in ChBE
- complete an additional 6 hours of honors courses in the ChE curriculum (ChE, CH, BSC, MA, PH, GES, EN, etc.)
- complete an additional 6 hours of any honors courses at UA (even if not on the ChBE flowchart).

Total of 18 hours of UA honors credits.
University Scholars Program (More Information on-line)
Eligible undergraduate students can elect an advanced program to earn both the BS and MS. ChE degrees in five years through the Scholars Program. Students must maintain a 3.3 GPA. A plan of study should be developed with the help of an advisor. The MS degree earned here is a non-thesis masters, and will not involve research, only classes. The stipends associated with graduate school generally don't apply for the Scholars program, as the stipends are given to students pursuing a thesis (research-based) master’s degree. For more information, see the undergraduate catalog, or consult brochures available in the ChBE office.

7. HY/SB and HU/L/FA ELECTIVES
The history/social behavior and humanities/languages/fine arts electives are part of the UA core curriculum and are meant to round out your education while at UA. The College of Engineering lists specific courses that are approved for each category. Three courses in each category are required for a BS degree, with at least two classes being a “depth sequence”, or being in the same subject (for example, Economics- EC 110 and 111- taken as 2 HY/SB electives, or Spanish 101 and 102- taken as 2 HU/L/FA electives).

8. CAREER ELECTIVES
Students can choose 6 hours of classes to count as "career electives". These 6 hours can be classes directed toward a minor (ex., 2 math classes) or just something that you feel will help you in your career (ex., a foreign language, communication, finance, marketing, additional ChBE classes, etc.). For students pursuing a pre-med option, a common way to achieve the 6 career elective hours is to combine BSC 115 (1 hour), BSC 116 (3 hours), BSC 117 (1 hour), plus one other hour of class.

If you wish to count a class not on the career electives list, fill out the ChBE Career Electives Approval Form. Students should write one paragraph explaining how the career electives will help their career, and have the form signed by a faculty advisor. Students generally select career electives in their junior year, although these classes can be taken at any time. You may change your selections while working on your ChE degree.

Students at UA following 2010 or earlier Undergraduate Catalogs will need to fill this form out, and drop it by the main ChBE office. If the Approved Elective courses they wish to take are listed on the CAREER electives list, the form doesn’t need to be signed. If the classes are NOT on the CAREER electives list, the form will need approval from a ChBE professor before the classes can be counted towards your degree.

9. MY DEGREE IS IN CHEMICAL ENGINEERING, BUT THE DEPARTMENT IS CHEMICAL AND BIOLOGICAL ENGINEERING. WHY?
The Alabama Commission on Higher Education has approved the degree plan, and regulates our offering an official degree in chemical engineering. The department’s official name includes biological engineering, and reflects the importance of biology and the life sciences for all students.

10. ABET
ABET is the Accrediting Board for Engineering and Technology, and certifies engineering programs at universities in the USA. This certification ensures that our program meets rigorous education goals. The accreditation process involves periodic independent reviews of our curriculum and departmental objectives. The University of Alabama’s Chemical and Biological Engineering program is fully accredited by ABET.
FAQ’s (continued)

11. ELECTIVES

Bio Elective (Advanced Biochemistry)
Students can select either CH 461 (Biochemistry I), which is taught every fall, or ChE 445 (Biochemical Engineering), which is taught every spring. Although CH 223 is listed as a pre-requisite for CH 461, overrides are commonly given to ChBE students who wish to take CH 461; see the instructor for CH 461 or visit the main office for the Chemistry Department in Shelby Hall to request an override.

Engineering Elective
Students may select MTE 271 or ECE 320 to count for the engineering elective.

Advanced Science
Several classes can count towards an advanced science class. These include:

- CHEMISTRY (CH): 223, 341, 424, 461, 462, or any 500+ class (lecture-based)
- ChE: 412/512, 418/518, 438/538, 440/540, 445/545 (not all ChE electives count for advanced science)
- BIOLOGY (BSC): 300, 310, 315, 442, 448 (others may count, but require petitioning ChBE)
- independent study courses (ChE 491, 492, 498, 499, or other majors), depending on science content

ChE Elective
Any non-required ChE course can be used for this elective. These include ChE 375, 412/512, 418/518, 438/538, 445/545, 440/540, 524, 525, 535, or independent study courses, 491, 492, 498 or 499.

** A MAXIMUM of 6 hours of independent study (non-lecture) classes can be used in the electives slots for Career Electives, Advanced Science Elective, and Chemical Engineering Elective. This includes CBH classes, ChE 498, ChE 499, BSC 398, BSC 399, CH 396, CH 398, CH 399, CH 497, CH 498, CH 499 and UA 155.

12. STUDY ABROAD

Studying abroad is a great way to enhance your degree. There are many programs that involve humanities or histories. Occasionally, there are engineering-related international programs that are available, including a ChE 320 summer lab experience in Denmark. To find out more about study abroad, visit the Capstone International offices in BB Comer Hall. Check with a ChBE professor to determine which engineering credits will transfer to your UA ChE degree.

13. DEGREE WORKS

Students can monitor their progress to degree using DegreeWorks, accessed through mybama.ua.edu. The courses listed on DegreeWorks will match those required for the B.S. degree in Chemical Engineering in the undergraduate catalog in effect when you first took a class at UA. This is a useful tool for advising, but PLEASE CONSULT THE CHBE FLOWCHART in addition to DegreeWorks to make sure that pre-requisite courses are taken in a timely fashion.

Q. I took CHE 445 to fill in the BIO EL class in the ChBE flowchart, but on DegreeWorks it shows up as a ChE Elective. Does that mean that I need to take CH461 to finish the BIO EL?

No. ChE 445 can fill into three different slots in the ChBE curriculum (CHE Elective, BIO elective or ADV SCI elective). You can use it in any of these slots, but after you complete the class DegreeWorks will slot it into one of these places, nearly randomly. If you later take a class that will count for the CHE elective, then CHE 445 will automatically be bumped to the BIO EL or ADV SCI EL slot. Similar situations occur with DegreeWorks, and will resolve themselves once all of the electives are taken.
14. PRE-REQUISITES, CO-REQUISITES AND THE THREE-ATTEMPT RULE

In ChBE, there are numerous classes that are pre-requisites for other classes. All pre-requisites must be completed with a C- or higher before you are allowed to enroll in the next class in the sequence. On the ChBE flowchart, pre-requisites are noted by solid arrows. Co-requisite classes are indicated by dashed arrows on the flowchart. A dashed arrow indicates that the class where the arrow points can only be taken if the preceding (co-requisite) class has already been completed or is enrolled during the same semester.

For each of the core (required) ChE classes, students are allowed a maximum of three attempts to earn the required grade (C- or better if the class is a pre-requisite for further classes; D- or better if the class is not a pre-requisite). Withdrawal from the class (grade of W) counts as one attempt to take the class. Once three unsuccessful attempts have been made for a particular class, the student will not be allowed to enroll in that class again.

HONORS PROGRAM

Chemical Engineering Honors Program

The chemical engineering honors program in the Department of Chemical and Biological Engineering at UA was created to offer exceptional students a challenging environment and to expose them to real-world problems and solutions, including societal, environmental, global and business impact, as well as the technical engineering perspective. Honors students will gain valuable tools to launch careers in diverse fields, including chemical process engineering, product design, biomedical research, microelectronics, chemical business management, law, and medicine.

Honors Program Newsletter (Fall 2009): Download
Honors Program Newsletter (Spring 2010): Download

Opportunities for ChBE Honors Students

- discover career opportunities
- explore engineering issues from multiple perspectives in forum setting
- enhance your degree status
- honors co-op program (Approval Form)
- study challenging problems
- options to work or study abroad

Contact Information

Chemical and Biological Engineering Honors Program,
The University of Alabama
Box 870203
Tuscaloosa, AL 35487
(205) 348-6450

Faculty
Dr. Chris Brazel

Admission Requirements

- No application required.
- Students with a minimum UA GPA of 3.3 may register for ChE honors classes. Freshmen or transfer
# ChBE Honors Program

## Senior Checklist

*(Please complete this form at the beginning of your last semester on campus if you plan to graduate ChBE honors)*

**Student:**

***Turn in to the ChBE department office or honor chair by January 31 for spring or summer graduation or by September 15 for fall graduation.***

<table>
<thead>
<tr>
<th>COURSES</th>
<th>HOURS</th>
<th>SEMESTER COMPLETED</th>
<th>Note(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Required Course</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ChE 225, 325, or 425</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL of REQUIRED COURSES</strong></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ChBE Courses</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ChE 512: Polymer Materials Engineering</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ChE 518: Tissue Engineering</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ChE 538: Integrated Circuit Fabrication Principles</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ChE 540: Health and Safety</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ChE 545: Biochemical Engineering</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ChE 498: Honors Research, Co-Op, Intern Describe:</td>
<td>Variable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ChE 499: Honors Design, Research, Co-Op Describe:</td>
<td>variable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other (additional ChBE honors forum, honors by contract). Describe:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL of ChBE HONORS COURSES</strong></td>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**ChBE Curriculum Honors Courses** *(select from any of the courses listed in the ChBE curriculum, including chemistry, physics, math, English, etc.)*

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TOTAL of ChBE CURRICULUM HONORS</strong></td>
<td>5 minimum</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Additional Honors Courses** *(select from any honors course offered at UA)*

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TOTAL of ADDITIONAL HONORS COURSES</strong></td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL of ALL HONORS COURSES</strong></td>
<td>18</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Required 1 Experiential Hands-On Course (3 hrs): Which class (from above)? ________________

---

1 Note: 3 hours of experiential coursework is required. This can be satisfied by REU or co-op credits, or by doing undergraduate research at UA—either with a ChBE professor as ChE 498/499, or outside of ChBE for UA credits.
ChBE Honors Co-Op / Internship / REU / Organization and Approval Form

Use this form prior to (or at the beginning) of a co-op term or internship to gain approval for earning UA credits. Students must give a presentation on their project at UA after completion of their experience.

Student: __________________________
Date: __________________________
Hours Completed: __________________________
E-mail address while on Co-op/internship/REU assignment: __________________________

Previous co-ops/internships/REUs:
  Company/Institution __________________________

Planned co-op/internship/REU for honors credit:
  Company/Institution __________________________
  Location __________________________
  Supervisor __________________________
    Supervisor’s Phone Number __________________________
    Supervisor’s E-mail Address __________________________

Project title: __________________________

Proposed Dates of Project Work: __________________________

You should attach a 1-2 page summary of the work planned, how it relates to chemical and biological engineering, and what the expected results will be. This should be coordinated with the supervisor, with their approval noted by signing a copy of the plan and faxing/returning the document to the chemical and biological engineering department. A ChBE faculty member will review the plan, and approve the project or suggest alterations to meet academic-specific requirements at The University of Alabama.

STUDENT SIGNATURE: __________________________ DATE: __________________________

APPROVED BY: __________________________ DATE __________________________
  (ChBE Faculty)

At the end of the semester of the project:
Received end of semester report: Date ________ Approved by: __________________________

OR

After completion of the presentation:
Oral presentation given on ChBE Honors Co-op/internship/REU project in the presence of ChBE Faculty.
Date of Presentation: __________________________

Approved by: __________________________ DATE: __________________________
  (ChBE Faculty)
HELPFUL PROGRAMS AND OFFICES ACROSS CAMPUS

ChBE Main Office

Currently in 116 Houser Hall

Main contact: Ms. Sues Noble, snoble@eng.ua.edu; 348-6455

Co-Operative Education Office

317 Houser Hall, coop.eng.ua.edu

Main contact: Mr. Roy Gregg, rtgregg@eng.ua.edu

Career Center Office

Engineering Satellite Office, 104 Bevill; uacc.ua.edu

Main Contact: Ms. Gayle Howell, ghowell@sa.ua.edu

Pre-Health Professions Advisor

Pre-Med Office, 301, 302, 312 Lloyd Hall; premed.ua.edu

Main contact: Mr. Chris Hutt, chutt@as.ua.edu

Student Organizations:

- AIChE (American Institute of Chemical Engineers); faculty sponsor: Dr. Jason Bara, jbara@eng.ua.edu; aiche.eng.ua.edu

- Engineers without Borders; faculty sponsor: Dr. Pauline Johnson, Pauline@eng.ua.edu

- Society for Engineers in Medicine: Dr. Chris Brazel, CBrazel@eng.ua.edu, uasem.ua.edu

- Society of Women Engineers; faculty sponsor: Dr. Beth Todd, btodd@eng.ua.edu

- National Society of Black Engineers; faculty sponsor: Mr. Greg Singleton, gsingleton@eng.ua.edu; http://bama.ua.edu/~uansbe/

- AED Alpha Epsilon Delta, Pre-Health Professions Society: aed.ua.edu, Advisor: Chris Hutt (CHutt@as.ua.edu)
Signature Attesting to Compliance

By signing below, I attest to the following:

That Chemical and Biological Engineering has conducted an honest assessment of compliance and has provided a complete and accurate disclosure of timely information regarding compliance with ABET’s *Criteria for Accrediting Engineering Programs* to include the General Criteria and any applicable Program Criteria, and the ABET *Accreditation Policy and Procedure Manual*.

Dean’s Name (As indicated on the RFE)

________________________________  _______________________
Signature      Date