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CLEMSON UNIVERSITY **Curriculum and Course Change System - General Education Checklist**

Major Name: Mathematical Sciences (BA)

Specific General Education Requirements

Requirement	Select from Gen Ed List	Select from Restricted Gen Ed List	Specific Course(s)	No Change
		Specify restrictions - e.g. PHIL courses only	Specify courses or cluster* of courses if appropriate	
English Composition			ENGL 103	
Oral Communication*	..	..	X COMM 250	..
Academic & Professional Development			X MTHSC 250 and MTHSC 492	..
Mathematics	..	..	X MTHSC 106	..
Natural Science with lab	..	X BIOL 103/105, CH 101, PHYS 221/223, GEOL 101/103	..	..
Math or Natural Science	..	X BIOL 104/106, CH 102, PHYS 222/224, GEOL 102, GEOL 112/114	..	..
Arts & Humanities (Literature)	X	..	..	..
Arts & Humanities (Non-Literature)	X	..	..	..
Social Sciences	..	X ECON 200 or ECON 211, and Select from Gen Ed List	..	..
Cross-Cultural Awareness	X	..	..	..
Science and Tech. in Society	X	..	..	..

*Departments may specify a cluster of courses to meet the Oral communication competency but must include a plan for implementation and assessment in the following textbox:

Distributed Competencies

The faculties of each degree program will decide the most appropriate ways to integrate learning experiences in each of the areas below. Quantification in terms of credit hours is avoided in favor of the presumption that faculties will want to place a serious effort in each area and distribute this effort to a significant degree throughout their curricula.

Ethical Judgement Integration Plan - Address competencies, implementation, and assessment:
Students will demonstrate an understanding of standards of professional ethical conduct and will demonstrate an understanding of common ethical issues. Both objectives will be achieved in MTHSC 492. In MTHSC 492 students will review published ethical guidelines from professional organizations in the mathematical sciences, e.g. the American Mathematical Society and the American Statistical Association. Students will also complete a module on ethical judgment on issues that impinge on the mathematical sciences. At the conclusion of this module, students will be required to submit a paper that discusses whether and how professional ethical guidelines apply to a case study in the module and that articulates an ethical position based on a valid ethical argument. Both objectives will be evaluated using a department-developed rubric. The benchmark for demonstration of the Ethical Judgement competency will be that ninety percent of students will achieve at least a seventy-five percent grade on this paper. If this benchmark is not met, the Mathematical Sciences Undergraduate Committee will use make changes to the MTHSC 492 curriculum to improve student competency in ethical judgement.

Communication Integration Plan - Address competencies, implementation, and assessment: Students will demonstrate
(1) effective professional communication skills and
(2) the ability to present mathematical arguments both orally and in writing, using correct mathematical terminology and notation.

Firstly, to demonstrate the ability to communicate effectively in the workplace, students are required to complete ENGL 314 in which they are given specific assignments to write instructions to their readers, write a proposal for a specific project, collaborate with team members, write progress reports throughout the semester, participate in meetings, conduct interviews, and research, write and revise a final deliverable to a client. These assignments will

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be evaluated by the instructor using an appropriate rubric. Grades in this class will be monitored. The benchmark for this competency will be that ninety percent of students will pass ENGL 314 with an A, B or C. If this benchmark is not met, the Mathematical Sciences Undergraduate Committee will use the evaluation data to improve student competency in this area.

Secondly, students will demonstrate the ability to present mathematical arguments in writing, using correct mathematical terminology and notation. Students develop the writing aspect of this competency throughout the required sequence of courses in the mathematical sciences. Assignments in MTHSC 412 Modern Algebra and MTHSC 453 Advanced Calculus will be evaluated by the instructors using appropriate rubrics. Grades in these courses will be monitored. The benchmark for demonstration of the ability to present mathematical arguments in writing, using correct mathematical terminology and notation will be that seventy-five percent of all students in MTHSC 412 and MTHSC 453 will earn an A, B or C in those courses. If this benchmark is not met, the Mathematical Sciences Undergraduate Committee will use the evaluation data to improve student competency in this area.

Finally, students will demonstrate the ability to present mathematical arguments orally and in writing by completing a capstone experience. This capstone experience provides an opportunity to pursue research, independent study, or an approved internship under the direction of a faculty member, or the opportunity to study mathematical models in some area of the mathematical sciences. The capstone experience requires a written report (thesis, computer code, project description, intern experience, etc) and an oral or poster presentation by each student. Specific courses that satisfy the capstone experience are MTHSC 407, 450, 482, 491, and 499. The written and oral portions of the capstone experiences will be evaluated using department rubrics. The benchmark for demonstration of the ability to present mathematical arguments both orally and in writing will be that ninety percent of students will achieve at least a seventy-five percent grade on both the oral presentation and the written presentation. If this benchmark is not met, the Mathematical Sciences Undergraduate Committee will use the evaluation data to improve student competency in oral and written communication.

Critical Thinking Integration Plan - Address competencies, implementation, and assessment: Critical thinking is developed throughout the math sciences curriculum. For example, in MTHSC 119/129, students demonstrate deductive reasoning by composing mathematical proofs. In MTHSC 208 students analyze and critique first-order, second-order and systems of differential equations. In MTHSC 302 students analyze data and present statistical arguments to support or reject hypotheses in a rigorous manner. In MTHSC 311 students apply abstract definitions of linear operators and vector spaces to specific examples. In MTHSC 360 students demonstrate logical reasoning by constructing computer programs that solve prototypical problems in the mathematical sciences. In MTHSC 412 students apply abstract definitions of groups and rings to specific examples. In MTHSC 453 students analyze the properties of real-valued functions given abstract definitions.

The capstone experience culminates in a report and presentation. This report and presentation demonstrate competency in critical thinking because the formulation and analysis of the problem addressed in the capstone experience requires the application of the mathematical knowledge and skills developed throughout the undergraduate program. Specific courses that satisfy the capstone experience are MTHSC 407, 450, 482, 491, and 499. The critical-thinking aspects of the written and oral portions of the capstone experiences will be evaluated using departmental-developed rubrics. The benchmark for demonstration of the critical thinking competency will be that ninety percent of students will achieve at least a seventy-five percent score on the critical thinking portion of this paper. If this benchmark is not met, the Mathematical Sciences Undergraduate Committee will use the evaluation data to improve student competency in critical thinking.

Form Originator: CAWOOD, Mark Cawood **Date Form Created:** 2/9/2011
Form Last Updated by: CAWOOD, Mark Cawood **Date Form Last Updated:** 4/14/2011 **Form Number:** 3766

Approval

Robert S. Taylor	4-18-11	Janice W. Mawdsley 5/6/2011 Mark E. Cawood	4/18/2011
Chair, Department Curriculum Committee	Date	Chair, Undergraduate Curriculum Committee	Date
Robert S. Taylor	4-18-11		
Department Chair	Date	Chair, Graduate Curriculum Committee	Date
	4/18/11		
Chair, College Curriculum Committee	Date	Provost	Date 6/17/20
	4-18-11	Doris R. Helms	
College Dean	Date	President	Date 6/17/20

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CLEMSON UNIVERSITY **Curriculum and Course Change System - General Education Checklist**

Major Name: Geology (BA)

Specific General Education Requirements

Requirement	Select from Gen Ed List	Select from Restricted Gen Ed List	Specific Course(s)	No Change
		Specify restrictions - e.g. PHIL courses only	Specify courses or cluster* of courses if appropriate	
English Composition			ENGL 103	
Oral Communication*	..	..	X GEOL 292/391/392/492	..
Academic & Professional Development			X GEOL 391/491/492	..
Mathematics	..	..	X MTHSC 101	..
Natural Science with lab	..	..	X GEOL 101/103	..
Math or Natural Science	..	..	X GEOL 102	..
Arts & Humanities (Literature)	..	..	..	X
Arts & Humanities (Non-Literature)	..	..	..	X
Social Sciences	..	..	..	X
Cross-Cultural Awareness	..	..	X GEOG 103	..
Science and Tech. in Society	..	..	X GEOL 300	..

*Departments may specify a cluster of courses to meet the Oral communication competency but must include a plan for implementation and assessment in the following textbox: Oral communication competencies are woven throughout the Geology Major, primarily through the required series of Creative Inquiry courses (GEOL 291, 292, 391, 392, 491, 492). In several of these courses, students receive instruction in making effective oral presentations and are given opportunities to demonstrate competence in giving both group and individual oral presentations. All oral reports are graded by faculty using rubrics adapted from online forms posted by Georgia Tech University and the Pomperaug Regional School District of Middlebury, CT. Group oral presentations are emphasized in GEOL 292 and GEOL 391, while individual oral presentations are assigned in GEOL 292 and GEOL 392. GEOL 492 focuses almost exclusively on oral communication skills and requires students to prepare and give a 20-minute professional presentation at the annual Clemson Hydrogeology

Symposium. Also required are a poster presentation at the annual "Focus on Creative Inquiry" poster symposium, a ten-minute radio interview, and a ten-minute interview with a newspaper reporter.

Distributed Competencies

The faculties of each degree program will decide the most appropriate ways to integrate learning experiences in each of the areas below. Quantification in terms of credit hours is avoided in favor of the presumption that faculties will want to place a serious effort in each area and distribute this effort to a significant degree throughout their curricula.

Ethical Judgement Integration Plan - Address competencies, implementation, and assessment: Ethical judgment competencies are addressed in the Geology curriculum primarily through the required series of Creative Inquiry courses (GEOL 291, 292, 391, 392, 491, 492). In GEOL 291 the issue of bias in conducting research is introduced in the assigned reading "The Nature of Science and the Scientific Method" by Christine McClelland. Lectures in GEOL 391 cover professional ethics and practices in the geosciences, including the Code of Ethics for professional geologists and case studies involving ethics, plus assigned reading of the National Academy of Science booklet "On Being a Scientist: Responsible Conduct in Research". Students in GEOL 391 are required to write two class reflections on ethical issues. In GEOL 491 and GEOL 492, issues of plagiarism are addressed and research reports are graded partially on the degree of adherence to professional ethical standards as expected in the geosciences. Ethical judgment and reasoning will be assessed from students' written class reflections in GEOL 391 and written reports in GEOL 491/492 using the grading scale given in the class syllabi. If 75% are not scored A (excellent) or B (good) an improvement mechanism will be triggered; assessment results will be used by instructors to improve the Creative Inquiry courses.

Communication Integration Plan - Address competencies, implementation, and assessment: Scientific writing and technical communications competencies are woven throughout the Geology Major, primarily through the required series of Creative Inquiry courses (GEOL 291, 292, 391, 392, 491, 492). GEOL 291 requires each student to prepare a written literature review and GEOL 292 introduces the digital electronic portfolio as a required mechanism for reporting data and for writing reflections on class topics, assigned readings, and the monthly progress being made on the student's research project. Written entries to the digital electronic portfolios are graded using a rubric adapted from the book "Electronic Portfolios: A Guide to Professional Development and Assessment" by Marilyn Heath (Linworth, 2004). In GEOL 391, students write reflections on class presentations about various geoscience careers and on ethical case studies. In GEOL 392, students write a complete project proposal which is graded according to guidelines published by the US Department of Energy. The primary emphasis of GEOL 491 is technical writing; students turn in ten written homework assignments in addition to a ten-page written progress report (in a format suitable for publication). For GEOL 492, students must turn in a complete written research report, suitable for publication. The progress and final reports are graded according to peer review

standards typically used by geoscience technical journals.
If 75% are not graded A (excellent) or B (good) an improvement mechanism will be triggered; assessment results will be used by instructors to improve the Creative Inquiry courses.

Critical Thinking Integration Plan - Address competencies, implementation, and assessment: Critical thinking competencies are woven throughout the Geology Major, primarily through the required series of Creative Inquiry courses (GEOL 291, 292, 391, 392, 491, 492). In GEOL 291, students are assigned to read articles such as "The Nature of Science and the Scientific Method" by Christine McLelland (published by Geological Society of America) and class discussions build on those themes. In GEOL 292, a major topic is the "Method of Multiple Working Hypotheses." In GEOL 391, students discuss the NAS booklet "On Being a Scientist." In GEOL 392, the focus in on planning an original research proposal that has a reasonable research design and can be accomplished in the allotted time frame within the allotted budget. In GEOL 491 and GEOL 492, students are responsible for self-directing, self-monitoring, and self-correcting their progress in implementing their research project. But in each of these courses, students practice their critical thinking skills most often during actual research project work, with assistance as needed from their faculty research mentor. Students must keep a professionally formatted research notebook and must anticipate issues associated with carrying out their research successfully, and devise strategies for dealing with unexpected problems and/or opportunities that may arise. Faculty project mentors grade the research notebooks in accordance with professionally accepted standards for such work. If 75% are not graded A (excellent) or B (good) an improvement mechanism will be triggered; assessment results will be used by instructors to improve the Creative Inquiry courses.

Form Originator: TJVRC, Thomas Overcamp **Date Form Created:** 2/10/2011
Form Last Updated by: TJVRC, Thomas Overcamp **Date Form Last Updated:** 4/14/2011 **Form Number:** 3772

Approval

Thomas J. Overcamp		5/6/2011 Janice W. Murdock
Chair, Department Curriculum Committee	Date	Chair, Undergra
[signature]	4/18/2011	
Department Chair	Date	Chair, Graduate
[signature]	4/15/11	
Chair, College Curriculum Committee	Date	Provost 6/7/2011
[signature]	4-18-11	[signature]
College Dean	Date	President 6/7/2011

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CLEMSON UNIVERSITY **Curriculum and Course Change System - General Education Checklist**

Major Name: B.A. in Computer Science

Specific General Education Requirements

Requirement	Select from Gen Ed List	Select from Restricted Gen Ed List	Specific Course(s)	No Change
		Specify restrictions - e.g. PHIL courses only	Specify courses or cluster* of courses if appropriate	
English Composition			ENGL 103	
Oral Communication*	..	..	..	X
Academic & Professional Development			..	X
Mathematics	..	..	..	X
Natural Science with lab	..	..	..	X
Math or Natural Science	..	..	..	X
Arts & Humanities (Literature)	..	..	..	X
Arts & Humanities (Non-Literature)	..	..	..	X
Social Sciences	..	..	..	X
Cross-Cultural Awareness	..	..	..	X
Science and Tech. in Society	..	..	..	X

*Departments may specify a cluster of courses to meet the Oral communication competency but must include a plan for implementation and assessment in the following textbox:

Distributed Competencies

The faculties of each degree program will decide the most appropriate ways to integrate learning experiences in each of the areas below. Quantification in terms of credit hours is avoided in favor of the presumption that faculties will want to place a serious effort in each area and distribute this effort to a significant degree throughout their curricula.

Ethical Judgement Integration Plan - Address competencies, implementation, and assessment: The School of Computing has identified "an understanding of professional, ethical, legal, security and social issues and responsibilities" as a student outcome for the program. While addressed throughout the curriculum, CP SC 291 "Seminar in Professional Issues I" and CP SC 491 "Seminar in Professional Issues II" contain specific components that address ethics in their syllabi and require students to make presentations and submit work on ethical issues as they relate to our discipline. Both CP SC 291 and 491 use required textbooks that address ethical issues, such as "Ethics for the Information Age" by Michael Quinn and "Ethics and Technology" by Herman Tavani. Both course emphasize the need for ethics for professional and social relationships. CP SC 491 discusses the ethical issues in the design and development of computer software. Assessment will be carried out in CP SC 291 and 491. Students will submit a paper on ethical issues related to the discipline in CP SC 291. In CpSc 491 students will be assessed through required papers, oral presentations and team presentations on ethical, societal and professional issues. Students may elect to submit artifacts from these courses to their university ePortfolio to satisfy competency requirements in ethical judgment. The school's assessment committee will use collected papers, presentations and test questions to assess distributed competencies outcomes related to ethical judgment. If in a given year less that 70% of the submitted work in CP SC 291 or 491 is evaluated as being unacceptable the curriculum

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committee will review the curriculum and make recommendations to improve student performance in this area.

Communication Integration Plan - Address competencies, implementation, and assessment: The School of Computing has identified "an ability to communicate effectively with a range of audiences" and "an ability to function effectively on teams to accomplish a common goal" as a student outcomes for the program. While effective communications is stressed through the curriculum, all students are required to satisfy the university's general education oral communications requirement. The curriculum also includes an advanced writing requirement that is typically satisfied by a 300 or 400 level English course. CP SC 291 "Seminar in Professional Issues I" and CP SC 491 "Seminar in Professional Issues II" each require both written and oral presentations on various topics related to the discipline. CpSc 291 requires both a paper and an oral presentation on ethical issues related to the discipline. Students in the class are also required to provide critiques of peer presentations. CpSc 491 involves the completion of a major project and requires both a final written and oral. The oral presentation must include appropriate audio-visual support. Oral presentations are video-taped and critiqued. If in a given year less that 70% of the submitted work in CpSc 291 or 491 is evaluated as being unacceptable the curriculum committee will review the curriculum and make recommendations to improve student performance in this area.

Critical Thinking Integration Plan - Address competencies, implementation, and assessment: The School of Computing has identified several student outcomes that relate to critical thinking. These include "An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices", "An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution", "An ability to apply design and development principles in the construction of software systems of varying complexity". The development of a software system involves the ability to critically analyze the quality and utility of knowledge and apply this knowledge to the development of the software system. Critical thinking is a key skill in computing and as such is integrated throughout the curriculum. This is not limited to just computer science courses. The literature general education requirement addresses the distributed competency to summarize, analyze and evaluate fictional texts. Students are required to take two semesters of calculus (MTHSC 106/108), a discrete structures course (CP SC 207), a statistics course (MTHSC 301, 302 or 309) and linear algebra (MTHSC 311) all of which involve to varying degrees inductive and deductive reasoning processes. Math is a prime tool in analyzing data. Most computer science classes require analyzing requirements and using available information to formulate and implement the design of a solution to a problem. In particular CP SC 491 "Seminar in Professional Issues II" requires student teams to identify a problem requiring a software solution, meet with "customers" to gather information about the problem, formulate a design and initiate a solution. Final results of the projects are presented both orally and in a written report. The school's assessment committee will collect artifacts from CP SC 491 to assess how effectively students have been able to use their undergraduate experience to formulate an acceptable solution. The assessment committee will review the projects submitted in CP SC 491. If less than 70% are found to be acceptable in a year the curriculum committee will review the curriculum and make recommendations to improve student performance in this area.

Form Originator: MADPROF, Alan Madison **Date Form Created:** 4/13/2011
Form Last Updated by: MADPROF, Alan Madison **Date Form Last Updated:** 4/13/2011 **Form Number:** 4032

Approval

Al Way - M	4/13/2011	
Chair, Department Curriculum Committee	Date	Chair, Undergraduate Curriculun
	4/13/11	

Department Chair	Date	Chair, Graduate Curriculum Com
	4/13/11	
Chair, College Curriculum Committee	Date	Provost 6/17/2011
	4-18-11	
College Dean	Date	President 6/17/2011
Undergraduate Curriculum, Chair	5/6/2011	

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CLEMSON UNIVERSITY **Curriculum and Course Change System - General Education Checklist**

Major Name: B.S. in Computer Information Systems

Specific General Education Requirements

Requirement	Select from Gen Ed List	Select from Restricted Gen Ed List	Specific Course(s)	No Change
		Specify restrictions - e.g. PHIL courses only	Specify courses or cluster* of courses if appropriate	
English Composition			ENGL 103	
Oral Communication*	..	..	..	X
Academic & Professional Development			..	X
Mathematics	..	..	..	X
Natural Science with lab	..	..	..	X
Math or Natural Science	..	..	..	X
Arts & Humanities (Literature)	..	..	..	X
Arts & Humanities (Non-Literature)	..	..	..	X
Social Sciences	..	..	..	X
Cross-Cultural Awareness	..	..	..	X
Science and Tech. in Society	..	..	..	X

*Departments may specify a cluster of courses to meet the Oral communication competency but must include a plan for implementation and assessment in the following textbox:

Distributed Competencies

The faculties of each degree program will decide the most appropriate ways to integrate learning experiences in each of the areas below. Quantification in terms of credit hours is avoided in favor of the presumption that faculties will want to place a serious effort in each area and distribute this effort to a significant degree throughout their curricula.

Ethical Judgement Integration Plan - Address competencies, implementation, and assessment: The School of Computing has identified "an understanding of professional, ethical, legal, security and social issues and responsibilities" as a student outcome for the program. While addressed throughout the curriculum, CP SC 291 "Seminar in Professional Issues I" and CP SC 491 "Seminar in Professional Issues II" contain specific components that address ethics in their syllabi and require students to make presentations and submit work on ethical issues as they relate to our discipline. Both CP SC 291 and 491 use required textbooks that address ethical issues, such as "Ethics for the Information Age" by Michael Quinn and "Ethics and Technology" by Herman Tavani. Both course emphasize the need for ethics for professional and social relationships. CP SC 491 discusses the ethical issues in the design and development of computer software. Assessment will be carried out in CP SC 291 and 491. Students will submit a paper on ethical issues related to the discipline in CP SC 291. In CpSc 491 students will be assessed through required papers, oral presentations and team presentations on ethical, societal and professional issues. Students may elect to submit artifacts from these courses to their university ePortfolio to satisfy competency requirements in ethical judgment. The school's assessment committee will use collected papers, presentations and test questions to assess distributed competencies outcomes related to ethical judgment. If in a given year less that 70% of the submitted work in CP SC 291 or 491 is evaluated as being unacceptable the curriculum

committee will review the curriculum and make recommendations to improve student performance in this area.

Communication Integration Plan - Address competencies, implementation, and assessment: The School of Computing has identified "an ability to communicate effectively with a range of audiences" and "an ability to function effectively on teams to accomplish a common goal" as a student outcomes for the program. While effective communications is stressed through the curriculum, all students are required to satisfy the university's general education oral communications requirement. The curriculum also includes an advanced writing requirement that is typically satisfied by a 300 or 400 level English course. CP SC 291 "Seminar in Professional Issues I" and CP SC 491 "Seminar in Professional Issues II" each require both written and oral presentations on various topics related to the discipline. CpSc 291 requires both a paper and an oral presentation on ethical issues related to the discipline. Students in the class are also required to provide critiques of peer presentations. CpSc 491 involves the completion of a major project and requires both a final written and oral. The oral presentation must include appropriate audio-visual support. Oral presentations are video-taped and critiqued. If in a given year less that 70% of the submitted work in CpSc 291 or 491 is evaluated as being unacceptable the curriculum committee will review the curriculum and make recommendations to improve student performance in this area.

Critical Thinking Integration Plan - Address competencies, implementation, and assessment: The School of Computing has identified several student outcomes that relate to critical thinking. These include "An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices", "An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution", "An ability to apply design and development principles in the construction of software systems of varying complexity". The development of a software system involves the ability to critically analyze the quality and utility of knowledge and apply this knowledge to the development of the software system. Critical thinking is a key skill in computing and as such is integrated throughout the curriculum. This is not limited to just computer science courses. The literature general education requirement addresses the distributed competency to summarize, analyze and evaluate fictional texts. Students are required to take two semesters of calculus (MTHSC 106/108), a discrete structures course (CP SC 207), a statistics course (MTHSC 301, 302 or 309) and linear algebra (MTHSC 311) all of which involve to varying degrees inductive and deductive reasoning processes. Math is a prime tool in analyzing data. Most computer science classes require analyzing requirements and using available information to formulate and implement the design of a solution to a problem. In particular CP SC 491 "Seminar in Professional Issues II" requires student teams to identify a problem requiring a software solution, meet with "customers" to gather information about the problem, formulate a design and initiate a solution. Final results of the projects are presented both orally and in a written report. The school's assessment committee will collect artifacts from CP SC 491 to assess how effectively students have been able to use their undergraduate experience to formulate an acceptable solution. The assessment committee will review the projects submitted in CP SC 491. If less than 70% are found to be acceptable in a year the curriculum committee will review the curriculum and make recommendations to improve student performance in this area.

Form Originator: MADPROF, Alan Madison **Date Form Created:** 4/13/2011
Form Last Updated by: MADPROF, Alan Madison **Date Form Last Updated:** 4/13/2011 **Form Number:** 4031

Approval

A. Madison	4/13/2011	
Chair, Department Curriculum Committee	Date	Chair, Undergraduate Curriculun
	4/13/11	

Department Chair	Date	Chair, Graduate Curriculum Com
	4/13/11	
Chair, College Curriculum Committee	Date	Provost 6/17/2011
	4-18-11	
College Dean	Date	President 6/17/2011
Janice W. Murdock	5/6/2011	

CLEMSON UNIVERSITY **Curriculum and Course Change System - General Education Checklist**

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Major Name: Chemistry (B.S.)

Specific General Education Requirements

Requirement	Select from Gen Ed List	Select from Restricted Gen Ed List	Specific Course(s)	No Change
		Specify restrictions - e.g. PHIL courses only	Specify courses or cluster* of courses if appropriate	
English Composition			ENGL 103	
Oral Communication*	..	..	..	X
Academic & Professional Development			..	X
Mathematics	..	..	..	X
Natural Science with lab	..	..	..	X
Math or Natural Science	..	..	..	X
Arts & Humanities (Literature)	..	..	..	X
Arts & Humanities (Non-Literature)	..	..	..	X
Social Sciences	..	..	..	X
Cross-Cultural Awareness	..	..	..	X
Science and Tech. in Society	..	..	..	X

*Departments may specify a cluster of courses to meet the Oral communication competency but must include a plan for implementation and assessment in the following textbox:

Distributed Competencies

The faculties of each degree program will decide the most appropriate ways to integrate learning experiences in each of the areas below. Quantification in terms of credit hours is avoided in favor of the presumption that faculties will want to place a serious effort in each area and distribute this effort to a significant degree throughout their curricula.

Ethical Judgement Integration Plan - Address competencies, implementation, and assessment:
Ethical judgment will be addressed in a range of courses over the whole curriculum, from the orientation course CH 141 to the Capstone course CH 450. Beginning students will discuss basic issues such as academic integrity and what constitutes academic dishonesty (CH 141, 152). As students move through the curriculum they will be exposed to other ethical issues. In the laboratory courses students will discuss the ethical use and manipulation of experimental data (CH 315, 339, 340). For example: statistical significance, when should outlying data be discarded, and what defensible conclusions can be made from the data (315, 339, 340).

Students in every laboratory course (but particularly in the organic chemistry laboratories CH 227, 228) will also be instructed on the ethical disposal of chemical wastes, and ways to minimize toxicity and environmental impact particularly by the use of Green Chemistry techniques. In addition, safety is of paramount importance in laboratories and the ethical necessity to work safely will be reinforced. In the introductory chemistry communication course CH 152 students will take part in a service learning project where they will work as a team to prepare materials for the public on some aspect of chemical health and safety.

In CH 141, 152, and 452 students will examine and discuss case studies such as those prepared by the National Academy of Sciences "On Being A Scientist: Responsible Conduct in Research". For example, the case studies describe "the social and historical context of science, the allocation of credit for discovery, the scientist's role in society, the issues revolving around publication, and many other aspects of scientific work." The materials to be studied also explore the inevitable conflicts that arise when the black and white areas of science meet the gray areas of human values and biases.

Assessment of the ethical judgement competency will take place in the Chemistry Capstone course (CH 450) required for all chemistry students. In the capstone course, students will examine and discuss case studies taken from current events and focusing on relevant ethical considerations. These case studies will involve the ethics of topics such as sustainability, drug development, and alternative energy. Students will address the ethical considerations during both group and class-wide discussions as well as in weekly reflective journals. Evaluation of the discussions and written materials will be achieved by instructor assessment based on a rubric presented in the corresponding course syllabi for CH 450 (Chemistry Capstone). The benchmark for demonstration of the Ethical Judgement competency will be 80% of students achieving an average of 70% or higher on the described course assignments. If this benchmark is not met, faculty in the chemistry department will use the evaluation data to make needed revisions to the course curricula to improve student competency in ethical judgement.

Communication Integration Plan - Address competencies, implementation, and assessment:
The communication competency is addressed in numerous courses within the chemistry curriculum

including ENGL 315 - Scientific Writing and Oral Communication. This is a course that has been developed to improve students' scientific communication skills relevant to chemistry majors.

In addition to ENGL 315, students' skills in communication will also be developed in the chemistry courses CH 152 and 452 - Chemistry Communication I and II. These courses will educate students in methods of scientific communication including oral, written and electronic formats.

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The oral communication competency assessment will be addressed through student oral presentations, given in CH 452, which focus on current chemical literature topics relevant to their undergraduate research projects. Assessment of these presentations will be accomplished through the instructor using a rubric presented in the course syllabus for CH 452. The benchmark for demonstration of oral competency will be 80% of students achieving 70% or higher. If this benchmark is not met, faculty in the chemistry department will use the evaluation data to make needed revisions to the course curricula to improve student competency in oral communication.

Critical Thinking Integration Plan - Address competencies, implementation, and assessment: Critical thinking development is integrated throughout the core chemistry curriculum. Problem solving through critical thinking is a major goal of any science course and these skills are essential for success as a chemist. The American Chemical Society, in its degree accreditation guidelines states " A strength of chemistry .... is that problem solving skills are emphasized and developed" We emphasize these skills in each course, beginning in general chemistry (CH 101, 102) where students must work in groups to solve open-ended problems in the laboratory.

This approach to problem solving and critical thinking is continued throughout the curriculum in both the laboratory courses and lecture courses cumulating in the capstone course CH 450 where students will work in groups on extended problem solving projects that will tie together their chemistry knowledge. Students will submit reports and weekly journals that will be assessed based on their demonstration of critical thinking. Evaluation is achieved through the instructors' assessment of these course assignments using rubrics published in the course syllabus for CH 450. The benchmark for demonstration of the critical thinking competency will be 80% of students achieving an average of 70% or higher on the described course assignments. If the identified benchmark is not met, faculty in the chemistry department will use the evaluation data to make needed revisions to the course curricula to improve student competency in critical thinking.

Form Originator: DOMINY, Brian Dominy **Date Form Created:** 2/8/2011
Form Last Updated by: DOMINY, Brian Dominy **Date Form Last Updated:** 4/13/2011 **Form Number:** 3762

Approval

	4/11/11		5/6/2011
Chair, Department Curriculum Committee	Date	Chair, Undergraduate Curriculum Committee	Date
	4/14/11		
Department Chair	Date	Chair, Graduate Curriculum Committee	Date
	4/15/11		
Chair, College Curriculum Committee	Date	Provost	Date 6/17/
	4-18-11		
College Dean	Date	President	Date 6/17/

CLEMSON UNIVERSITY **Curriculum and Course Change System - General Education Checklist**

000033

Major Name: Chemistry (B.A.)

Specific General Education Requirements

Requirement	Select from Gen Ed List	Select from Restricted Gen Ed List	Specific Course(s)	No Change
		Specify restrictions - e.g. PHIL courses only	Specify courses or cluster* of courses if appropriate	
English Composition			ENGL 103	
Oral Communication*	..	..	..	X
Academic & Professional Development			..	X
Mathematics	..	..	..	X
Natural Science with lab	..	..	..	X
Math or Natural Science	..	..	..	X
Arts & Humanities (Literature)	..	..	..	X
Arts & Humanities (Non-Literature)	..	..	..	X
Social Sciences	..	..	..	X
Cross-Cultural Awareness	..	..	..	X
Science and Tech. in Society	..	..	..	X

*Departments may specify a cluster of courses to meet the Oral communication competency but must include a plan for implementation and assessment in the following textbox:

Distributed Competencies

The faculties of each degree program will decide the most appropriate ways to integrate learning experiences in each of the areas below. Quantification in terms of credit hours is avoided in favor of the presumption that faculties will want to place a serious effort in each area and distribute this effort to a significant degree throughout their curricula.

Ethical Judgement Integration Plan - Address competencies, implementation, and assessment:
Ethical judgment is addressed in a range of courses over the whole curriculum, from the orientation course CH 141 to the Capstone course CH 450. Beginning students will discuss basic issues such as academic integrity and what constitutes academic dishonesty (CH 141, 152). As students move through the curriculum they will be exposed to other ethical issues.

Students in every laboratory course (but particularly in the organic chemistry laboratories CH 227, 228) will also be instructed on the ethical disposal of chemical wastes, and ways to minimize toxicity and environmental impact particularly by the use of Green Chemistry techniques. In addition, safety is of paramount importance in laboratories and the ethical necessity to work safely will be reinforced. In the introductory chemistry communication course CH 152 students will take part in a service learning project where they will work as a team to prepare materials for the public on some aspect of chemical health and safety.

In CH 141, 152, and 452 students will examine and discuss case studies such as those prepared by the National Academy of Sciences "On Being A Scientist: Responsible Conduct in Research". For example, the case studies describe "the social and historical context of science, the allocation of credit for discovery, the scientist's role in society, the issues revolving around publication, and many other aspects of scientific work." The materials to be studied also explore the inevitable conflicts that arise when the black and white areas of science meet the gray areas of human values and biases.

Assessment of the ethical judgement competency will take place in the Chemistry Capstone course (CH 450) required for all chemistry students. In the capstone course, students will examine and discuss case studies taken from current events and focusing on relevant ethical considerations. These case studies will involve the ethics of topics such as sustainability, drug development, and alternative energy. Students will address the ethical considerations during both group and class-wide discussions as well as in weekly reflective journals. Evaluation of the discussions and written materials will be achieved by instructor assessment based on a rubric presented in the corresponding course syllabi for CH 450 (Chemistry Capstone). The benchmark for demonstration of the Ethical Judgement competency will be 80% of students achieving an average of 70% or higher on the described course assignments. If this benchmark is not met, faculty in the chemistry department will use the evaluation data to make needed revisions to the course curricula to improve student competency in ethical judgement.

Communication Integration Plan - Address competencies, implementation, and assessment:
The communication competency is implemented in numerous courses throughout the chemistry curriculum including ENGL 315 - Scientific Writing and Oral Communication. This is a course that has been developed to improve students' scientific communication skills relevant to chemistry majors.

In addition to ENGL 315, students' skills in communication will also be developed in the chemistry courses CH 152 and 452 - Chemistry Communication I and II. These courses will educate students in methods of scientific communication including oral, written and electronic formats.

000034

The oral communication competency assessment will be addressed through student oral presentations, given in CH 452, which focus on current chemical literature topics relevant to their undergraduate research projects. Assessment of these presentations will be accomplished through the instructor using a rubric presented in the course syllabus for CH 452. The benchmark for demonstration of oral competency will be 80% of students achieving 70% or higher. If this benchmark is not met, faculty in the chemistry department will use the evaluation data to make needed revisions to the course curricula to improve student competency in oral communication.

Critical Thinking Integration Plan - Address competencies, implementation, and assessment: Critical thinking development is integrated throughout the core chemistry curriculum. Problem solving through critical thinking is a major goal of any science course and these skills are essential for success as a chemist. The American Chemical Society, in its degree accreditation guidelines states " A strength of chemistry .... is that problem solving skills are emphasized and developed" We emphasize these skills in each course, beginning in general chemistry (CH 101, 102) where students must work in groups to solve open-ended problems in the laboratory.

This approach to problem solving and critical thinking is continued throughout the curriculum in both the laboratory courses and lecture courses cumulating in the capstone course CH 450 where students will work in groups on extended problem solving projects that will tie together their chemistry knowledge. Students will submit reports and weekly journals that will be assessed based on their demonstration of critical thinking. Evaluation is achieved through the instructors' assessment of these course assignments using rubrics published in the course syllabus for CH 450. The benchmark for demonstration of the critical thinking competency will be 80% of students achieving an average of 70% or higher on the described course assignments. If the identified benchmark is not met, faculty in the chemistry department will use the evaluation data to make needed revisions to the course curricula to improve student competency in critical thinking.

Form Originator: DOMINY, Brian Dominy **Date Form Created:** 3/8/2011
Form Last Updated by: DOMINY, Brian Dominy **Date Form Last Updated:** 4/13/2011 **Form Number:** 3820

Approval

	4/11/11	Janice W. Murdock	5/6/2011
Chair, Department Curriculum Committee	Date	Chair, Undergraduate Curriculum Committee	Date
Stephen Prescher	4/14/11		
Department Chair	Date	Chair, Graduate Curriculum Committee	Date
	4/15/11		
Chair, College Curriculum Committee	Date	Provost	Date 6/17/11
4-18-11		Doris R. Helms	
College Dean	Date	President	Date 6/17/11

CLEMSON UNIVERSITY **Curriculum and Course Change System - General Education Checklist**

000045

Major Name: Electrical Engineering

Specific General Education Requirements

Requirement	Select from Gen Ed List	Select from Restricted Gen Ed List	Specific Course(s)	No Change
		Specify restrictions - e.g. PHIL courses only	Specify courses or cluster* of courses if appropriate	
English Composition			ENGL 103	
Oral Communication*	..	..	X COMM 150 or 250	..
Academic & Professional Development			X ECE 201	..
Mathematics	..	..	X MTHSC 106	..
Natural Science with lab	..	..	X CH 101	..
Math or Natural Science	..	..	X MTHSC 108	..
Arts & Humanities (Literature)	X	..	..	..
Arts & Humanities (Non-Literature)	X	..	..	..
Social Sciences	X	..	..	..
Cross-Cultural Awareness	X	..	..	..
Science and Tech. in Society	X	..	..	..

*Departments may specify a cluster of courses to meet the Oral communication competency but must include a plan for implementation and assessment in the following textbox:

Distributed Competencies

The faculties of each degree program will decide the most appropriate ways to integrate learning experiences in each of the areas below. Quantification in terms of credit hours is avoided in favor of the presumption that faculties will want to place a serious effort in each area and distribute this effort to a significant degree throughout their curricula.

Ethical Judgement Integration Plan - Address competencies, implementation, and assessment: Ethical Judgment is defined as the ability to identify, comprehend, and deal with ethical problems and their ramifications in a systematic, thorough, and responsible way. Ethical Judgment is assessed as part of our annual ABET assessment process. ABET Student Outcome "f" requires that students, at the time of graduation, should "have an understanding of professional and ethical responsibility." This outcome is assessed in the following required courses: ECE 360 - Electric Power Systems, ECE 371 - Microcontroller Interfacing, and ECE 495 - Integrated Systems Design I, which is a capstone design course. In ECE 360 and in ECE 371, students are required to find an article involving engineering and ethics and then write a short summary of what the paper conveys. Students are also required to state their opinion on the information in the paper. In ECE 495 students are required to examine and report on the ethical implications of an engineering design project. Student performance on this outcome is first assessed by the course instructor as being either "Satisfactory" or "Unsatisfactory." The next stage of assessment is by the Subject Area Committee associated with each of the courses involved. The Subject Areas associated with the above courses are Power Systems (for ECE 360), Computer Systems Architecture (for ECE 371), and Intelligent Systems (for ECE 495). Each of these Subject Area committee also assess the "ethics" outcome as "Satisfactory" or "Unsatisfactory." This report is then reviewed by the ECE Department's Assessment Committee which coordinates the information from the Subject Area committees and makes an overall assessment evaluation of the "ethics" outcome for the current year. If assessment indicates "Unsatisfactory" performance for this outcome, remedial actions are recommended. The final step in the annual assessment process is a written report to the faculty summarizing the assessment of the "ethics" outcome (and all other outcomes for the Electrical Engineering program.) Assessment information for the "ethics" (and all other) outcomes is also obtained from senior exit interviews, alumni surveys, and co-op employer surveys. This information is also provided to the ECE Department's Assessment Committee which they utilize along with the assessment data from the courses listed above.

Communication Integration Plan - Address competencies, implementation, and assessment: Communications is assessed as part of our annual ABET assessment process. ABET Student Outcome "g" requires that students, at the time of graduation, should "be able to communicate effectively." This outcome is assessed in the following required courses: ECE 372 - Microcontroller Interfacing Laboratory, and ECE 495 - Integrated Systems Design I, which is a capstone design course. In ECE 372, assessment of students' written communications is based on lab reports that students are required to complete for each lab. Students are provided with feedback that they can use to improve future lab reports. In ECE 495 students are required to write a report on their design. They are also required to give an oral presentation of their final project to a jury which includes professors and also engineers from industry. Student performance on this outcome is first assessed by the course instructor as being either "Satisfactory" or "Unsatisfactory." The next stage of assessment is by the Subject Area Committee associated with each course. The Subject Areas associated with the above courses are Computer Systems Architecture (for ECE 372), and Intelligent Systems (for ECE 495). Each of these Subject Area committees also assess this outcome as "Satisfactory" or "Unsatisfactory." This report is then reviewed by the ECE Department's Assessment Committee which coordinates the information from the Subject Area committees and makes an overall assessment evaluation of the "communications" outcome for the current year. If assessment indicates "Unsatisfactory" performance for this outcome, remedial actions are recommended. The final step in the annual assessment process is a written report to the faculty summarizing the assessment of the "communications" outcome (and all other outcomes for the Electrical Engineering program.) Assessment information for the "communications" (and all other) outcomes is also obtained from senior exit interviews, alumni surveys, and co-op employer surveys. This information is also provided to the ECE Department's Assessment Committee which they utilize along with the assessment data from the courses listed above.

Critical Thinking Integration Plan - Address competencies, implementation, and assessment: Critical thinking is defined as the ability to critically analyze the quality and utility of knowledge gained throughout the undergraduate experience and apply this knowledge to a wide range of problems. Critical Thinking is assessed as part of our annual ABET assessment process. ABET Student Outcome "e" requires that students, at the time of graduation, should "be able to identify, formulate, and solve engineering problems." We have identified this ABET Student Outcome as very closely aligned with the university's definition of "critical thinking." This outcome is assessed in the following required courses: ECE 360 - Electric Power Systems, ECE 381 - Fields, Waves, and Circuits, ECE 409 - Continuous and Discrete Systems Design, ECE 427 - Communications Systems, and ECE 495 - Integrated Systems Design I, which is a capstone design course. In ECE 381, ECE 409, and ECE 427, assessment of this outcome is based on students' performance on key questions on the final exam. In ECE 495, assessment of this outcome is based on students' performance on a major design project. The next stage of assessment is by the Subject Area Committee associated with each course. The Subject Areas associated with the above courses are Applied Electromagnetics (for ECE 381), Intelligent Systems (for ECE 409), Communications Systems and Networks (for ECE 427), and Intelligent

Systems (for ECE 495). Each of these Subject Area committees also assesses this outcome as "Satisfactory" or "Unsatisfactory." This report is then reviewed by the ECE Department's Assessment Committee which coordinates the information from the Subject Area committees and makes an overall assessment evaluation of the this outcome for the current year. If assessment indicates "Unsatisfactory" performance for this outcome, remedial actions are recommended. The final step in the annual assessment process is a written report to the faculty summarizing the assessment of the this outcome (and all other outcomes for the Electrical Engineering program.) Assessment information for all outcomes is also obtained from senior exit interviews, alumni surveys, and co-op employer surveys. This information is also provided to the ECE Department's Assessment Committee which they utilize along with the assessment data from the courses listed above.

Form Originator: JGOWDY, John Gowdy **Date Form Created:** 3/3/2011
Form Last Updated by: JGOWDY, John Gowdy **Date Form Last Updated:** 3/3/2011 **Form Number:** 3899

Approval

Chair, Department Curriculum Committee	Date 4/6/11	Chair, Undergraduate Curriculum Committee	Date 5/6/2011
Department Chair	Date 4/11/11	Chair, Graduate Curriculum Committee	Date
Chair, College Curriculum Committee	Date 4/11/11	Provost	Date 6/17/2011
College Dean	Date 4-18-11	President	Date 6/17/2011

CLEMSON UNIVERSITY **Curriculum and Course Change System - General Education Checklist**

Major Name: Computer Engineering

000044

Specific General Education Requirements

Requirement	Select from Gen Ed List	Select from Restricted Gen Ed List	Specific Course(s)	No Change
		Specify restrictions - e.g. PHIL courses only	Specify courses or cluster* of courses if appropriate	
English Composition			ENGL 103	
Oral Communication*	..	..	X comm 150 or 250	..
Academic & Professional Development			X ECE 201	..
Mathematics	..	..	X MTHSC 106	..
Natural Science with lab	..	..	X CH 101	..
Math or Natural Science	..	..	X MTHSC 108	..
Arts & Humanities (Literature)	X	..	..	..
Arts & Humanities (Non-Literature)	X	..	..	..
Social Sciences	X	..	..	..
Cross-Cultural Awareness	X	..	..	..
Science and Tech. in Society	X	..	..	..

*Departments may specify a cluster of courses to meet the Oral communication competency but must include a plan for implementation and assessment in the following textbox:

Distributed Competencies

The faculties of each degree program will decide the most appropriate ways to integrate learning experiences in each of the areas below. Quantification in terms of credit hours is avoided in favor of the presumption that faculties will want to place a serious effort in each area and distribute this effort to a significant degree throughout their curricula.

Ethical Judgement Integration Plan - Address competencies, implementation, and assessment: Ethical Judgment is defined as the ability to identify, comprehend, and deal with ethical problems and their ramifications in a systematic, thorough, and responsible way. Ethical Judgment is assessed as part of our annual ABET assessment process. ABET Student Outcome "f" requires that students, at the time of graduation, should "have an understanding of professional and ethical responsibility." This outcome is assessed in the following required courses: ECE 352 - Programming Systems, ECE 371 - Microcontroller Interfacing, and ECE 495 - Integrated Systems Design I, which is a capstone design course. In ECE 352, students are evaluated based on performance on a special assignment involving ethics in the context of computer software. In ECE 371, students are required to find an article involving engineering and ethics and then write a short summary of what the paper conveys. Students are also required to state their opinion on the information in the paper. In ECE 495 students are required to examine and report on the ethical implications of an engineering design project. Student performance on this outcome is first assessed by the course instructor as being either "Satisfactory" or "Unsatisfactory." The next stage of assessment is by the Subject Area Committee associated with each course involved. The Subject Areas associated with the above courses are Computer Software and Architecture (for ECE 352), Computer Systems Architecture (for ECE 371), and Intelligent Systems (for ECE 495). Each of these Subject Area committee also assess the "ethics" outcome as "Satisfactory" or "Unsatisfactory." This report is then reviewed by the ECE Department's Assessment Committee which coordinates the information from the Subject Area committees and makes an overall assessment evaluation of the "ethics" outcome for the current year. If assessment indicates "Unsatisfactory" performance for this outcome, remedial actions are recommended. The final step in the annual assessment process is a written report to the faculty summarizing the assessment of the "ethics" outcome (and all other outcomes for the Electrical Engineering program.) Assessment information for the "ethics" (and all other) outcomes is also obtained from senior exit interviews, alumni surveys, and co-op employer surveys. This information is also provided to the ECE Department's Assessment Committee which they utilize along with the assessment data from the courses listed above.

Communication Integration Plan - Address competencies, implementation, and assessment: Communications is assessed as part of our annual ABET assessment process. ABET Student Outcome "g" requires that students, at the time of graduation, should "be able to communicate effectively." This outcome is assessed in the following required courses: ECE 372 - Microcontroller Interfacing Laboratory, and ECE 495 - Integrated Systems Design I, which is a capstone design course. In ECE 372, assessment of students' written communications is based on lab reports that students are required to complete for each lab. Students are provided with feedback that they can use to improve future lab reports. In ECE 495 students are required to write a report on their design. They are also required to give an oral presentation of their final project to a jury which includes professors and also engineers from industry. Student performance on this outcome is first assessed by the course instructor as being either "Satisfactory" or "Unsatisfactory." The next stage of assessment is by the Subject Area Committee associated with each course. The Subject Areas associated with the above courses are Computer Systems Architecture (for ECE 372), and Intelligent Systems (for ECE 495). Each of these Subject Area committees also assess this outcome as "Satisfactory" or "Unsatisfactory." This report is then reviewed by the ECE Department's Assessment Committee which coordinates the information from the Subject Area committees and makes an overall assessment evaluation of the "communications" outcome for the current year. If assessment indicates "Unsatisfactory" performance for this outcome, remedial actions are recommended. The final step in the annual assessment process is a written report to the faculty summarizing the assessment of the "communications" outcome (and all other outcomes for the Electrical Engineering program.) Assessment information for the "communications" (and all other) outcomes is also obtained from senior exit interviews, alumni surveys, and co-op employer surveys. This information is also provided to the ECE Department's Assessment Committee which they utilize along with the assessment data from the courses listed above.

Critical Thinking Integration Plan - Address competencies, implementation, and assessment: Critical thinking is defined as the ability to critically analyze the quality and utility of knowledge gained throughout the undergraduate experience and apply this knowledge to a wide range of problems. Critical Thinking is assessed as part of our annual ABET assessment process. ABET Student Outcome "e" requires that students, at the time of graduation, should "be able to identify, formulate, and solve engineering problems." We have identified this ABET Student Outcome as very closely aligned with the university's definition of "critical thinking." This outcome is assessed in the following required courses: ECE 327 - Digital Computer Design, ECE 352 - Programming Systems, ECE 427 - Communications Systems, and ECE 495 - Integrated Systems Design I, which is a capstone design course. In ECE 327, ECE 352, and ECE 427, assessment of this outcome is based on students' performance on key questions on the final exam and/or on a major assignment. In ECE 495, assessment of this outcome is based on students' performance on a major design project. The next stage of assessment is by the Subject Area Committee associated with each course. The Subject Areas associated with the above courses are Computer Systems Arhitecture (for

CLEMSON UNIVERSITY **Curriculum and Course Change System - General Education Checklist**

Major Name: Computer Engineering

000044

Specific General Education Requirements

Requirement	Select from Gen Ed List	Select from Restricted Gen Ed List	Specific Course(s)	No Change
		Specify restrictions - e.g. PHIL courses only	Specify courses or cluster* of courses if appropriate	
English Composition			ENGL 103	
Oral Communication*	..	..	X comm 150 or 250	..
Academic & Professional Development			X ECE 201	..
Mathematics	..	..	X MTHSC 106	..
Natural Science with lab	..	..	X CH 101	..
Math or Natural Science	..	..	X MTHSC 108	..
Arts & Humanities (Literature)	X	..	..	..
Arts & Humanities (Non-Literature)	X	..	..	..
Social Sciences	X	..	..	..
Cross-Cultural Awareness	X	..	..	..
Science and Tech. in Society	X	..	..	..

*Departments may specify a cluster of courses to meet the Oral communication competency but must include a plan for implementation and assessment in the following textbox:

Distributed Competencies

The faculties of each degree program will decide the most appropriate ways to integrate learning experiences in each of the areas below. Quantification in terms of credit hours is avoided in favor of the presumption that faculties will want to place a serious effort in each area and distribute this effort to a significant degree throughout their curricula.

Ethical Judgement Integration Plan - Address competencies, implementation, and assessment: Ethical Judgment is defined as the ability to identify, comprehend, and deal with ethical problems and their ramifications in a systematic, thorough, and responsible way. Ethical Judgment is assessed as part of our annual ABET assessment process. ABET Student Outcome "f" requires that students, at the time of graduation, should "have an understanding of professional and ethical responsibility." This outcome is assessed in the following required courses: ECE 352 - Programming Systems, ECE 371 - Microcontroller Interfacing, and ECE 495 - Integrated Systems Design I, which is a capstone design course. In ECE 352, students are evaluated based on performance on a special assignment involving ethics in the context of computer software. In ECE 371, students are required to find an article involving engineering and ethics and then write a short summary of what the paper conveys. Students are also required to state their opinion on the information in the paper. In ECE 495 students are required to examine and report on the ethical implications of an engineering design project. Student performance on this outcome is first assessed by the course instructor as being either "Satisfactory" or "Unsatisfactory." The next stage of assessment is by the Subject Area Committee associated with each course involved. The Subject Areas associated with the above courses are Computer Software and Architecture (for ECE 352), Computer Systems Architecture (for ECE 371), and Intelligent Systems (for ECE 495). Each of these Subject Area committee also assess the "ethics" outcome as "Satisfactory" or "Unsatisfactory." This report is then reviewed by the ECE Department's Assessment Committee which coordinates the information from the Subject Area committees and makes an overall assessment evaluation of the "ethics" outcome for the current year. If assessment indicates "Unsatisfactory" performance for this outcome, remedial actions are recommended. The final step in the annual assessment process is a written report to the faculty summarizing the assessment of the "ethics" outcome (and all other outcomes for the Electrical Engineering program.) Assessment information for the "ethics" (and all other) outcomes is also obtained from senior exit interviews, alumni surveys, and co-op employer surveys. This information is also provided to the ECE Department's Assessment Committee which they utilize along with the assessment data from the courses listed above.

Communication Integration Plan - Address competencies, implementation, and assessment: Communications is assessed as part of our annual ABET assessment process. ABET Student Outcome "g" requires that students, at the time of graduation, should "be able to communicate effectively." This outcome is assessed in the following required courses: ECE 372 - Microcontroller Interfacing Laboratory, and ECE 495 - Integrated Systems Design I, which is a capstone design course. In ECE 372, assessment of students' written communications is based on lab reports that students are required to complete for each lab. Students are provided with feedback that they can use to improve future lab reports. In ECE 495 students are required to write a report on their design. They are also required to give an oral presentation of their final project to a jury which includes professors and also engineers from industry. Student performance on this outcome is first assessed by the course instructor as being either "Satisfactory" or "Unsatisfactory." The next stage of assessment is by the Subject Area Committee associated with each course. The Subject Areas associated with the above courses are Computer Systems Architecture (for ECE 372), and Intelligent Systems (for ECE 495). Each of these Subject Area committees also assess this outcome as "Satisfactory" or "Unsatisfactory." This report is then reviewed by the ECE Department's Assessment Committee which coordinates the information from the Subject Area committees and makes an overall assessment evaluation of the "communications" outcome for the current year. If assessment indicates "Unsatisfactory" performance for this outcome, remedial actions are recommended. The final step in the annual assessment process is a written report to the faculty summarizing the assessment of the "communications" outcome (and all other outcomes for the Electrical Engineering program.) Assessment information for the "communications" (and all other) outcomes is also obtained from senior exit interviews, alumni surveys, and co-op employer surveys. This information is also provided to the ECE Department's Assessment Committee which they utilize along with the assessment data from the courses listed above.

Critical Thinking Integration Plan - Address competencies, implementation, and assessment: Critical thinking is defined as the ability to critically analyze the quality and utility of knowledge gained throughout the undergraduate experience and apply this knowledge to a wide range of problems. Critical Thinking is assessed as part of our annual ABET assessment process. ABET Student Outcome "e" requires that students, at the time of graduation, should "be able to identify, formulate, and solve engineering problems." We have identified this ABET Student Outcome as very closely aligned with the university's definition of "critical thinking." This outcome is assessed in the following required courses: ECE 327 - Digital Computer Design, ECE 352 - Programming Systems, ECE 427 - Communications Systems, and ECE 495 - Integrated Systems Design I, which is a capstone design course. In ECE 327, ECE 352, and ECE 427, assessment of this outcome is based on students' performance on key questions on the final exam and/or on a major assignment. In ECE 495, assessment of this outcome is based on students' performance on a major design project. The next stage of assessment is by the Subject Area Committee associated with each course. The Subject Areas associated with the above courses are Computer Systems Arhitecture (for

ECE 327 and ECE 352), Communications Systems and Networks (for ECE 427), and Intelligent Systems (for ECE 495). Each of these Subject Area committees also assesses this outcome as "Satisfactory" or "Unsatisfactory." This report is then reviewed by the ECE Department's Assessment Committee which coordinates the information from the Subject Area committees and makes an overall assessment evaluation of this outcome for the current year. If assessment indicates "Unsatisfactory" performance for this outcome, remedial actions are recommended. The final step in the annual assessment process is a written report to the faculty summarizing the assessment of the this outcome (and all other outcomes for the Electrical Engineering program.) Assessment information for all outcomes is also obtained from senior exit interviews, alumni surveys, and co-op employer surveys. This information is also provided to the ECE Department's Assessment Committee which they utilize along with the assessment data from the courses listed above.

Form Originator: JGOWDY, John Gowdy **Date Form Created:** 3/3/2011
Form Last Updated by: JGOWDY, John Gowdy **Date Form Last Updated:** 3/3/2011 **Form Number:** 3900

Approval

Chair, Department Curriculum Committee	Date 4/11/11	Chair, Undergraduate Curriculum Committee	Date 5/6/2011
Department Chair	Date 4/11/11	Chair, Graduate Curriculum Committee	Date
Chair, College Curriculum Committee	Date 4/11/11	Provost	Date 6/17/2011
College Dean	Date 4-18-11	President	Date 6/17/2011

CLEMSON UNIVERSITY **Curriculum and Course Change System - General Education Checklist**

Major Name: Chemical Engineering

Specific General Education Requirements

Requirement	Select from Gen Ed List	Select from Restricted Gen Ed List	Specific Course(s)	No Change
		Specify restrictions - e.g. PHIL courses only	Specify courses or cluster* of courses if appropriate	
English Composition			ENGL 103	
Oral Communication*	..	..	X ChE 307, 407, 433, 444	..
Academic & Professional Development			X ChE 443, 444	..
Mathematics	..	..	X MTHSC 106	..
Natural Science with lab	..	..	X Ch 101	..
Math or Natural Science	..	..	X MTHSC 108	..
Arts & Humanities (Literature)	X	..	..	..
Arts & Humanities (Non-Literature)	X	..	..	..
Social Sciences	X	..	..	..
Cross-Cultural Awareness	X	..	..	..
Science and Tech. in Society	X	..	..	..

*Departments may specify a cluster of courses to meet the Oral communication competency but must include a plan for implementation and assessment in the following textbox: Oral communication skills are developed in a four-course sequence, beginning with ChE 307. Basic instruction is provided on preparation and oral presentation of laboratory plans and analysis of experiment results. Each student makes and receives constructive feedback and a grade on two such presentations. In ChE 407 student ability is developed further through additional instruction and practice with respect to laboratory work. In ChE 433 the context changes to oral presentations on chemical process design projects. Each student must take an active role in two progress reports and a final presentation. Critique and instruction are provided after each progress report. The final project presentation is evaluated by a panel of professional practitioners as well as the course instructor. In ChE 444 student teams prepare and present a 40-minute talk on a current topic relevant to professional practice.

Evaluation of student performance on these activities is documented each year in our annual assessment report. If more than 20% of senior oral presentations are judged by the faculty or external design jury to be less than competent at the level expected of new BS graduates, the Undergraduate Committee must convene to investigate reasons for the deficiency in oral communication and recommend action to the faculty.

Distributed Competencies

The faculties of each degree program will decide the most appropriate ways to integrate learning experiences in each of the areas below. Quantification in terms of credit hours is avoided in favor of the presumption that faculties will want to place a serious effort in each area and distribute this effort to a significant degree throughout their curricula.

Ethical Judgement Integration Plan - Address competencies, implementation, and assessment: The Accreditation Board of Engineering and Technology (ABET) mandates that

graduates of accredited programs must understand their professional and ethical responsibilities. Chemical Engineering students are introduced to ethical responsibilities in the freshman courses, CES 102 and ChE 130. In all subsequent chemical engineering courses, ethical responsibilities of professional practice are discussed as appropriate to the technical topic. Assignments on ethics are not usually required in these courses, but the consistent message is that appropriate ethical conduct is a part of the profession. At the junior and senior level in ChE 307, 407, 431, and 433, ethical responsibilities become more concrete in the context of instruction and assignments related to health and safety in chemical process operations and environmental protection outside the plant boundaries. Each lab experiment plan prepared by the students must include a discussion of proper safety precautions. Safety and environmental protection are major categories of evaluation in the capstone design project. In addition, ChE 444 always includes one or more student oral presentations on aspects of business ethics in the practice of chemical engineering.

Evaluation of student performance on these issues is documented each year in our annual assessment report. If the average score of Clemson's senior level chemical engineering students is more than one standard deviation below the national average score on the ethics portion of the Fundamentals of Engineering Exam, the Undergraduate Committee must convene to investigate reasons for the deficiency in ethical judgment and recommend action to the faculty. [Note: We do not have access to scores of individual students on the FE exam. We receive information only on the number of students who passed (at Clemson and nationally) and the average score of students on each topic (at Clemson and nationally).]

Communication Integration Plan - Address competencies, implementation, and assessment: The ability to communicate effectively is another ABET-mandated Student Outcome that we must assess and evaluate annually to maintain program accreditation. Oral and written communications are developed together in the four-course sequence already described above. Though earlier courses frequently include oral presentations and narrative written assignments, formal instruction begins in ChE 307. Instruction is provided on written preparation or laboratory plans and reports of experiment results. Some of these assignments must be converted into and oral format. In ChE 307 each student makes and receives constructive feedback and a grade on six written reports and two oral presentations. Much of this work is done in team format, but individual work is broken out so that the skills of each student can be developed and evaluated. In ChE 407 communication skills are developed further through additional instruction and practice with respect to laboratory work. Normally five written reports and one oral presentation are required. In ChE 433 the context changes to chemical process design projects. Each student must take an active role in two progress reports and a final presentation. One interim and one final written report are required. These are not short assignments. The written reports are typically 50 pages each. Critique and instruction are provided after each interim or progress report. The final project report and presentation are evaluated by a panel of professional practitioners as well as the course instructor. In ChE 444 student teams prepare and present a 40-minute talk on a current topic relevant to professional practice.

Evaluation of student performance on these activities is documented each year in our annual assessment report. If more than 20% of senior oral presentations or written reports are judged by the faculty or external design jury to be less than competent at the level expected of new BS graduates, the Undergraduate Committee must convene to investigate reasons for the deficiency in communication skills and recommend action to the faculty.

Critical Thinking Integration Plan - Address competencies, implementation, and assessment: Five ABET-mandated Student Outcomes address critical thinking directly. These are the requirements that BS graduates must demonstrate:

- The ability to apply knowledge of math, engineering, and science,
- The ability to design and conduct experiments, and to analyze and interpret data,
- The ability to design a system, component, or process to meet needs within realistic

constraints,
- The ability to identify, formulate, and solve engineering problems,
- The ability to apply engineering tools, skills, and techniques.

The undergraduate program in chemical engineering at Clemson is a blend of classroom instruction, laboratory practice, and project work designed to insure that all students develop these critical thinking skills, which are required to function successfully as an engineer. The courses that address critical thinking in greatest depth are:

- ChE 307 Unit Operations Lab I
- ChE 407 Unit Operations Lab II
- ChE 433 Process Design II

In the lab courses students are given specific objectives, but only general instructions. They must develop their own detailed lab plans to accomplish the objectives; they must write their own procedures; they must figure out how to reduce their experimental data to a form that addresses the objectives; and they must analyze their results, compare them to prior knowledge on the subject, and write a cogent report. This entire sequence is repeated at least seven times over the breadth of the two courses. The reports generated from each experiment are evaluated by the faculty teaching the course, and detailed critiques are returned to the students.

In the capstone design course (ChE 433) students are again given specific objectives but not detailed instructions. Each semester-long project is open-ended. Students must conduct an independent literature search to assess the current state of knowledge on their subject and use what they find to develop a solution to their assigned problem. Project reports are evaluated by the course instructor and by a team of external engineering practitioners.

Evaluation of student performance on these critical thinking activities is documented each year in our annual assessment report. The Undergraduate Committee must convene to investigate reasons for the deficiency in critical thinking skills and recommend action to the faculty if either of the following occurs:
- The percentage of Clemson's senior level chemical engineering students score who pass the Fundamentals of Engineering Exam is lower than the national average two years in a row,
- More than 20% of senior teams are judged by the faculty or external design jury to be less than competent at the level expected of new BS graduates in any area other than teamwork or communication skills.

Form Originator: CHGDNG, Charles Gooding **Date Form Created:** 10/2/2011
Form Last Updated by: CHGDNG, Charles Gooding **Date Form Last Updated:** 10/2/2011
Form Number: 4441

Approval

Chair, Department Curriculum Committee	10/2/11 Date	Chair, Undergraduate Curriculun
Department Chair	10/2/11 Date	Chair, Graduate Curriculum Com
Chair, College Curriculum Committee	10/13/11 Date	Provost
College Dean	Date	President

CLEMSON UNIVERSITY 000023

Curriculum and Course Change System - General Education Checklist

Major Name: Chemical Engineering

Specific General Education Requirements

Requirement	Select from Gen Ed List	Select from Restricted Gen Ed List	Specific Course(s)	No Change
		Specify restrictions - e.g. PHIL courses only	Specify courses or cluster* of courses if appropriate	
English Composition			ENGL 103	
Oral Communication*	..	..	X ChE 307, 407, 433, 444	..
Academic & Professional Development			X ChE 443, 444	..
Mathematics	..	..	X MTHSC 106	..
Natural Science with lab	..	..	X Ch 101	..
Math or Natural Science	..	..	X MTHSC 108	..
Arts & Humanities (Literature)	X	..	..	..
Arts & Humanities (Non-Literature)	X	..	..	..
Social Sciences	X	..	..	..
Cross-Cultural Awareness	X	..	..	..
Science and Tech. in Society	X	..	..	..

*Departments may specify a cluster of courses to meet the Oral communication competency but must include a plan for implementation and assessment in the following textbox: Oral communication skills are developed in a four-course sequence, beginning with ChE 307. Basic instruction is provided on preparation and oral presentation of laboratory plans and analysis of experiment results. Each student makes and receives constructive feedback and a grade on two such presentations. In ChE 407 student ability is developed further through additional instruction and practice with respect to laboratory work. In ChE 433 the context changes to oral presentations on chemical process design projects. Each student must take an active role in two progress reports and a final presentation. Critique and instruction are provided after each progress report. The final project presentation is evaluated by a panel of professional practitioners as well as the course instructor. In ChE 444 student teams prepare and present a 40-minute talk on a current topic relevant to professional practice.
Evaluation of student performance on these activities is documented each year in our annual assessment report. If more than 20% of senior oral presentations are judged by the faculty or external design jury to be less than competent at the level expected of new BS graduates, the Undergraduate Committee must convene to investigate reasons for the deficiency in oral communication and recommend action to the faculty.

Distributed Competencies

The faculties of each degree program will decide the most appropriate ways to integrate learning experiences in each of the areas below. Quantification in terms of credit hours is avoided in favor of the presumption that faculties will want to place a serious effort in each area and distribute this effort to a significant degree throughout their curricula.

Ethical Judgement Integration Plan - Address competencies, implementation, and assessment: The Accreditation Board of Engineering and Technology (ABET) mandates that graduates of accredited programs must understand their professional and ethical responsibilities.

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Chemical Engineering students are introduced to ethical responsibilities in the freshman courses, CES 102 and ChE 130. In all subsequent chemical engineering courses, ethical responsibilities of professional practice are discussed as appropriate to the technical topic. Assignments on ethics are not usually required in these courses, but the consistent message is that appropriate ethical conduct is a part of the profession. At the junior and senior level in ChE 307, 407, 431, and 433, ethical responsibilities become more concrete in the context of instruction and assignments related to health and safety in chemical process operations and environmental protection outside the plant boundaries. Each lab experiment plan prepared by the students must include a discussion of proper safety precautions. Safety and environmental protection are major categories of evaluation in the capstone design project. In addition, ChE 444 always includes one or more student oral presentations on aspects of business ethics in the practice of chemical engineering.
Evaluation of student performance on these issues is documented each year in our annual assessment report. If Clemson's senior level chemical engineering students score below the national average on the ethics portion of the Fundamentals of Engineering Exam, the Undergraduate Committee must convene to investigate reasons for the deficiency in ethical judgment and recommend action to the faculty.

Communication Integration Plan - Address competencies, implementation, and assessment: The ability to communication effectively is another ABET-mandated Student Outcome that we must assess and evaluate annually to maintain program accreditation. Oral and written communications are developed together in the four-course sequence already described above. Though earlier courses frequently include oral presentations and narrative written assignments, formal instruction begins in ChE 307. Instruction is provided on written preparation or laboratory plans and reports of experiment results. Some of these assignments must be converted into and oral format. In ChE 307 each student makes and receives constructive feedback and a grade on six written reports and two oral presentations. Much of this work is done in team format, but individual work is broken out so that the skills of each student can be developed and evaluated. In ChE 407 communication skills are developed further through additional instruction and practice with respect to laboratory work. Normally five written reports and one oral presentation are required. In ChE 433 the context changes to chemical process design projects. Each student must take an active role in two progress reports and a final presentation. One interim and one final written report are required. These are not short assignments. The written reports are typically 50 each. Critique and instruction are provided after each interim or progress report. The final project report and presentation are evaluated by a panel of professional practitioners as well as the course instructor. In ChE 444 student teams prepare and present a 40-minute talk on a current topic relevant to professional practice. Evaluation of student performance on these activities is documented each year in our annual assessment report. If more than 20% of senior oral presentations or written reports are judged by the faculty or external design jury to be less than competent at the level expected of new BS graduates, the Undergraduate Committee must convene to investigate reasons for the deficiency in communication skills and recommend action to the faculty.

Critical Thinking Integration Plan - Address competencies, implementation, and assessment: Five ABET-mandated Student Outcomes address critical thinking directly. These are the requirements that BS graduates must demonstrate:

- The ability to apply knowledge of math, engineering, and science,
- The ability to design and conduct experiments, and to analyze and interpret data,
- The ability to design a system, component, or process to meet needs within realistic constraints,
- The ability to identify, formulate, and solve engineering problems.
- The ability to apply engineering tools, skills, and techniques.

The undergraduate program in chemical engineering at Clemson is a blend of classroom instruction, laboratory practice, and project work designed to insure that all students develop these critical thinking skills, which are required to function successfully as an engineer. The

courses that address critical thinking in greatest depth are:

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- ChE 307 Unit Operations Lab I
- ChE 407 Unit Operations Lab II
- ChE 433 Process Design II

In the lab courses students are given specific objectives, but only general instructions. They must develop their own detailed lab plans to accomplish the objectives; they must write their own procedures; they must figure out how to reduce their experimental data to a form that addresses the objectives; and they must analyze their results, compare them to prior knowledge on the subject, and write a cogent report. This entire sequence is repeated at least seven times over the breadth of the two courses. The reports generated from each experiment are evaluated by the faculty teaching the course, and detailed critiques are returned to the students.

In the capstone design course (ChE 433) students are again given specific objectives but not detailed instructions. Each semester-long project is open-ended. Students must conduct an independent literature search to assess the current state of knowledge on their subject and use what they find to develop a solution to their assigned problem. Project reports are evaluated by the course instructor and by a team of external engineering practitioners.

Evaluation of student performance on these critical thinking activities is documented each year in our annual assessment report. The Undergraduate Committee must convene to investigate reasons for the deficiency in critical thinking skills and recommend action to the faculty if either of the following occurs:

- Clemson's senior level chemical engineering students score below the national average on the the Fundamentals of Engineering Exam two years in a row,
- More than 20% of senior teams are judged by the faculty or external design jury to be less than competent at the level expected of new BS graduates in any area other than teamwork or communication skills.

Form Originator: CHGDNG, Charles Gooding **Date Form Created:** 3/8/2011
Form Last Updated by: CHGDNG, Charles Gooding **Date Form Last Updated:** 4/13/2011
Form Number: 3916

Approval

	4/13/2011	5/6/11
Chair, Department Curriculum Committee	Date	Chair, Undergraduate Curriculun
	4/13/11	
Department Chair	Date	Chair, Graduate Curriculum Com
	4/15/11	
Chair, College Curriculum Committee	Date	Provost 6/17/2011
	4-18-11	
College Dean	Date	President 6/17/2011

CLEMSON UNIVERSITY **Curriculum and Course Change System - General Education Checklist**

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Major Name: Industrial Engineering

Specific General Education Requirements

Requirement	Select from Gen Ed List	Select from Restricted Gen Ed List	Specific Course(s)	No Change
		Specify restrictions - e.g. PHIL courses only	Specify courses or cluster* of courses if appropriate	
English Composition			ENGL 103	
Oral Communication*	..	..	X COMM 150 or 250	..
Academic & Professional Development			X IE 200 and IE 368	..
Mathematics	..	..	X MTHSC 106	..
Natural Science with lab	..	..	X CH 101	..
Math or Natural Science	..	..	X MTHSC 108	..
Arts & Humanities (Literature)	X	..	..	..
Arts & Humanities (Non-Literature)	X	..	..	..
Social Sciences	X	..	..	..
Cross-Cultural Awareness	X	..	..	..
Science and Tech. in Society	X	..	..	..

*Departments may specify a cluster of courses to meet the Oral communication competency but must include a plan for implementation and assessment in the following textbox:

Distributed Competencies

The faculties of each degree program will decide the most appropriate ways to integrate learning experiences in each of the areas below. Quantification in terms of credit hours is avoided in favor of the presumption that faculties will want to place a serious effort in each area and distribute this effort to a significant degree throughout their curricula.

Ethical Judgement Integration Plan - Address competencies, implementation, and assessment: "Ethical Judgement" is operationalized as the requirement that students will demonstrate an understanding of common ethical issues, and construct a personal framework in which ethical decisions can be made in a systematic, reflective, and responsible way. This is also reflected in the ABET-mandated Student Outcome which requires that students attain "understanding of professional and ethical responsibility". This is achieved through the following individual Course Learning Objectives:
IE 200 (Sophomore Seminar in Industrial Engineering): View Cheating 101 vignettes produced by the Robert J. Rutland Institute for Ethics and either respond to questions provided or write a reflection on personal beliefs about academic integrity; IE 201 (System Design I): Recognize ethical considerations involved in testing design concepts and prototypes with users; IE 368 (Professional Practice in Industrial Engineering): Recognize the relationships between organizational and individual ethics; IE 467 (Systems Design II): Describe the role of ethics in engineering decision-making and discuss the use of the NSPE Code of Ethics for Engineering and corporate policies in evaluating alternative courses of action.

In each semester, the department uses a closed-loop assessment process to evaluate and respond to the evaluation of the achievement of these Course Learning Objectives. This process is documented in our annual assessment plan is summarized here:
1. The instructor ensures that at least one work-product related to each Course Learning Objective (CLO) is given and scored, and submitted for review in part 2. Scores are entered into a department-created form which creates a histogram of the scores on that work-product. The instructor completes responses to the following prompts: "Comment on the student performance as reflected in the histogram or annotated student work", "Comment on what worked and what didn't", and "Describe potential changes for the future". The instructor also determines whether he/she believes the course achieved this CLO.
2. Two faculty members are assigned to the "oversight committee" for each course and reviews the forms created in step 1 for each course. Each member responds to the following prompts: 1) The measures selected by the course instructor adequately address the learning objectives associated with the course. Yes/No and provide comments if needed; 2) Comments on student performance as reflected in the histogram or annotated student work. 3) Does the course, as evidenced by the current course syllabus, address the topics specified by the ABET/Departmental course syllabus? Yes/No and provide comments if needed; 4.)Please provide suggestions to the Instructor and Department Chair that could be used to improve the course.
3. The instructor receives the results of step 2 and responds in writing to the following prompts: 1) Do you propose to make any changes to the Course's Learning Objectives? If "Yes," please indicate and justify the changes. If "No," and the Course Oversight Committee recommended that changes be proposed, please provide justification for not proposing changes. 2) Do you plan to make any changes to the measures used to assess achievement of the Course's Learning Objectives? If "Yes," please indicate the changes, identifying the Course Learning Objective that was impacted by this change. If "No," and the Course Oversight Committee recommended that changes be made, please provide justification for not making changes. 3) Do you plan to make any other changes to the course as a result of the assessment process? If "Yes," please indicate the changes. If "No," and the Course Oversight Committee recommended that other changes be made, please provide justification for not making changes.
The results of this process are reported in the department's annual assessment report and presented to the faculty annually.

Communication Integration Plan - Address competencies, implementation, and assessment: "Communication" is operationalized as the ABET-mandated Student Outcome which requires that students attain an "ability to communicate effectively". This is achieved through the following individual Course Learning Objectives: IE 201 (System Design I): Produce report to document completion of design project; IE 210 (Design and Analysis of Work Systems): Produce laboratory reports to summarize experimental results; IE 467 Systems Design II): Produce oral and written communications to document planning, progress and completion of design project
In each semester, the department uses a closed-loop assessment process to evaluate and respond to the evaluation of the achievement of these Course Learning Objectives. This process is documented in our annual assessment plan is summarized here:
1. The instructor ensures that at least one work-product related to each Course Learning Objective (CLO) is given and scored, and submitted for review in part 2. Scores are entered into a department-created form which creates a histogram of the scores on that work-product. The instructor completes responses to the following prompts: "Comment on the student performance as reflected in the histogram or annotated student work", "Comment on what worked and what didn't", and "Describe potential changes for the future". The instructor also determines whether he/she believes the course achieved this CLO.

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CLEMSON UNIVERSITY **Curriculum and Course Change System - General Education Checklist**

Major Name: Bioengineering

Specific General Education Requirements

Requirement	Select from Gen Ed List	Select from Restricted Gen Ed List	Specific Course(s)	No Change
		Specify restrictions - e.g. PHIL courses only	Specify courses or cluster* of courses if appropriate	
English Composition			ENGL 103	
Oral Communication*	..	..	X cluster	..
Academic & Professional Development			X BioE 400	..
Mathematics	..	..	X MthSc 106	..
Natural Science with lab	..	..	X CH 102	..
Math or Natural Science	..	..	X MthSc 108	..
Arts & Humanities (Literature)	X	..	..	..
Arts & Humanities (Non-Literature)	X	..	..	..
Social Sciences	X	..	..	..
Cross-Cultural Awareness	X	..	..	..
Science and Tech. in Society	X	..	..	..

*Departments may specify a cluster of courses to meet the Oral communication competency but must include a plan for implementation and assessment in the following textbox: Effective oral communication is particularly critical for bioengineers that commonly serve as interdisciplinary team leaders and must coordinate activities of team members with diverse backgrounds. Effective oral communication is also mandated by the ABET student outcome 3g (ability to communicate effectively). Training in oral communication begins in BioE 201 (Introduction to Biomedical Engineering) with the course learning objectives: -Prepare and produce oral and written communication describing the physiology, pathology, and bioengineering solutions of a specific organ system and -Locate and summarize popular and peer-reviewed scientific literature. Training in literature searching (PubMed, Lexis Nexus) is provided. Students work in teams and deliver oral reports at the end of the semester. Each student presents their individual component of the project, is graded individually by the instructor according to the departmental oral grading rubric approved by the faculty, which along with other comments is returned to the students. In BioE 370 (Bioinstrumentation) oral communication continues with the course learning objective: Design, in a team-based setting, an experiment to measure and analyze biological/physiological sample properties. Students prepare posters and present and discuss them in a public research forum and the end of the semester. In BioE 403 (Applied Bioengineering Design), oral communication is addressed through the course learning objective: Communicate the design of a biomedical engineering project. Students meet bi-weekly throughout the semester with the instructor, corporate sponsor representatives, and two external faculty advisors to provide oral presentations of their project progress. After each meeting, students receive feedback/critique forms from all faculty members. Oral communication is also addressed in BioE 448 (Tissue Engineering) through the course learning objective: Formulate a design strategy targeted at the restoration or replacement of a dysfunctional tissue or organ. Students are assessed according to the departmental oral grading rubric.

Assessment at the departmental level is coordinated with preparation of the ABET course notebooks and Outcomes Portfolio. Each course notebook contains student artifacts representative of high, intermediate, and low performance on assignments fulfilling the course learning objectives described above. Annually, the notebook is reviewed by another faculty member and a written critique of the notebook prepared and presented to the faculty. In addition, summary statistics of student performance during oral presentations in BioE 201 and BioE 448 are collected and a representative example of student work are collected in the ABET Outcomes Portfolio and reviewed by the faculty during the ABET Spring Retreat. The summary statistics collected for the artifacts in Outcomes Portfolio include criteria for the percent of students with an acceptable score. Based on the assessment of the oral communication competency in BioE 448, if 80% of students fail to achieve 80% or higher on this assessment, the department chair and Undergraduate Program committee will meet to formulate a plan to revise the curriculum to improve the students' grasp of the oral communication competency. Additional assessment measures include senior exit and alumni surveys.

Distributed Competencies

The faculties of each degree program will decide the most appropriate ways to integrate learning experiences in each of the areas below. Quantification in terms of credit hours is avoided in favor of the presumption that faculties will want to place a serious effort in each area and distribute this effort to a significant degree throughout their curricula.

Ethical Judgement Integration Plan - Address competencies, implementation, and assessment: Ethical judgment is central to bioengineering as the development, testing, and implementation of medical technologies involves human patients and requires analysis of risk versus benefit. This topic is also mandated under the ABET Student Outcome 3f (understanding of ethical and professional responsibility). Training in ethical consideration and decision making is implemented through the following course learning objectives: BioE 201 (Introduction to Biomedical Engineering) Describe biomedical device testing and regulatory approval process; BioE 400 (Senior Seminar) Recognize and discuss ethic issues in bioengineering; BioE 401 (Bioengineering Design Theory) Describe design principles as related to bioengineering, Propose the design a novel solution to a bioengineering problem, and Recognize contemporary and ethical issues; and BioE 403 (Applied Bioengineering Design) Describe design principles as related to bioengineering and Recognize contemporary and ethical issues. Central to all 4 courses are guiding principles for the ethical use of animal models, enrollment of human subjects and clinical trials, and professional responsibilities such as medical device reporting. The senior design sequence (BioE 401/403) incorporates Design Failure Mode Effects Analysis (DFMEA) and an essay of a current topic of ethical relevance, for example the recent Medical Device Safety Act of 2009. In BioE 400, students are assigned case studies related to common ethical issues in the profession and lead discussions based on team resolutions for each example. Students are also required to pass compliance training from CITI on the use of animal and human subjects in biomedical research.

Assessment at the departmental level is coordinated with preparation of the ABET course notebooks and Outcomes Portfolio. Each course notebook contains student artifacts representative of high, intermediate, and low performance on assignments fulfilling the course learning objectives described above. Annually, the notebook is reviewed by another faculty member and a written critique of the notebook prepared and presented to the faculty. In addition, summary statistics of student performance on ethics-related assignments in BioE 201 and BioE 400 and a representative example of student work are collected in the ABET Outcomes Portfolio and reviewed by the faculty during the ABET Spring Retreat. Based on the assessment of the ethical judgment competency in BioE 400, if 80% of students fail to achieve 80% or higher on this assessment, the department chair and Undergraduate Program committee will meet to formulate a plan to revise the curriculum to improve the students' grasp of the ethical judgment competency. Additional assessment measures include senior exit and

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alumni surveys.

Communication Integration Plan - Address competencies, implementation, and assessment: Oral communication is addressed as described above. Attainment of effective written communication is achieved through the following course learning objectives: BioE 201 (Introduction to Biomedical Engineering) Prepare and produce oral and written communication describing the physiology, pathology, and bioengineering solutions of a specific organ system and Locate and summarize popular and peer-reviewed scientific literature; BioE 320 (Biomechanics) Analyze and present both orally and in writing the mechanical behavior of tissues, human motions, and performance of implantable biomedical devices; BioE 401 (Bioengineering Design Theory) and BioE 403 (Applied Bioengineering Design) Communicate the design of a biomedical engineering project and BioE 448 (Tissue Engineering) Formulate a design strategy targeted at the restoration or replacement of a dysfunctional tissue or organ. To achieve integration of oral/written communication many courses require parallel assignments where the same content is delivered in both formats (for example BioE 201).
Assessment at the departmental level is coordinated with preparation of the ABET course notebooks and Outcomes Portfolio. Each course notebook contains student artifacts representative of high, intermediate, and low performance on assignments fulfilling the course learning objectives described above. Annually, the notebook is reviewed by another faculty member and a written critique of the notebook prepared and presented to the faculty. In addition, summary statistics of student performance on a written assignment in BioE 201 and BioE 448 and a representative example of student work are collected in the ABET Outcomes Portfolio and reviewed by the faculty during the ABET Spring Retreat. Based on the assessment of the communication integration competency in BioE 448, if 80% of students fail to achieve 80% or higher on this assessment, the department chair and Undergraduate Program committee will meet to formulate a plan to revise the curriculum to improve the students' grasp of the communication integration competency. Additional assessment measures include senior exit and alumni surveys.

Critical Thinking Integration Plan - Address competencies, implementation, and assessment: Critical thinking is taught throughout the Bioengineering curriculum in accordance with the ABET Student Outcomes 3b (design/conduct experiments, analyze/interpret data); 3c (design a system, component, or process to meet desired needs), and 3e (identify, formulate, and solve engineering problems). In addition, the ability to place critical thinking in a societal context is covered within the ABET student Outcome 3h (broad education necessary to understand the impact of engineering solutions in a global and societal context). Training in critical thinking is achieved through the course learning objectives: BioE 370 (Bioinstrumentation) Develop the ability to acquire and analyze physiological signals including images and Select and operate optimal instrument for solving biomedical problems, BioE 401 (Bioengineering Design Theory) Propose the design a novel solution to a bioengineering problem, BioE 403 (Applied Bioengineering Design) Demonstrate the design of a novel solution to a bioengineering problem
Assessment at the departmental level is coordinated with preparation of the ABET course notebooks and Outcomes Portfolio. Each course notebook contains student artifacts representative of high, intermediate, and low performance on assignments fulfilling the course learning objectives described above. Annually, the notebook is reviewed by another faculty member and a written critique of the notebook prepared and presented to the faculty. In addition, summary statistics of student performance on critical thinking assignments in BioE 370, 401, and 403 and a representative example of student work are collected in the ABET Outcomes Portfolio and reviewed by the faculty during the ABET Spring Retreat. Based on the assessment of the critical thinking competency in BioE 403, if 80% of students fail to achieve 80% or higher on this assessment, the department chair and Undergraduate Program committee will meet to formulate a plan to revise the curriculum to improve the students' grasp of the critical thinking competency. Additional assessment measures include senior exit and alumni surveys.

Form Originator: KWEBB, Charles Webb **Date Form Created:** 3/4/2011
Form Last Updated by: KWEBB, Charles Webb **Date Form Last Updated:** 3/10/2011 **Form Number:** 3902

Approval

Chair, Department Curriculum Committee	Date: 3/5/11	Chair, Undergraduate Curriculum Committee	Date: 4/1/2011
Department Chair	Date: 3/5/11	Chair, Graduate Curriculum Committee	Date
Chair, College Curriculum Committee	Date: 3/11/11	Provost	Date: 5/18/11
College Dean	Date: 3/14/11	President	Date: 5/19/11

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CLEMSON UNIVERSITY **Curriculum and Course Change System - General Education Checklist**

Major Name: Biosystems Engineering

Specific General Education Requirements

Requirement	Select from Gen Ed List	Select from Restricted Gen Ed List	Specific Course(s)	No Change
		Specify restrictions - e.g. PHIL courses only	Specify courses or cluster* of courses if appropriate	
English Composition			ENGL 103	
Oral Communication*	..	..	X BE 210, 474, 475	..
Academic & Professional Development			X BE 474/475	..
Mathematics	..	..	X MTHSC 106	..
Natural Science with lab	..	..	X CH 101	..
Math or Natural Science	..	..	X MTHSC 108	..
Arts & Humanities (Literature)	X	..	..	..
Arts & Humanities (Non-Literature)	X	..	..	..
Social Sciences	X	..	..	..
Cross-Cultural Awareness	X	..	..	..
Science and Tech. in Society	X	..	..	..

*Departments may specify a cluster of courses to meet the Oral communication competency but must include a plan for implementation and assessment in the following textbox:

Distributed Competencies

The faculties of each degree program will decide the most appropriate ways to integrate learning experiences in each of the areas below. Quantification in terms of credit hours is avoided in favor of the presumption that faculties will want to place a serious effort in each area and distribute this effort to a significant degree throughout their curricula.

Ethical Judgement Integration Plan - Address competencies, implementation, and assessment: Ethics in engineering has long been regarded as an important aspect of the profession because ultimately, the outcomes from engineering design of biological systems and processes may affect the health and well-being of humans and the environment. Aspects of ethical judgment will be implemented within the BE curriculum. This curriculum provides material in support of the following ABET criteria: develop understanding of professional and ethical responsibility, and provide a broad education necessary to understand the impact of engineering solutions in a global and societal context. CES 102 will introduce students to ethical judgment related to general engineering and science matters. BE 210 and 212 will introduce ethical judgment specific to the Biosystems Engineering discipline that involves both bioethics (issues concerning ecosystems, microorganisms, hazardous substances, etc.) and engineering ethics (judgment of statistical data and outliers, impact and safety of engineering design on biosystems, etc.) BE 415 discusses ethics related to instrumentation, data analysis, potential risks of electrical systems, and impact of electrical systems in biosystems design choices. BE 435 and 464 discuss ethical issues related to applied biotechnology and ecosystems, respectively. The capstone design course, BE 474, discusses ethical issues specific to the impact of design of biosystems to the environment, society, and responsibility in government or industry related jobs. Issues related to personal and professional ethics will be integrated into: classroom discussions, laboratories, technical presentations, technical papers, data collection and analysis, and biosystems engineering design. Students will be required to judge existing engineering solutions, research, and design from a systemic perspective that takes into account the following: human health and safety, environmental impacts, economic impacts, public policy and government, social consequences, undesirable design consequences, and global impacts of technological change in the senior courses. Assessment of these outcomes are documented in the course syllabus/rubrics and meet the requirements as set by the ABET assessment plan for outcome criterion 6) assessment of the ability to understand the need for professional conduct and high ethical standards.

Based on the Biosystems Engineering Assessment Plan, the general education competency of Ethical Judgment will be assessed within BE Capstone course sequence (BE 474/475) whereby at least 80% of the students can make a cogent written synopsis or oral presentation regarding the ethical issues involved in applying their solutions to the problems presented as well as at least 80% of the students respond in an acceptable manner ethically when presented with other scenarios for solving the problem presented to them in the senior project.

Communication Integration Plan - Address competencies, implementation, and assessment: The full implementation of the competencies will vary for different students depending on the courses they select. Most courses on the 200 level assign part of the grade for classroom reports and many require and evaluate projects that are written. Some 300 level courses also require and grade written reports or other types of written presentations such as lab reports. When written reports are required, class time is spent discussing writing techniques. Students are required to take two 400 level courses which are taught in seminar style with discussion and extensive student participation in written activities from resumes to progress reports to final reports. Students will formally study written communication techniques and practice and be evaluated on these techniques in BE 210. The professor will teach techniques for effective writing. Students will also study the particular techniques of writing used by engineers. Further instruction in written communication will be provided in BE 474, particularly for the formal reports. After students have taken both BE 210 and BE 474, they will have had instruction in written communication for lab reports and formal and informal reports to their classes. Final assessment of written communication competency will take place by written final reports in BE 475. Assessment of these outcomes are documented in the course syllabus/rubrics and meet the requirements as set by the ABET assessment plan for outcome criterion 7) ability to communicate effectively.

The full implementation of the competencies will vary for different students depending on the courses they select. Most courses on the 200 level assign a small part of the grade for classroom discussion and many require and evaluate projects that are presented orally. Some 300 level courses also require and grade oral reports or other types of oral presentations. When oral reports are required, class time is spent discussing oral presentation techniques. Students are required to take two 400 level courses which are taught in seminar style with discussion of and extensive student participation in oral activities from discussion to progress reports in the classroom. Students will formally study oral communication techniques and practice and be evaluated on these techniques in BE 210. The professor will teach techniques for effective large and small group discussion and oral presentation. Students will also study the particular techniques of oral presentation used by engineers. Further instruction in oral communication will be provided in BE 474, particularly for the formal presentations. After students have taken both BE 210 and BE 474, they will have had instruction in oral communication for seminar discussions and formal and informal presentations to their classes. Final assessment of oral communication competency will take place by oral presentations in BE 475. Assessment of these outcomes are documented in the course syllabus/rubrics and meet the requirements as

set by the ABET assessment plan for outcome criterion 7) ability to communicate effectively. 000041

Based on the Biosystems Engineering Assessment Plan, the general education competency of Communication will be assessed within BE Capstone course sequence (BE 474/475) whereby: 1) all groups produce written reports that are coherent and present the data in a logical, convincing fashion, 2) at least 80% of the students making the final oral presentation (assuming that each team member has responsibility for a different aspect of the final presentation) score an average of "good" or "excellent" on the following: presentation, planning, clarity, logical sequencing ability to answer questions etc, and 3) at least 80% of the students making final oral presentations score "excellent" or "good" by a majority of faculty and/or external experts on the following: logic, grammar, understandability, and technical accuracy.

Critical Thinking Integration Plan - Address competencies, implementation, and assessment: Engineering disciplines are based on and strongly integrate reasoning, critical thinking and problem solving into their core curricula. These are also strictly required for ABET accreditation through the 11 stipulated outcomes and assessment measures. These assessment tools and process are in place and have been utilized for several years. The Biosystems Engineering program courses require students to integrate these through knowledge of mathematics, biological and chemical sciences, engineering, and through general education requirements. Emphasis on open-ended problem solving, and critical thinking is required of students through science and engineering courses and many hands-on laboratory experiences. Reasoning, critical thinking and problem solving are implemented through core courses in the BE curriculum. The senior capstone design courses, BE 474 and 475, require teamwork to implement reasoning, critical thinking, and problem solving by addressing complex real-world biosystems-related problems. These problems integrate technical knowledge of math, sciences, and engineering as well as communication skills to relay their design projects to departmental faculty and industry partners. CH 101, PHYS 122 and 221 focus primarily on problem solving and associated reasoning and critical thinking processes. Mathematical and experimental problem solving modes are used. Math requirements address problem solving, associated reasoning, and critical thinking processes. EG 209 involves three dimensional thinking skills and two and three dimensional representation of physical objects. Biosystems Engineering is composed of courses based upon or have this competency integrated into them. Student engineers cannot assemble information and data, conceptualize a solution and create the design of a physical component, system or process without doing reasoning, critical thinking and problem solving. Assessment necessary to determine whether the student has successfully completed these courses is synonymous to assessment of this competency.

Based on the Biosystems Engineering Assessment Plan, the general education competency of Critical Thinking will be assessed within BE Capstone course sequence (BE 474/475) whereby: 1) at least 80% of the students are able to identify and formulate the problem in a logical manner so as to enable progress towards a solution and 2) at least 80% of the students make substantial progress in solving the problem presented to them (or) in making substantial improvements in the performance of the engineering process presented.

Form Originator: PRIVETT, Charles Privette Iii **Date Form Created:** 2/8/2011
Form Last Updated by: PRIVETT, Charles Privette Iii **Date Form Last Updated:** 3/14/2011 **Form Number:** 3760

Approval

3/14/11		Patricia W. Murdoch 4/1/2011	
Chair, Department Curriculum Committee	Date	Chair, Undergraduate Curriculum Committee	Date
3/14/11			
Department Chair	Date	Chair, Graduate Curriculum Committee	Date
3/14/11		Doris R. Helms	5/18/11
Chair, College Curriculum Committee	Date	Provost	Date
3/14/11			5/19/11
College Dean	Date	President	Date

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CLEMSON UNIVERSITY **Curriculum and Course Change System - General Education Checklist**

Major Name: Environmental Engineering

Specific General Education Requirements

Requirement	Select from Gen Ed List	Select from Restricted Gen Ed List	Specific Course(s)	No Change
		Specify restrictions - e.g. PHIL courses only	Specify courses or cluster* of courses if appropriate	
English Composition			ENGL 103	
Oral Communication*	..	..	X EE&S 201, EE&S 202, EE&S 475, EE&S 485	..
Academic & Professional Development			X CES 102, EE&S 450, EE&S 451	..
Mathematics	..	..	X MTHSC 106	..
Natural Science with lab	..	..	X BIOL 103, BIOL 105	..
Math or Natural Science	..	..	X CH 102	..
Arts & Humanities (Literature)	X	..	..	..
Arts & Humanities (Non-Literature)	X	..	..	..
Social Sciences	X	..	..	..
Cross-Cultural Awareness	X	..	..	..
Science and Tech. in Society	..	..	X HIST 124	..

*Departments may specify a cluster of courses to meet the Oral communication competency but must include a plan for implementation and assessment in the following textbox: The Accreditation Board for Engineering and Technology (ABET) requirement 3(g) requires our students to have "an ability to communicate effectively," which includes oral communication competency. The "Environmental Engineering Body of Knowledge" (EnvE BOK, http://www.aaee.net/Website/EEBoK.htm), written by a task force of the American Academy of Environmental Engineering, which is the lead ABET member society for environmental environmental engineering, has proposed an appropriate levels of achievement for the communications competency at the BS level in its Outcome 14, Effective Communications. We have adopted these as the minimum level of competency for our graduates.

Our program consists of a cluster of course: EE&S 201, EE&S 202, EE&S 475, and EE&S 485. These courses will have oral presentations by its students with critical evaluation by the instructor and peer evaluation by the other students.

The oral competency assessment of student performance will be in the final oral presentation in EE&S 475, Capstone Design Project. The evaluators will be faculty members and external members selected from environmental engineering practioners and industry. The rubrics for evaluation are based on the EnvE BOK levels of achievement.

The criteria for assessment is 80% of our students will perform at or above the level of

performance given by the EnvE BOK and the rubric. If we do not achieve this level, the faculty will reevaluate its curriculum.

Distributed Competencies

The faculties of each degree program will decide the most appropriate ways to integrate learning experiences in each of the areas below. Quantification in terms of credit hours is avoided in favor of the presumption that faculties will want to place a serious effort in each area and distribute this effort to a significant degree throughout their curricula.

Ethical Judgement Integration Plan - Address competencies, implementation, and assessment: ABET requirement 3(f) requires "an understanding of professional and ethical responsibility." The EnvE BOK Outcome 13, Professional and Ethical Responsibilities, sets forth the levels of achievement at the BS level. We have adopted these as the minimum level of competency for our graduates.

Our program consists of a cluster of courses: EE&S 201, EE&S 202, EE&S 450, EE&S 475, and EE&S 485 that will promote ethical judgement.

The assessment of student performance will be in EE&S 475, Capstone Design Project and in the performance of our students taking the National Council of Examiners for Engineering and Surveying (NCEES) Fundamentals of Engineering Examination (Ethics & Business Practices).

In EE&S 475, the students will demonstrate ethics and ethical decision making in the capstone design report, their oral report, and in the decisions that they made in their design. The evaluators will be faculty members and external members selected from environmental engineering practioners and industry. The rubrics for evaluation are based on the EnvE BOK levels of achievment.

The criteria for assessment is 80% of our students will perform at or above the level of performance given by the EnvE BOK and the rubrics. If we do not achieve this level, the faculty will reevaluate its curriculum.

In addition, the results from the Ethics and Business Practices section of the Fundamentals of Engineering examination of our students taking the will be used to assess their ethical judgement.

Communication Integration Plan - Address competencies, implementation, and assessment: ABET requirement 3(g) requires our students to have "an ability to communicate effectively." The EnvE BOK has proposed an appropriate level of achievement for the communications competency at the BS level in its Outcome 14, Effective Communications. We have adopted these as the minimum level of competency for our graduates. Since oral communications was covered in the oral competency plan above, this will focus on written communications.

Our program consists of a cluster of courses: EE&S 201, EE&S 202, EE&S 475, and EE&S 485. In addition, we have graded writing assignments in EE&S 430 and EE&S 484.

The assessment of student performance will be in final report for EE&S 475, Capstone Design Project. The rubrics for evaluation are based on the EnvE BOK levels of achievement.

The criteria for assessment is 80% of our students will perform at or above the level of performance given by the ENv BOK and the rubrics. If we do not achieve this level, the faculty will reevaluate its curriculum.

Critical Thinking Integration Plan - Address competencies, implementation, and assessment: ABET requires critical thinking in a number of its criteria including 3(c) that requires "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" and 3(h) that requires "the broad education necessary to

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understand the impact of engineering solutions in a global, economic, environmental, and societal context." The EnvE BOK has a number of students outcomes addressing these. For 3(c), those specifically dealing with critical think are Outcome 7, Creative Design, and Outcome 8, Sustainability. They have proposed levels of achievement at the BS level. We have based our rubrics on these levels.

We rely on both General Education courses in literature, the humanities, and the social sciences, and the science and engineering courses in our curriculum to develop these thinking skills.

The assessment of student performance will be in final report, oral presentation, and answers to questions, for EE&S 475, Capstone Design Project. The evaluators will be faculty members and external members selected from environmental engineering practioners and industry. The rubrics for evaluation are based on the EnvE BOK levels of achievement.

The criteria for assessment is 80% of our students will perform at or above the level of performance given by the EnvE BOK and our rubrics. If we do not achieve this level, the faculty will reevaluate its curriculum.

Form Originator: TJVRC, Thomas Overcamp **Date Form Created:** 11/22/2010
Form Last Updated by: TJVRC, Thomas Overcamp **Date Form Last Updated:** 2/24/2011
Form Number: 3682

Approval

		Patricia W. Murdock 4/1/30.
Chair, Department Curriculum Committee	Date	Chair, Undergraduate Curriculun
Thomas Overcamp	24 Feb 2011	
Department Chair	Date	Chair, Graduate Curriculum Com
Tash Kozel	2/25/11	Doris R Helms 5/18/11
Chair, College Curriculum Committee	Date	Provost
	3/9/11	5/19/11
College Dean	Date	President
	3/15/11	

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CLEMSON UNIVERSITY **Curriculum and Course Change System - General Education Checklist**

Major Name: Geology (BS)

Specific General Education Requirements

Requirement	Select from Gen Ed List	Select from Restricted Gen Ed List	Specific Course(s)	No Change
		Specify restrictions - e.g. PHIL courses only	Specify courses or cluster* of courses if appropriate	
English Composition			ENGL 103	
Oral Communication*	..	..	X GEOL 292/391/392/492	..
Academic & Professional Development			X GEOL 391/392/492	..
Mathematics	..	..	X MTHSC 106	..
Natural Science with lab	..	..	X GEOL 101/103	..
Math or Natural Science	..	..	X GEOL 102	..
Arts & Humanities (Literature)	X	..	..	..
Arts & Humanities (Non-Literature)	X	..	..	..
Social Sciences	X	..	..	..
Cross-Cultural Awareness	X	..	..	..
Science and Tech. in Society	..	..	X GEOL 300	..

*Departments may specify a cluster of courses to meet the Oral communication competency but must include a plan for implementation and assessment in the following textbox: Oral communication competencies are woven throughout the Geology Major, primarily through the required series of Creative Inquiry courses (GEOL 291, 292, 391, 392, 491, 492). In several of these courses, students receive instruction in making effective oral presentations and are given opportunities to demonstrate competence in giving both group and individual oral presentations. All oral reports are graded by faculty using rubrics adapted from online forms posted by Georgia Tech University and the Pomperaug Regional School District of Middlebury, CT. Group oral presentations are emphasized in GEOL 292 and GEOL 391, while individual oral presentations are assigned in GEOL 292 and GEOL 392. GEOL 492 focuses almost exclusively on oral communication skills and requires students to prepare and give a 20-minute professional presentation at the annual Clemson Hydrogeology

Symposium. Also required are a poster presentation at the annual "Focus on Creative Inquiry" poster symposium, a ten-minute radio interview, and a ten-minute interview with a newspaper reporter.

Distributed Competencies

The faculties of each degree program will decide the most appropriate ways to integrate learning experiences in each of the areas below. Quantification in terms of credit hours is avoided in favor of the presumption that faculties will want to place a serious effort in each area and distribute this effort to a significant degree throughout their curricula.

Ethical Judgement Integration Plan - Address competencies, implementation, and assessment: Ethical judgment competencies are addressed in the Geology curriculum primarily through the required series of Creative Inquiry courses (GEOL 291, 292, 391, 392, 491, 492). In GEOL 291 the issue of bias in conducting research is introduced in the assigned reading "The Nature of Science and the Scientific Method" by Christine McClelland. Lectures in GEOL 391 cover professional ethics and practices in the geosciences, including the Code of Ethics for professional geologists and case studies involving ethics, plus assigned reading of the National Academy of Science booklet "On Being a Scientist: Responsible Conduct in Research". Students in GEOL 391 are required to write two class reflections on ethical issues. In GEOL 491 and GEOL 492, issues of plagiarism are addressed and research reports are graded partially on the degree of adherence to professional ethical standards as expected in the geosciences. Ethical judgment and reasoning will be assessed from students' written class reflections in GEOL 391 and written reports in GEOL 491/492 using the grading scale given in the class syllabi. If 75% are not scored A (excellent) or B (good) an improvement mechanism will be triggered; assessment results will be used by instructors to improve the Creative Inquiry courses.

Communication Integration Plan - Address competencies, implementation, and assessment: Scientific writing and technical communications competencies are woven throughout the Geology Major, primarily through the required series of Creative Inquiry courses (GEOL 291, 292, 391, 392, 491, 492). GEOL 291 requires each student to prepare a written literature review and GEOL 292 introduces the digital electronic portfolio as a required mechanism for reporting data and for writing reflections on class topics, assigned readings, and the monthly progress being made on the student's research project. Written entries to the digital electronic portfolios are graded using a rubric adapted from the book "Electronic Portfolios: A Guide to Professional Development and Assessment" by Marilyn Heath (Linworth, 2004). In GEOL 391, students write reflections on class presentations about various geoscience careers and on ethical case studies. In GEOL 392, students write a complete project proposal which is graded according to guidelines published by the US Department of Energy. The primary emphasis of GEOL 491 is technical writing; students turn in ten written homework assignments in addition to a ten-page written progress report (in a format suitable for publication). For GEOL 492, students must turn in a complete written research report, suitable for publication. The progress and final reports are graded according to peer review

standards typically used by geoscience technical journals.
If 75% are not graded A (excellent) or B (good) an improvement mechanism will be triggered; assessment results will be used by instructors to improve the Creative Inquiry courses.

Critical Thinking Integration Plan - Address competencies, implementation, and assessment: Critical thinking competencies are woven throughout the Geology Major, primarily through the required series of Creative Inquiry courses (GEOL 291, 292, 391, 392, 491, 492). In GEOL 291, students are assigned to read articles such as "The Nature of Science and the Scientific Method" by Christine McLelland (published by Geological Society of America) and class discussions build on those themes. In GEOL 292, a major topic is the "Method of Multiple Working Hypotheses." In GEOL 391, students discuss the NAS booklet "On Being a Scientist." In GEOL 392, the focus in on planning an original research proposal that has a reasonable research design and can be accomplished in the allotted time frame within the allotted budget. In GEOL 491 and GEOL 492, students are responsible for self-directing, self-monitoring, and self-correcting their progress in implementing their research project. But in each of these courses, students practice their critical thinking skills most often during actual research project work, with assistance as needed from their faculty research mentor. Students must keep a professionally formatted research notebook and must anticipate issues associated with carrying out their research successfully, and devise strategies for dealing with unexpected problems and/or opportunities that may arise. Faculty project mentors grade the research notebooks in accordance with professionally accepted standards for such work. If 75% are not graded A (excellent) or B (good) an improvement mechanism will be triggered; assessment results will be used by instructors to improve the Creative Inquiry courses.

Form Originator: TJVRC, Thomas Overcamp **Date Form Created:** 2/25/2011
Form Last Updated by: TJVRC, Thomas Overcamp **Date Form Last Updated:** 4/14/2011 **Form Number:** 3868

Approval

Thomas J. Overcamp	14 April 2011	Janice W. Murdock 5/6/2011
Chair, Department Curriculum Committee	Date	Chair, Undergra
Carl Kozak	4/18/2011	
Department Chair	Date	Chair, Graduate
	4/15/11	
Chair, College Curriculum Committee	Date	Provost 6/17/2011
	4-18-11	6/17/2011
College Dean	Date	President

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CLEMSON UNIVERSITY **Curriculum and Course Change System - General Education Checklist**

Major Name: Civil Engineering

Specific General Education Requirements

Requirement	Select from Gen Ed List	Select from Restricted Gen Ed List	Specific Course(s)	No Change
		Specify restrictions - e.g. PHIL courses only	Specify courses or cluster* of courses if appropriate	
English Composition			ENGL 103	
Oral Communication*	..	..	X CE L351 and CE 459	..
Academic & Professional Development			X CE 331, CE 353, CE 459	..
Mathematics	..	..	X MTHSC 106	..
Natural Science with lab	..	..	X CH 101	..
Math or Natural Science	..	..	X MTHSC 108	..
Arts & Humanities (Literature)	X	..	..	..
Arts & Humanities (Non-Literature)	X	..	..	..
Social Sciences	X	..	..	..
Cross-Cultural Awareness	X	..	..	..
Science and Tech. in Society	X	..	..	..

*Departments may specify a cluster of courses to meet the Oral communication competency but must include a plan for implementation and assessment in the following textbox: In CE 351L the students are required to make oral presentations on their semester project. The oral communication skills of the students comprise 40% of the semester project grade. CE 459 (Capstone Design) is a class which requires a comprehensive understanding of all forms of communication. As students work together in small teams they must communicate their design ideas and progress in the form of technical memos, project reports, technical sketches and drawings, and design plans. As a culminating experience they are required to orally present and defend their designs to not only their peers but also a jury of professionals. Competency in oral communication is considered achieved if at least 75 percent of all respondents to annual exit interviews, alumni surveys and employer surveys believe our students are effective oral communicators. Additionally, the capstone design jury of professionals is asked to rate the effectiveness of each oral presentation of the final design.

Distributed Competencies

The faculties of each degree program will decide the most appropriate ways to integrate learning experiences in each of the areas below. Quantification in terms of credit hours is avoided in favor of the presumption that faculties will want to place a serious effort in each area and distribute this effort to a significant degree throughout their curricula.

Ethical Judgement Integration Plan - Address competencies, implementation, and assessment: Competency: Having a program accredited by the Accreditation Board of Engineering and Technology (ABET) the Civil Engineering program at Clemson University explicitly answers the need for developing ethical judgment in students. The specific program outcomes, as outlined by ABET, which are related to this need are to develop an "understanding of professional and ethical responsibility" and to develop a "recognition of the need for, and an ability to engage in life-long learning."

Implementation: The curriculum is designed to implement the topic of ethics in a clear and notable fashion. CE 331 (Construction Engineering & Management) includes course discussions dealing with ethical behavior in engineering practice including the American Society of Civil Engineers' (ASCE's) code of ethics. The professional seminar (CE 353) has a licensed professional engineer give a guest lecture on ethics in the profession. The capstone design (CE 459) class devotes several class periods (4 – 5 hours) to the explicit treatment of professional ethics. Both the National Society of Professional Engineers (NSPE) and the ASCE have a code of ethics which is used for the foundation of a number of in-class activities which include the reading and discussion of five case studies, role-playing and a quiz. Groups are expected to provide ethical judgments in each case and propose possible ethical alternatives. Special emphasis is placed on the fact that a strictly legal response will not necessarily guarantee an ethical response.

Assessment: Exam and quiz questions specific to ethics and professional practice are monitored in all relevant classes. The percentage of students who get these questions correct is monitored. An indicator of an adequate competency level is if students average 75 percent or more correct answers to these questions. Further assessment is conducted in the form of annual student exit interviews, alumni surveys and employer surveys. An acceptance threshold of 75 percent of respondents believing an understanding of ethical responsibility has been obtained has been established for this competency. Finally, student performance on the Fundamentals of Engineering (FE) exam for questions falling in the category of "Ethics and Business Aspects" is monitored. Satisfactory performance is defined as the Civil Engineering Department's average on these questions being at or above the National average.

Communication Integration Plan - Address competencies, implementation, and assessment: Communication Integration Plan – Address competencies, implementation, and assessment:

Competency: This competency is fully captured in the ABET program outcome which requires that a student has the "ability to communicate effectively." This communication effectiveness should be achieved in both written (textual, graphical and mathematical) and oral media.

Implementation: ENGL 103 (Composition I) and ENGL 314 (Technical Writing) are explicit writing courses developed to teach students show how to communicate their ideas clearly in textual form. They are given writing assignments requiring the communication of technical information including but not limited to research findings, resumes and memos. EG 210 (Introduction to Engineering Graphics) and CE 255 (Geomatics) are classes which foster communication in graphical form. Students are instructed in and complete many assignments dealing with the graphical conveyance of technical information, and the production of design plans and descriptive maps. CE 206L (Structural Mechanics Lab), CE 321L (Geotechnical Engineering Lab), CE 341L (Fluid Mechanics Lab) and CE 351L (Construction Materials Lab) are all technical labs which require the students to generate lab reports which clearly communicate purpose, setup, acquisition and interpretation of data. Each of these labs requires some of the reports to be created individually and some to be written in small groups. Guidance for the generation of lab reports is given at the beginning of each semester. In CE 351L the students are required to make oral presentations on their semester project. The oral communication skills of the students comprise 40% of the semester project grade. CE 459 (Capstone Design) is a class which requires a comprehensive understanding of all forms of communication. As students work together in small teams they must communicate their design ideas and progress in the form of technical memos, project reports, technical sketches and drawings, and design plans. As a culminating experience they are required to orally present and defend their designs to not only their peers but also a jury of professionals.

Assessment: Assessment of written communication is established through graded writing assignments in both English and Lab based courses. A consistent lab report grading rubric is established for all lab assistants to use. Furthermore, each semester, two group lab reports are selected for a quality check by external reviewers. Competency in textual communication is considered achieved if 75 percent of all students' work is rated satisfactory or better and if at least 75 percent of all respondents to annual exit interviews, alumni surveys and employer surveys believe our students are effective communicators in writing.

Oral communication is also assessed through the same series of interviews and surveys. The 75 percent threshold is also used for this assessment of effectiveness. Additionally, the capstone design jury of professionals is asked to rate the effectiveness of each oral presentation of the final design. An acceptable level of performance is if 75 percent or more of the students are rated as satisfactory or above.

Critical Thinking Integration Plan - Address competencies, implementation, and assessment: Competency: Critical thinking is essential for any engineering student and is directly accounted for in the ABET required program outcomes which state that a student must have the "ability to design and conduct experiments, analyze and interpret data" and also has the "ability to identify, formulate and solve engineering problem." While other ABET program outcomes also facilitate the development of critical thinking these two outcomes and their associated implementation capture well the focus which the Civil Engineering Department gives to this competency.

Implementation: Implementation is achieved in the following required courses: CE 206L (Structural Mechanics Lab), CE 321L (Geotechnical Engineering Lab), CE 341L (Fluid Mechanics Lab) and CE 351L (Construction Materials Lab), whcih are all labs that require students to generate experimental data, analyze it and provide an interpretation thereof. The process of considering data in a critical manner is facilitated through feedback in graded reports and repetition. The very nature of ExSt 301 (Introduction to Statistics) helps students to develop not only the habit but also the tools necessary to critically evaluate data. They receive assignments which require them to examine various forms of data and make meaningful inferences there from.

Every technical requirement course taught in the Civil Engineering curriculum has specific focus on identifying, formulating and solving engineering problems. The very nature of engineering requires this level of critical thinking. Helping students to break a problem down into manageable and distinct steps and to critically evaluate a problem are some of the basic tenets of these courses. Homework assignments, in-class demonstrations, class projects and cases studies are given to develop this level of thinking and are typical of these technical courses.

Assessment: Assessment of critical thinking is performed primarily through graduating student exit interviews, alumni surveys and employer surveys. Questions are designed to address the ability to analyze and interpret data and also the formulation and solution of engineering problems. If 75 percent of the Department's constituents identify our students as satisfactory in these areas, then this competency is considered satisfied. Additionally, the Capstone Design class (CE 459) uses the jury of professionals to evaluate the overall competency of Civil Engineering graduates.

Form Originator: JLBRT, James Burati **Date Form Created:** 2/27/2011
Form Last Updated by: JLBRT, James Burati **Date Form Last Updated:** 2/27/2011 **Form Number:** 3873

Approval

J L Burati Jr.	2/27/11	Patricia W. Murdock	4/1/2011
Chair, Department Curriculum Committee	Date	Chair, Undergraduate Curriculum Committee	Date
Nabil M. Ayyub	3/3/11		
Department Chair	Date	Chair, Graduate Curriculum Committee	Date
	3/9/11	Denis R. Nelson	5/18/11
Chair, College Curriculum Committee	Date	Provost	Date
	3/15/11		5/19/11
College Dean	Date	President	Date