Writing in the Majors Plan for Materials Engineering
Comments from the University Writing Committee

Criterion	Comments, Questions, Suggestions
Principles 1 & 2: Provides opportunities for students to practice the kinds of writing most useful to the major	Yes
Demonstrates that most students in the major have multiple writing experiences	Yes
Principle 3: Provides opportunities for students to write for different purposes and audiences	Yes
Principle 4: Provides opportunities for feedback and revision	Yes
Principle 5: Assessment plan identifies what the department is working on in relation to writing	Yes
Principle 5: Assessment plan identifies what data will be collected to aid in decisions related to writing	Yes
Identifies steps necessary for implementation	no indication of implementation of critical listening component

Other Comments:

The Committee found this plan to be clear and easy to follow. We especially appreciate the creativity in adapting the self-report required for your ABET accreditation and the use of the visual cues to help readers find where you were addressing the Principles of Writing. We found the appendices helpful, especially the inclusion of rubrics.

We are less clear about how you will implement critical listening to address the problems you suspect are making seniors perform at a lower level than your juniors. Perhaps written assignments would be beneficial even at the senior level. Likewise, while the assessment plan suggests strategies for developing areas in which student do not perform according to expectations, it does not explicitly address how individual students will be helped if they fail to meet expectations. We suggest the faculty consider what additional instruction, if any, could be made available to students who need assistance. We will expect your next report to include an update on these issues.

__*___ Plan is approved and will be posted on the OUW website
approval date: September 9, 2010

_____ Plan needs revision as indicated above Resubmit due date: _____

Plan

for

Writing In the

Materials Engineering Major

at

Auburn University

Auburn, AL

Date: July 20, 2010

Professors Jeff Fergus (844-3405) and Tony Overfelt (844-5940)
Materials Engineering

Contents

EXECUTIVE SUMMARY

The Materials Engineering Program at Auburn University has been meeting the accreditation requirements of the American Board for Engineering and Technology for a number of years. The Materials Engineering desired educational outcome relevant to the Writing Across the Majors Initiative is demonstrated "proficiency in written and oral communication." The current document details how the Materials Engineering Program provides communication skills instruction along with student opportunities to develop and refine written and oral communication abilities. The instruction and skill building exercises are spread across a number of courses and a quantitative assessment methodology is in place that allows monitoring the extent to which students attain the desired educational outcome. All five of the Principles of Writing for All Majors are satisfied with the ABET-accreditation activities already in place.

1.0 Materials Engineering Administrative Contact Information

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2.0 Overview of Writing-Relevant ABET Accreditation Requirements

Undergraduate students at Auburn University can earn a Bachelor of Materials Engineering degree through the Materials Engineering Program administered by the Department of Mechanical Engineering. The Materials Engineering Program is accredited every six years through the ABET and has been fully accredited since 1975. Currently, ABET accreditation criterion 3(g) states that

"Engineering programs must demonstrate that their students attain …
an ability to communicate effectively."

A correlation and mapping of the ABET requirements and the Materials Engineering Program Educational Outcomes from the most recent ABET Self Study Report (15 May 2010) is attached as Appendix A to this document. The Materials Engineering Program's Educational Outcomes pertinent to the Writing Across the Majors Initiative is that Materials Engineering graduates will have demonstrated:

"Proficiency in written and oral communication…"

This educational outcome is addressed in several required courses throughout the Materials Engineering curriculum (see Appendix B). Table 1 below (taken directly from the ABET Self-Study Report) summarizes the outcomes to which each course or set of courses in the curriculum contributes. In each case, the contribution is identified as either a MAJOR or a

minor contributor to each particular outcome. As can be seen in Table 1, the desired student educational outcome to demonstrate the ABET requirement for effective "communication" (i.e., proficiency in written and oral communication) is addressed in the following courses (**BOLD**) which ALL materials engineering undergraduate students must take: ENGL 1110, ENGL 1120, MATL 3101, MATL 3201, MATL 4500, MATL 4980, and MATL 5201.

Table 1. Course-Outcome Correlation

Outcomes	Application / integration of sci. & eng. to solve materials problems	Analytical, experimental, statistical, computat. techniques	Communica-tion and multi-disciplinary teamwork	Contempor-ary, societal and ethical issues	Lifelong learning and professional development
Courses					
Composition (ENGL 1110,1120)			**MAJOR**		
Literature (ENGL 2200,2210)				MAJOR	
Ethics (PHIL 1020)				MAJOR	
Economics (ECON 2020)				MAJOR	
Social Science				MAJOR	
Fine Arts				MAJOR	
History				MAJOR	
Calculus (MATH 1610, 1620, 2630)		MAJOR			
Differential Equat. (MATH 2650)		MAJOR			
Linear Algebra (MATH 2660)		MAJOR			
Physics (PHYS 1610/1620)	MAJOR	MAJOR			
Chemistry (1030/1,1040/1)	MAJOR	MAJOR			
Computer Prog. (COMP 1200)		MAJOR			
Intro. Eng. (ENGR 1110)	MAJOR	MAJOR			
Statics (ENGR 2050)	MAJOR	MAJOR			
Mechanics Mater. (ENGR 2070)	MAJOR	MAJOR			

Table 1. Course-Outcome Correlation (continued)					
Outcomes	Application / integration of sci. & eng. to solve materials problems	Analytical, experimental, statistical, computat. techniques	Communica-tion and multi-disciplinary teamwork	Contempor-ary, societal and ethical issues	Lifelong learning and professional development
Courses					
Thermo. Fluids, Heat (ENGR 2220)	MAJOR	MAJOR			
Statistics (STAT 3010)		MAJOR			
Circuits (ENGR 3810)	MAJOR	MAJOR			
Intro. Mater. Science (MATL 2100)	MAJOR	MAJOR		minor	
Metals (MATL 3100)	MAJOR			minor	
Metallography Lab. (MATL 3101)	MAJOR	MAJOR	**MAJOR**		
Polymers (MATL 3200)	MAJOR	MAJOR		minor	
Poly. & Comp. Lab. (MATL 3201)	MAJOR	MAJOR	**MAJOR**		
Ceramics (MATL 3300)	MAJOR	MAJOR	minor	minor	
Mater. Selection (MATL 4500)	MAJOR	MAJOR	**MAJOR**	MAJOR	MAJOR
Senior Design (MATL 4980)	MAJOR	MAJOR	**MAJOR**	MAJOR	MAJOR
Thermodynamics (MATL 5100)	MAJOR	MAJOR			
Crystallography (MATL 5200)	MAJOR	MAJOR			
X-Ray Diffraction Lab (MATL 5201)	MAJOR	MAJOR	**MAJOR**		
Phase Transform. (MATL 5300)	MAJOR	MAJOR			
Physics of Solids (MATL 5400)	MAJOR				
Numer. Simul. Mater. Processing (MATL 5500)	MAJOR	MAJOR	minor		
Cross-Disciplinary Sequence	MAJOR				

3.0 Overview of Writing-Relevant Materials Engineering Courses

The materials engineering curriculum, shown in Appendix B, supports the materials engineering program educational outcomes and satisfies all ABET requirements. In addition, the courses satisfy all the required Principles for Writing for All Majors (See Appendix E). In the discussion below, each specific Writing Principle is shown as a boxed side-bar alongside the actual discussion of where the principle is satisfied by the relevant Materials Engineering course.

3.1 Laboratory Courses: MATL 3101, MATL 3201 & MATL 5201

MATL 3101 and MATL 3201 are generally taken during Fall and Spring semesters, respectively, of the junior year by materials engineering undergraduates. MATL 5201 is a laboratory course taken as a senior. As shown in the attached syllabi (Appendix C), students in these courses learn to write technical laboratory reports using acceptable engineering standards for data analysis, interpretation, presentation and grammar. Seven separate laboratory reports are required for MATL 3101, four or five reports are required in MATL 5201 and separate weekly reports are required for MATL 3201. In total, *over 2 dozen separate laboratory reports are required* in these three courses taken during student's junior and senior years. In each course, the laboratory reports are graded and returned to the students so that *improvements can be incorporated in subsequent reports*. Thus Writing Across the Major Principles 1 and 4 are satisfied by materials engineering courses MATL 3101, MATL 3201 and MATL 5201.

> Writing for All Majors Principle #1: Provide <u>more than one opportunity</u> for students to practice writing

> Writing for All Majors Principle #4: Provide opportunities for students to <u>revise</u> their written work based on individual feedback from the instructor and from peers to improve both the content and form of their work.

3.2 Capstone Design Experience Courses: MATL 4500 and MATL 4980

To prepare the students for the final senior design project during the Spring semester of the senior year, a series of preparatory assignments are completed during the Fall semester of the senior year in the MATL 4500 course. In MATL 4500, students are divided into competing teams to prepare a written proposal for a major government sponsor to supply multiple materials (polymers and metals) that have specified materials properties. Each team is provided with unknown materials (a metal and several polymers) for identification using standard materials testing techniques. The teams must first identify the materials using reverse engineering techniques. The teams then compete for the one production contract by *presenting their findings and proposal in oral and written form.* The students in this class prepare *weekly written progress reports*, write *a letter of intent* to respond to a request for quote; learn about critical path scheduling using standard software such as Microsoft project; learn how to search the web for instructions and requirements for proposal submission to a government agency; learn how to

> Writing for All Majors Principle #2: Provide opportunities for students to practice producing more than one kind of writing.

find accepted engineering standards to specify parts and tests (SAE bolt specifications, ASTM specifications for tensile, impact, Jominy testing, etc.); demonstrate that they have life long learning skills through assignments such as anodizing aluminum to specified colors; *keep properly recorded log books*; undergo an industry employee performance review; demonstrate understanding of ethical issues through oral evaluations by external practicing engineers in regard to professional ethics scenarios; demonstrate the ability to make engineering recommendations; learn how statistics can affect profit margins (i.e. how setting standard deviation limits affects the number of products that can be sold); calculate economic costs of engineering, design and production; and *present laboratory results in oral and written reports.*

Writing for All Majors #3: Provide opportunities for students to write for different purposes and audiences.

The skills that are learned in MATL 4500 are then used to complete a major design experience in MATL 4980 involving team-based projects. Recent projects have involved the design and manufacture of aluminum barrel and polymer barrel pens. In MATL 4980 the students are also divided into teams for an assignment involving a civil litigation resulting from the failure of a material. Students must depose witnesses, gather evidence from the scene of the failure, test evidence, perform numerical simulations and analyses. *Each of these activities involves informal or formal writing assignments* to integrate the various datasets, interpret results using standard engineering concepts and finally prepare a *carefully coordinated written and oral presentation.* A mock trial is held with witnesses and jurors with the jurors deciding the outcome of the trial.

4.0 Writing-Relevant Student Assessment Methodology and Recent Results

Writing for All Majors Principle #5: Include an assessment plan that uses the data obtained to make decisions about what else needs to be done to enhance the writing experiences of students in the major.

The primary method for evaluation of student progress towards a "demonstrated proficiency in written and oral communication" is the use of standardized assessment forms to evaluate student work relative to the specific outcome. Standardization of the assessment methodology enables measurement/monitoring of changes in the effectiveness of the Materials Engineering Program in meeting our desired student educational outcomes. The current assessment forms relevant to "written and oral communication" are forms for the evaluation of (i) written presentations, (ii) oral presentations and (iii) laboratory reports. Copies of the assessment forms are included in Appendix D. The forms include a numerical rating of from 1 to 5 relative to the outcome, in which the specific criteria for each number is described on the form. The criteria for the number 3 is considered the minimum satisfactory performance, so ratings less than 3 identify areas for improvement. Most forms are completed by faculty members evaluating student work. Faculty members sometimes have students complete these forms for peer evaluation of other students. This

Writing for All Majors Principle #4: Provide opportunities for students to <u>revise</u> their written work based on individual feedback from the instructor and from peers to improve both the content and form of their work.

practice is especially common for oral presentations, but is sometimes used as part a peer-review process of written reports.

The assessment forms are used throughout the year. At the beginning of each summer, the ABET coordinator compiles the assessment results collected during the previous academic year. The results are organized, analyzed and then summarized in a report distributed to the materials engineering faculty. After reviewing the report, the faculty meets to discuss the results and any changes that might be needed. This meeting typically occurs in late summer, before Fall semester, so that any needed changes can be implemented during the following academic year. Recent Assessment results relevant to our desired educational outcome for student "proficiency in written and oral communication" are shown in Appendix E.

4.1 Recent Results of Assessment of Written Laboratory Reports

The results of the assessment of written laboratory reports during the last three years are summarized in Figure 1. The average of the scores is 3.5, but a number of lower scores were reported. The scores at the beginning of each semester, particularly in MATL 3101 and MATL 5201 are typically low and then increase throughout the semester as the students learn what is required for the laboratory reports and incorporate the feedback into their subsequent written documents. Similar problems of incomplete analysis and poorly written reports are also sometimes observed in MATL 4500. Although there are some scores lower than 3, this is part of the learning process. In addition, the number of lower scores has been decreasing for the past few years.

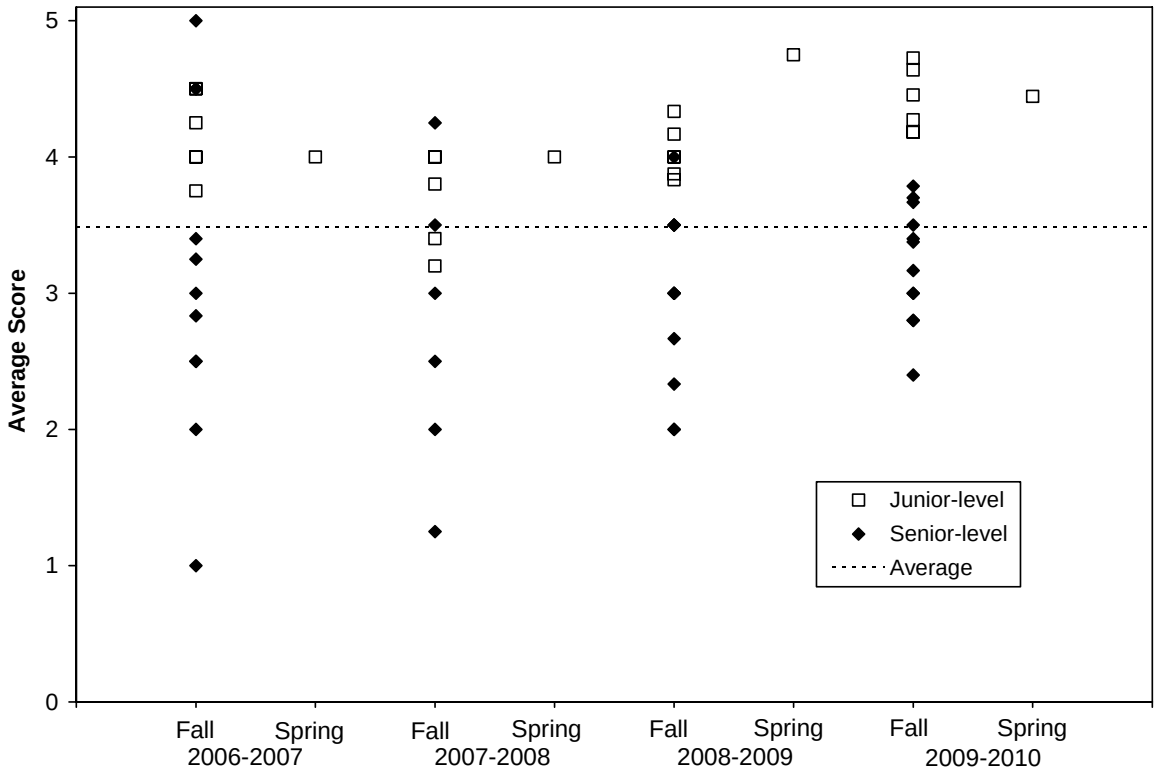

Figure 1. Assessment Results for Written Laboratory Reports.

4.2 Recent Results of Assessment of Written and Oral Presentations

The results of the assessment of written and oral presentations during the last three years are summarized in Figures 2 and 3, respectively.

The average of the scores for written communication is 3.4. In MATL 4500, students are required to write different types of communications (*e.g.* letters, progress reports, proposals), so, as discussed above for laboratory reports, the quality of the first attempts at a particular type of document are sometimes low as the students learn to use different and more appropriate formats and properly address different audiences.

The average for oral presentations (3.8) is higher than that for written communication. Students are generally capable of preparing and delivering oral presentations.

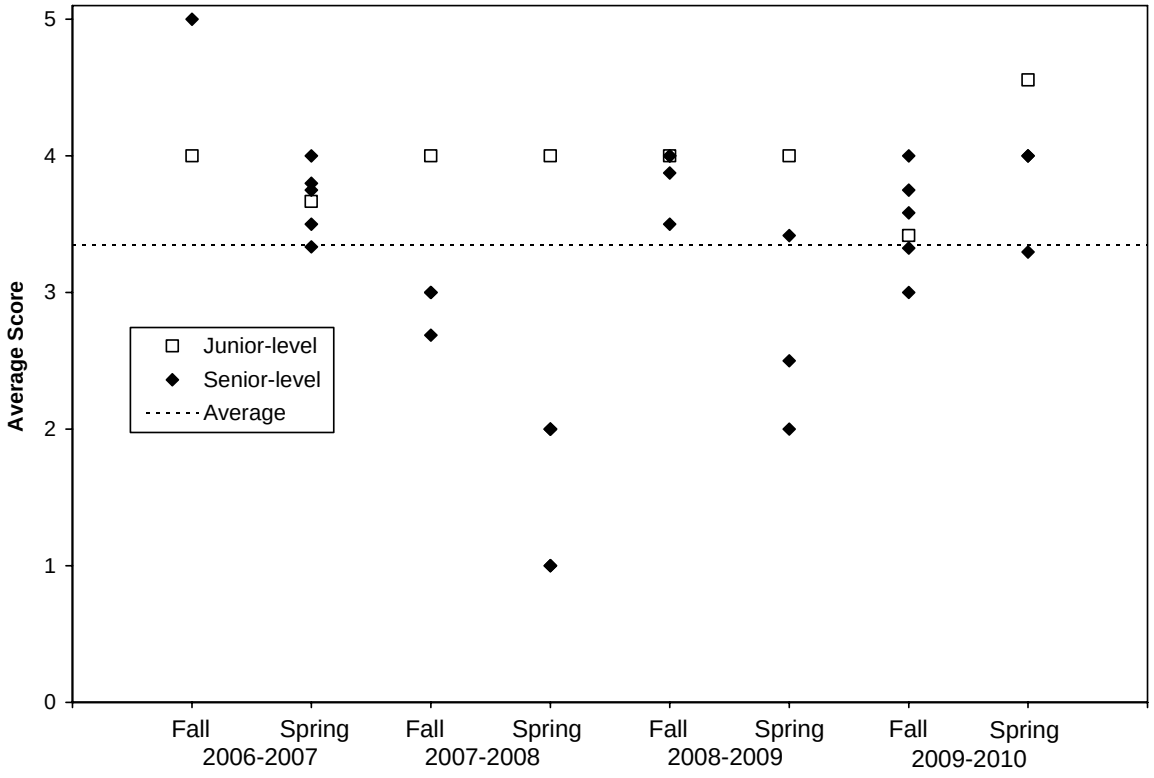

Figure 2. Assessment Results for Written Communication.

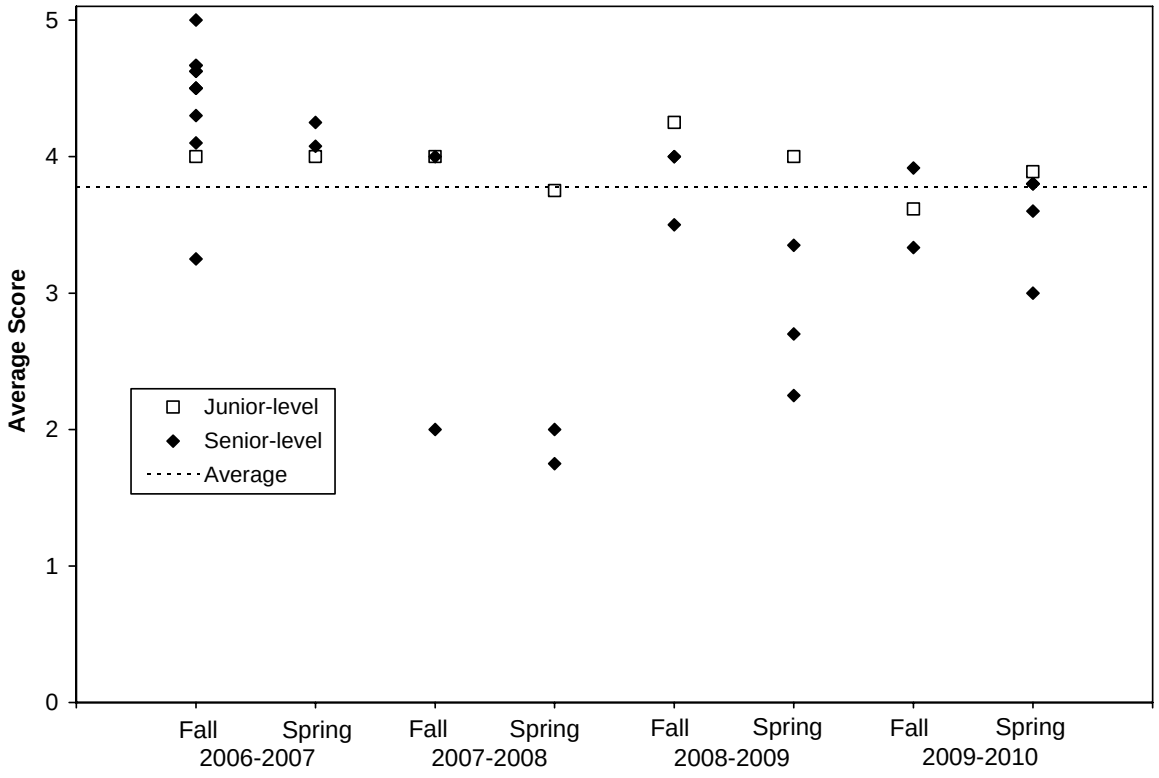

Figure 3. Assessment Results for Oral Communication.

4.3 Plan for the Future Based upon the Assessment Results

The assessment results for the last four academic years indicate that although Materials Engineering students graduate as effective communicators, senior students unfortunately tend to perform at a lower level than junior students -- particularly for written laboratory reports as shown in Figure 1 above. This result was discussed by the Materials Engineering faculty and the faculty believes that the principal difference is due to higher expectations of the senior students for the writing assignments. In junior level courses students are generally provided with detailed written instructions for the assignments while in senior courses students are generally provided with detailed oral instructions. In the future faculty members teaching the senior level courses intend to provide additional instruction on critical listening skills so that senior students will perform at a higher level when completing the written assignments.

In addition, the faculty believes that lessons learned in the undergraduate courses can be utilized in the graduate program in Materials Engineering to enhance the writing experience and performance of our graduate students. English is the second language of many of our graduate students, so considerable discussion and planning will be required for this initiative to be successful. Appropriate objectives, assignments, assessment tools and potential assistance from the Writing Program will be considered during the next year.

APPENDIX A

ABET Requirements Correlated with AU Materials Engineering Educational Outcomes

Correlation Between ABET and AU Educational Outcomes	
Criterion 3 Requirements a-k	AU Materials Engineering Outcomes 1-5
(a) an ability to apply knowledge of mathematics, science and engineering	1. An ability to *apply and integrate science and engineering principles* to solving engineering problems related to the structure, properties, processing and performance of materials systems.
(b) an ability to design and conduct experiments, as well as to analyze and interpret data	2. An ability to *utilize analytical experimental, statistical* and computational methods in the practice of materials engineering.
(c) an ability to design a system, component, or process to meet desired needs	1. An ability to apply and integrate science and engineering principles to *solving engineering problems related to the structure, properties, processing and performance of materials systems.*
(d) an ability to function on multidisciplinary teams	3. Proficiency in written and oral communication and working as part of a *multi-disciplinary team.*
(e) an ability to identify, formulate, and solve engineering problems	1. An ability to apply and integrate science and engineering principles to *solving engineering problems* related to the structure, properties, processing and performance of materials systems.
(f) an understanding of professional and ethical responsibility	4. An appreciation for and understanding of contemporary issues, the impact of engineering solutions on societal problems and the *ethical responsibilities of engineers*
(g) an ability to communicate effectively	3. Proficiency in *written and oral communication* and working as part of a multi-disciplinary team.
(h) the broad education necessary to understand the impact of engineering solutions in a global and societal context	4. An appreciation for and understanding of contemporary issues, the impact of engineering solutions on *societal problems* and the ethical responsibilities of engineers.
(i) a recognition of the need for, and an ability to engage in life-long learning	5. An appreciation of and ability for *lifelong learning* and professional development.
(j) a knowledge of contemporary issues	4. An appreciation for and understanding of *contemporary issues*, the impact of engineering solutions on societal problems and the ethical responsibilities of engineers.
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	2. An ability to utilize analytical experimental, statistical and *computational methods* in the practice of materials engineering.

APPENDIX B

Materials Engineering Curriculum

Curriculum

Materials Engineering

Semester	Course (Department, Number, Title)	Category (Credit Hours)			
		Math & Basic Sciences	Engineering Topics *Check if Contains Significant Design (✓)*	General Education	Other
Fall Freshman	CHEM 1030: Fundamentals of Chemistry I	3	( )		
	CHEM 1031: Fundamentals of Chemistry I – Lab	1	( )		
	MATH 1610: Calculus I	4	( )		
	COMP 1200: Intro. to Computer Programming		2 ( )		
	ENGL 1100: English Composition I		( )	3	
	ENGR 1100: Engineering Orientation		0 ( )		
	Core History		( )	3	
Spring Freshman	PHYS 1600: Engineering Physics I	4	( )		
	MATH 1620: Calculus II	4	( )		
	ENGL 1120: English Composition II		( )	3	
	ENGR 1110 Intro. to Engineering		2 (✓)		
	History		( )	3	
Fall Sophomore	CHEM 1040: Fundamentals of Chemistry II	3	( )		
	CHEM 1040: Fundamentals of Chemistry II – Lab	1	( )		
	ENGR 2050: Engineering Mechanics Statics		3 ( )		
	MATH 2630: Calculus III	4	( )		
	PHIL 1020: Intro. to Ethics		( )	3	
	ECON 2020: Principles of Microeconomics		( )	3	

Curriculum (continued)

Materials Engineering

Semester	Course (Department, Number, Title)	Category (Credit Hours)			
		Math & Basic Sciences	Engineering Topics *Check if Contains Significant Design (✓)*	General Education	Other
Spring Sophomore	MATH 2650: Linear Differential Equations	3	( )		
	STAT 3010: Statistics for Engineers and Scientists	3			
	ENGR 2070: Mechanics of Materials		3 ( )		
	PHYS 1610: Engineering Physics II	4	( )		
	MATL 2100: Intro. to Materials Science	2	1 ( )		
Fall Junior	MATL 3100: Engineering Materials – Metals		3 ( )		
	MATL 3101: Metallography Lab.		1 ( )		
	MATL 3300: Engineering Materials – Ceramics		3 ( )		
	ELEC 3810: Fund. Electrical Engineering		3 ( )		
	MATH 2660: Linear Algebra	3	( )		
	Social Science Elective		( )	3	
Spring Junior	MATL 3200: Engineering Materials – Polymers		3 ( )		
	MATL 3201: Polymer and Composite Materials Lab.		1 ( )		
	ENGR 2200: Intro. to Thermodynamics, Fluids and Heat		3 ( )		
	ENGL 2200: World Literature I		( )	3	
	Technical Elective I		( )		3
	Fine Arts Elective		( )	3	

Curriculum (continued)

Materials Engineering

Semester	Course (Department, Number, Title)	Category (Credit Hours)			
		Math & Basic Sciences	Engineering Topics *Check if Contains Significant Design (✓)*	General Education	Other
Fall Senior	MATL 4500: Materials Properties and Selection		4 (✓)		
	MATL 5100: Thermodynamics of Materials Systems		3 ( )		
	MATL 5200: Crystallography		2 ( )		
	MATL 5201: X-Ray Diffraction Lab.		1 ( )		
	Technical Elective II		( )		3
	ENGL 2210: World Literature II		( )	3	
Spring Senior	MATL 4980: Senior Design Project		3 (✓)		
	MATL 5300: Phase Transformation in Materials Processing		3 ( )		
	MATL 5400: Physics of Solids		3 ( )		
	MATL 5500: Numerical Simulation of Materials Processing		3 ( )		
	Technical Elective III		( )		3
TOTALS-ABET BASIC-LEVEL REQUIREMENTS		39*	51*	30	9*
OVERALL TOTAL FOR DEGREE	128 hrs				
PERCENT OF TOTAL		30%	39%	23%	7%
Totals must satisfy one set	Minimum semester credit hours	32 hrs	48 hrs		
	Minimum percentage	25%	37.5 %		

* Technical elective can be courses in mathematics, science and/or engineering, but the distribution between "Math & Basic Sciences" and "Engineering Topics" depends on the particular cross-disciplinary sequence selected by the student. Thus, the "Math & Basic Sciences" and "Engineering Topics" are minimum one or both will be higher for all students.

APPENDIX C

Writing-Relevant Course Syllabi

MATL 3101: Metallography Laboratory

Credit: 1 hour laboratory
Contact Time: One 3-hour laboratory session per week
Co-requisite: MATL 3100
Required for MATL students

Course Description: The use of microstructural characterization to understand the relationship between microstructure and properties of metallic materials.

I. Course Content / Objectives

1. Objectives

The aim of this course is to familiarize students with the microstructural characterization of metals and alloys by means of light microscopy.

2. Tentative Schedule and Outline

Date	Report	Laboratory
Aug 18	1	Lab Safety & Tensile Testing of Ferrous Alloys: Gray Iron and Ductile Iron
Aug 25	1	Tensile Testing of Aluminum Alloys: 2024, 6061, 7075 (start metallography)
Sept 1	1	Metallography of Tensile Bars
Sept 8	2	Copper Work Hardening and Annealing
Sept 15	2	Copper Work Hardening and Annealing: Metallography
Sept 22	3	Phase Diagram Determination: Pb-Sn Alloys
Sep 29	3	Quantitative Metallography: Pb-Sn Alloys
Oct 6	4	Solution Heat Treating and Aging of 2024 Aluminum Alloys
Oct 13	4	Solution Heat Treating and Aging of 2024 Aluminum Alloys (continued)
Oct 20	5	Hardening of Steels: Jominy End Quench Testing of 4340, 4140, 1045
Oct 27	5	Hardening of Steels: Metallography
Nov 3	6	Carburization/decarburization of Steel
Nov 10	6	Carburization/decarburization of Steel: Microhardness and Metallography
Nov 17	7	Fracture: Charpy Impact Testing
Nov 24	--	Thanksgiving Break -- NO LAB
Dec 1	7	Introduction to SEM: Examination of fracture surfaces

3. Textbook

Useful supplemental info: "A Laboratory Manual of Metals and Alloys," by S.M. Ashraf, Sharif Ahmad and Ufana Riaz; IK International Publishing House, 2009, ISBN 978-81-907462-4-3

4. Contribution to Professional Component

In addition to providing students with an understanding of the relationships among processing, microstructure, and properties of metallic materials, this course also reinforces the students' understanding of engineering as a creative profession (from MATL 3100) that requires trade-offs and compromises among the constraints faced by materials engineers (strength vs. ductility, manufacturing process costs vs. component property needs, theoretical properties vs. the influence of manufacturing defects, impurities, etc.) .

5. Relationship to Program Outcomes

1. This course develops an ability to apply and integrate science and engineering principles to solving hands-on engineering problems related to the structure, properties, processing and performance of materials systems involving metals, by focusing on the relationships among processing, microstructure, properties and engineering applications of metallic materials. The student is required to demonstrate the ability to utilize experimental techniques of metallography in characterizing microstructures of a wide range of metals subjected to rolling, casting, heat treating, hardness testing, basic tensile testing, and Jominy end quench testing.
2. Additionally, this course also requires students to demonstate the ability to communicate their findings by submitting a number of formal written reports throughout the term. When the course has an adequate number of students, the final project is worked in teams and requires the student to integrate their work activities within the overall team activity.

II. Grading and Evaluation

1. Course Requirements and Grading System

(1) There are no exams in MATL 3101 since this is a laboratory course. Your assignments will consist of a series of laboratory exercises that will result in 7 formal, written lab reports.

(2) Course grades will be evaluated based upon (1) technical content and (2) effectiveness of the presentation in the submitted written reports. The maximum individual report grades will be assessed first on technical content as follows:

A - Report draws appropriate conclusions (based upon the experimental results) using (1) theory presented in class and the textbook, and (2) information gathered outside of class AND

B - Report explains results correctly (even unexpected results) using (1) theory from class and the textbook and (2) outside materials, etc., AND

C - Report effectively presents appropriate information and data with only minimal explanation and conclusions AND

D - Report contains required basic information and data AND

F - Report contains required sections

"Presentation" includes (but is not limited to) technical quality of the data (micrographs, metallurgical data, etc.), incorrect grammar and/or poor utilization of the English language, unprofessional style of writing, lack of clarity, unprofessional report format (appearance, figures, tables, etc), etc. The laboratory report grade as determined by the technical content may be reduced by 1 OR MORE letter grades due to a poor and ineffective presentation.

(3) Collaboration in the laboratory between and among students is encouraged. However, each written report must represent each individual student's own written work. The thoughts and written expression must be your intellectual work product. When a situation calls for using another student's work in your written document (e.g., a picture taken by someone else, metallurgical test data taken by someone else or taken collectively as a group, etc.) then that must be clearly referenced in your written report by at least a specific and detailed listing of "who contributed what" in the Appendix of the report. Academic dishonesty is an offense that will be reported to the Academic Honesty Committee per the Tiger Cub.

(4) Laboratory reports will be written for each numbered sequence of coordinated lab exercises.

(5) Reports are due at the beginning of the next scheduled laboratory activity. Late reports will NOT be accepted and will receive a grade of zero.

Syllabus revised by R.A. Overfelt (19 August 2009)

MATL 3201: Polymers and Composite Materials Laboratory

Credit: 1 hour laboratory
Contact Time: One 3-hour laboratory sessions per week
Corequisite: MATL 3200
Required for MATL students

Course Description: A hands-on lab course on the synthesis, processing, structure, and properties of polymers and polymer matrix composites.

I. Course Content/Objectives

1. Objectives

Provide the student with opportunities to synthesize, process, and characterize polymers and composites. Also provide the student with the ability to analyze engineering problems related to fabrication and properties of these two classes of materials.

2. Tentative Schedule and Outline (indicate weeks/laboratories/lectures for each topic)

Introduction to lab safety and polymer synthesis ..... week 1
Polymer Synthesis..... week 2~3
Polymer and Composition Processing ..... week 4~9
- Extrusion Molding
- Compression Molding
- Injection Molding
- Solution Casting (2 weeks)
- Mechanical Stretching

Polymer Characterization..... week 10~14
- Tensile Test
- Observation of the Morphology of Crystalline Polymer (2 weeks)
- DSC Study of Polymers (2 weeks)

Final Presentation ..... 1 week

3. Textbook

None

4. Contribution to Professional Component

a. College level mathematics and basic science: Statistics, Thermodynamics
b. Engineering topics – Engineering Science and engineering design: Materials process, Materials property characterization, Structure – properties relationship

5. Relationship to Program Outcomes

1. An ability to apply and integrate science and engineering principles to solving engineering problems: Polymer and composite process, Property and structure characterization, Effect of materials properties on process.
2. An ability to utilize analytical experimental, statistical and computational methods in the practice of materials engineering: Statistics in measurement, Characterization of mechanical property and structure as well as thermal properties,
3. Proficiency in written and oral communication: Team work, oral presentation.

II. Grading and Evaluation

1. Course requirements (papers, exams....)

Weekly lab reports and final presentation

2. Grading system

Lab reports 80%
Final presentation..... 20%

Syllabus revised by J.W. Hong (19 August 2009)

MATL 3300: Engineered Materials – Ceramics

Credit: 3 hours lecture
Contact Time: Three 50-minute lectures per week
Prerequisite: MATL 2100
Required for MATL students

Course Description: An introduction to the engineering of ceramic materials. Structural-property relationships of crystalline and glassy ceramics will be included.

I. Course Content/Objectives

1. Objectives

Provide the student with an understanding of the structure property relationships, processing and applications of ceramic materials.

2. Tentative Schedule and Outline (indicate weeks/lectures for each topic)

Introduction .....1 class
Crystalline and Amorphous Structure of Ceramics ..... 5 classes
Phase Diagrams ..... 5 classes
Ceramic Fabrication..... 6 classes
- Raw material production
- Forming
- Powder Processing
- Sintering

Properties ..... 9 classes
- Mechanical
- Dielectric / Ferroelectric
- Piezoelectric
- Magnetic

Control of Properties..... 7 classes
Applications ..... 9 classes
- Structural
- Electronic
- Chemical
- Biological

Exams ..... 3 classes

3. Reference books

C. B. Carter and M. G. Norton, *Ceramic Materials: Science and Engineering* (Springer, 2007)
Y.M. Chiang, D. Birnie and W.D. Kingery, *Physical Ceramics: Principles for Ceramic Science and Engineering* (Wiley, 1997).
M. W. Barsoum, *Fundamentals of Ceramics* (Institute of Physics Publishing, 2002).

4. Contribution to Professional Component

- Students apply their basic knowledge of ceramic material properties to changes in material behavior due to manufacturing processes.
- Students will learn to engineer the ceramic material for the process and for the final applications.

5. Relationship to Program Outcomes

Upon successful completion of the course, the student will be able to:

- Apply mathematics, basic science and engineering concepts to materials engineering
- Identify, formulate, and solve engineering problems, and particularly to conceptualize objectives and constraints, identify governing principles, apply fundamental analytical tools, and predict.
- Communicate technical material effectively, both in written and oral formats.
- Understand the implications associated with ethical conduct in science and engineering formats.
- Be familiar with current and emerging engineering materials technologies formats.

II. Grading and Evaluation

1. Course requirements (papers, exams....)

Homework assignments (approximately weekly)
Presentations on general and student-selected topics
Three exams during regular class
Final exam

2. Grading system

Homework 10%
Presentations (Written and Oral) 20%
Hourly exams 40%
Final exam 30%

Syllabus prepared by Dong-Joo Kim (15 August 2009)

MATL 4500: Materials Properties and Selection

Credit: 4 hours (3 hours lecture, 1 hours laboratory)
Contact Time: Two 75-minute and one 3-hour per week
Prerequisites: MATL 3100 and MATL 3200
Required for MATL students

Course Description: Methods for microstructure control. Design of processing sequences, statistical and economic analysis.

I. Course Content/Objectives

1. Objectives
Provide the student with laboratory testing procedures, thermo-mechanical treatments to control microstructure and hence properties, fundamental statistics for quality assurance and preparation of budgets for cost proposals.

2. Tentative Schedule and Outline (indicate weeks/lectures for each topic)
Group oral presentations ..... 1 week
Laboratory testing procedures ..... 6 weeks
Tensile testing, hardness testing, compression testing, microhardness testing, fatigue testing, impact testing, Jominy end quench test, ultrasonic testing, quantitative metallography, dye penetrant testing, ASTM/SAE/AISI procedures, computer data acquisition, infrared thermography
Fabrication procedures ..... 4 weeks
Thermocouple fabrication and measurement, cold and hot working, machining, shearing, injection molding, induction heating, vacuum furnaces and processing, brazing and welding, surface cleaning
Statistics ..... 1 week
Student T test, least squares analysis, 1, 2, 3 sigma limits, batch processing statistics
Professional Ethics ..... 1 week
Cost Accounting ..... 2 weeks
Project management, budget preparation, economic analysis, replacement cost, analysis, scientific and managerial reporting

<u>Laboratory Schedule</u>
Mechanical Testing ..... 3 weeks
Metallography ..... 2 weeks
Non-destructive Evaluation ..... 1 week
Casting / Molding ..... 2 weeks
Hot Working / Cold Working ..... 2 weeks
Heat Treatment ..... 2 weeks
Joining of Materials ..... 2 weeks

3. Textbook
None

4. Contribution to Professional Component

Students in this course are required to prepare a proposal to supply multiple materials (polymers and metals) that will meet specified requirements of a government organization. This learning exercise involves an infinite number of solutions. The students must develop and demonstrate life long learning skills, address economic production issues, evaluate manufacturability of the materials, establish and adhere to schedules (GANT Charts), and address sociological, health and safety concerns during the manufacture of materials. The students are required to present their work in form of engineering recommendations, both orally and in written form. The students in this course are required to design several processes to obtain different specified properties of the material. Students submit weekly team reports describing their progress.

5. Relationship to Program Outcomes
MTL 4500 exercises and evaluates the student's ability to
1) apply and integrate science and engineering principles to solve engineering problems related to structure, properties, process and performance of Materials Systems (reverse engineering to identify unknown alloys and polymers, proposal to produce materials)
2) ability to utilize analytical, experimental, statistical and computational methods in the practice of engineering (hardness and strain gauge measurements labs)
3) proficiency in written and oral communication and working as part of a multi-disciplinary team (proposal presentations and reports, weekly team reports)
4) appreciation of and ability for life long learning and professional development (students required to research and make recommendations on tolerances for straightness, welding method, drilling and machining speeds that have never been addressed in formal classes, must perform a life long learning project, example anodizing of aluminum to specified colors)
5) appreciation for and understanding of contemporary issues and impact on society (students are given an oral examination by faculty and practicing engineers that examine the ethical, social and environmental professionalism of the students).

II. Grading and Evaluation

1. Course requirements (papers, exam...)
Weekly written progress reports (10), Oral Midterm Progress Team Report (1), Final Oral Team Report (1), Final Exam (1)

2. Grading system

Progress Reports	30%
Midterm	20%
Final Oral Presentation	20%
Final Exam	30%

Syllabus prepared by B.A. Chin (Updated 18August 2009)

MATL 4980: Senior Design Project

Credit: 3 hours (1 hour lecture, 2 hours laboratory)
Contact Time: One 50-minute and two 2-hour sessions per week
Prerequisite: MATL 4500
Required for MATL students

Course Description: Students select, design, schedule, fabricate and perform an engineering design project related to materials engineering.

I. Course Content/Objectives

1. Objectives

This project requires the student to use the knowledge accumulated in all fields of science and engineering to design a solution to a specific problem. The student will design a project, execute experiments, analyze and interpret the results and make a final and written report.

2. Tentative Schedule and Outline (indicate weeks/lectures for each topic)

Oral Presentations ..... 3 lectures
Design Methodology ..... 1 lecture
Project Scheduling and Management ..... 2 lectures
Weekly Reporting and Presentations ..... 1 lecture
Quality Assurance ..... 2 lectures
Failure Analysis ..... 3 lectures
Professional Ethics ..... 3 lectures

Laboratory Schedule will vary from project to project. The following is an example laboratory schedule:

Establish design objectives ..... 1 week
Establish preliminary design ..... 1 week
Research / order materials ..... 1 week
Build device / testing apparatus ..... 3 weeks
Test design ..... 3 weeks
Modify design ..... 2 weeks
Test modified design ..... 2 weeks
Prepare for presentation ..... 1 week

3. Textbook
None

4. Contribution to Professional Component

Students in this course are split into mock defense and complainant teams to perform failure analysis on a part that led to loss of life. The students depose mock witnesses, gather evidence from the accident scene, analyze failed parts, and perform engineering modeling/analyses to determine the probable cause of failure leading to the accident. The students present their findings in a mock trial with a jury made up of other students/staff. This course also includes the capstone design project where the students as a team are required to design a product, manufacture that product, package the product for marketing, perform an economic cost report and estimate sales and profit if the product was placed into production at different levels. Recent student projects have included the design and manufacture of aluminum pens and polymer barrel pens. The students must develop and demonstrate life long learning skills, address economic production issues, evaluate manufacturability of the materials, establish and adhere to schedules (GANT Charts), and address sociological, health and safety concerns during the manufacture of materials. The students are required to present their work in form of engineering recommendations, both orally and in written form to an external practicing engineer. Students submit weekly team reports describing their progress.

5. Relationship to Program Outcomes
MTL 4900 exercises and evaluates the student's ability to
1) apply and integrate science and engineering principles to solve engineering problems related to structure, properties, process and performance of Materials Systems (failure analysis case and capstone design and manufacturing project)
2) ability to utilize analytical, experimental, statistical and computational methods in the practice of engineering (capstone design and manufacturing experiment)
3) proficiency in written and oral communication and working as part of a multi-disciplinary team (proposal presentations and reports, weekly team reports)
4) appreciation of and ability for life long learning and professional development (students required to design, research and make recommendations on manufacturing of a product)
5) appreciation for and understanding of contemporary issues and impact on society (students are required to address the ethical, social and environmental issues of manufacturing their capstone design project).

II. Grading and Evaluation
1. Course requirements (papers, exam...)
Three Oral Presentations and Written Reports
Written weekly reports
Final Oral Presentation and Written Report
2. Grading system
Oral/Written Reports..... 45%
Weekly Written Reports 10%
Final Oral and Written Report 45%

Syllabus Prepared by B.A. Chin (Updated 18 August 2009)

MATL 5201: X-Ray Diffraction Laboratory

Credit: 1 hour laboratory
Contact Time: One 3-hour laboratory session per week
Corequisite: MATL 5200
Required for MATL students

Course Description: Laboratory on the use of x-ray diffraction for materials characterization.

I. Course Content / Objectives

1. Objectives

The aim of this course is to provide practical with x-ray diffraction. The course is to be taken with MATL 5200, which will cover the relevant concepts and theory.

2. Tentative Schedule and Outline

Laboratories

Phase Identification	2 weeks
Determination of Amount of Phases	2 weeks
SEM/Energy Dispersive X-Ray Analysis	1 week
Lattice Parameter Determination	2 weeks
Peak Intensity Analysis	3 weeks
Peak Width Analysis	2 weeks
Debye Sherrer	1 week
Laue Diffraction	1 week

3. Textbook

M. De Graef and M.E. McHenry, *Structure of Materials: An Introduction to Crystallography, Diffraction and Symmetry* (Cambridge University Press, Cambridge, UK, 2007) ISBN 978-0-521-65151-6

4. Contribution to Professional Component

As a laboratory, the course will develop the student's experimental and analytical skills.

5. Relationship to Program Outcomes

The outcomes addressed are the ability to apply the theoretical concepts from the lecture course (MATL 5200), utilize analytical experimental methods and a proficiency in written communication.

II. Grading and Evaluation

1. Course Requirements and Grading System

Laboratory Reports 100%

Syllabus Prepared by J.W. Fergus (01 March 2010)

APPENDIX D

Writing-Relevant Assessment Forms

1. Evaluation of Written Presentations

Student:_____ **Evaluator:**_____

Course: _____ **Date:** _____

Description of Assignment:_____

The document …				
1	2	3	4	5
incompletely conveys the intended information	conveys the intended information, but with difficulty for the reader	clearly conveys the intended information, but the writing is dull or awkward	conveys the intended information in an interesting and effective manner	conveys the intended information in an interesting and professional-quality manner

Comment on any of the following aspects that were notably good or bad. You need not comment on all aspects. Please provide comments on other aspects in the black spaces.		
Negative Comments	Aspect	Positive Comments
	Organization	
	Clarity	
	Use of graphics	
	Grammar and engineering conventions	
	Appropriateness to target audience	
	Quality of conclusions / recommendations	
	Presentation of engineering tradeoffs	

2. Evaluation of Oral Presentations

Student:_____ **Evaluator:**_____

Course: _____ **Date:** _____

Description of Assignment:_____

The student …				
1	2	3	4	5
incompletely conveyed the intended information	conveyed the intended information, but with difficulty for the audience	clearly conveyed the intended information, but the presentation was dull or awkward	conveyed the intended information in an interesting and effective manner	conveyed the intended information in an interesting and professional-quality manner

Comment on any of the following aspects that were notably good or bad. You need not comment on all aspects. Please provide comments on other aspects in the black spaces.		
Negative Comments	Aspect	Positive Comments
	Relevance of topic / Appropriateness to target audience	
	Clarity	
	Organization	
	Quality / use of audiovisual material	
	Followed accepted engineering conventions (units, scale bars *etc.*)	
	Use of allotted time	
	Response to questions	

3. Evaluation of Laboratory Reports

Student:_____ **Evaluator:**_____

Course: _____ **Date:** _____

Description of Assignment:_____

The report…				
1	2	3	4	5
contains all required sections	contains all required information and data	Effectively presents appropriate information with only minimal explanation	correctly explains all results (including unexpected results) based on theory from class	draws appropriate conclusions based on results, theory from class and information not presented in class

Comment on any of the following aspects that were notably good or bad. You need not comment on all aspects. Please provide comments on other aspects in the black spaces.		
Negative Comments	Aspect	Positive Comments
	Organization	
	Clarity / grammar / use of engineering standards	
	Data presentation	
	Data analysis	
	Statistical analysis	
	Conclusions	

APPENDIX E

Principles of Writing for All Majors

Principles of Writing for All Majors

Introduction:

The goal of implementing writing in the majors is to provide students with instruction in, and opportunities to practice, the kinds of writing most relevant to their field of study and future careers, and to have these experiences under the direction of faculty members who are experts in that major. Recognizing that no single plan will fit the needs of all departments, the University Writing Committee will review plans devised by departments to ensure that all plans satisfy the five principles identified below. Though not required, the Committee has also identified common practices that might serve to guide the development, implementation and assessment of programmatic plans. Rather than standardize the submission documents, we ask that plans be presented in a format that makes sense to the department, that they provide a clear explanation of where the principles occur across the major, and that the assessment procedures are clearly connected to the kinds of writing outcomes the department articulates for their majors.

Criteria for evaluating writing in the majors:

The plan will:

1. Provide more than one opportunity for students to practice writing. While a program might want to designate a specific course or courses as "writing intensive," it is equally possible to weave opportunities to write throughout the curriculum so that no one course or faculty member shoulders the burden of teaching writing to all majors. The Writing Committee does NOT expect that every class will contain significant writing experiences.
2. Provide opportunities for students to practice producing more than one kind of writing. Programs should identify the types of writing that are a) most useful to students during the major, b) necessary to advanced study in the major, or c) expected in the professions students with the major typically enter. The opportunities provided might include using print and electronic forms as appropriate. Examples of types of writing to consider include: letters, memos, formal reports, research articles, field reports, annotations, summaries, reading responses, interviews, essays of critical analysis, position statements, design plans, research or design posters, original video scripts, websites, etc.
3. Provide opportunities for students to write for different purposes and audiences. Programs are encouraged to consider the range of purposes and audiences that their students need to address and to include opportunities for students to practice writing. Examples of different purposes and audiences include: to learn, to think critically, to inquire, to provide useful feedback to other writers, to communicate with clients outside the classroom, to reflect, to take a stance, to develop an argument, to present disciplinary research for a lay audience or for experts in the field, etc.
4. Provide opportunities for students to revise their written work based on individual feedback from the instructor and from peers to improve both the content and form of their work. Revision can take many forms and occur at different points in the writing process. Programs are encouraged to consider the most appropriate ways to include feedback and revision opportunities that support both writing and other curricular objectives. For example, feedback on early assignments helps students revise their approach to later assignments of the same type, feedback from peer responders allows students to revise before the instructor sees the

writing, feedback on component parts of a long assignment allows students to revise before submitting the compiled document, feedback on a draft allows students to revise to incorporate suggestions, feedback on finished work can encourage revisions that shift the audience or extend and deepen the project, etc.

5. Include an assessment plan that uses the data obtained to make decisions about what else needs to be done to enhance the writing experiences of students in the major. How programs assess their plan depends on what aspects of the student writing experience the faculty has decided to work on. Programs might select a specific issue to focus on such as: expanding types of writing, distributing writing over more courses, improving feedback and revision, incorporating extra-curricular writing components, improving peer responses, etc.

Common Program-level Practices

- Identify the writing competencies expected of graduates of the major.
- Engage faculty members in developing a plan for providing opportunities for students to practice and produce multiple kinds of writing for different purposes and receive feedback that allows students to work on their writing in courses across the major.
- Identify and provide additional instruction to students whose writing is judged to be unacceptable in terms of standard written English.
- Assess the plan and use the data obtained to make decisions about what else needs to be done to enhance the writing experiences of students in the major.

Common Course-level/Faculty-level Practices

- Develop writing assignments or activities appropriate to the level and content of the course using print and electronic forms appropriate for the major.
- Provide appropriate instruction in the features of writing necessary for the students to complete the writing assignments.
- Provide students with peer and individual feedback, including feedback for all students writing collaboratively as part of a group, ensuring that the feedback reflects the goals of the writing assignment.
- Provide opportunities for students to revise their work after receiving feedback.
- Identify and provide additional instruction (perhaps by referring the student to the writing center) for those students who do not produce reasonably fluent, standard written English.

Common Student-level Practices

- Build on writing experiences from core courses to produce writing relevant to the major
- Be able to produce more than one kind of writing, for different purposes, using appropriate print and electronic forms.
- Be able to use feedback from the instructors and peers to revise writing to improve both content and form.
- Be able to produce writing that others will judge to be acceptable in terms of standard written English and that responds appropriately to the rhetorical situation (audience, purpose, genre, format, material).

- Has strategies for working on writing, e.g. is able to use feedback from others to make decisions about revising a piece of writing, is able to shift to different audiences or formats, is able to manage technical issues like citation of sources, inclusion of visual materials, or proofreading, etc.