

Appendix E - Continuous Improvement System (CIS) documents

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Items not present in Appendix E but available in hard copy form at the time of review are

- Archival Records
- Score Cards
- Outcome Summaries
- A panoply of Grand Summary renderings including
 - Graphical Summary of each outcome over time
 - Graphical Summary of all outcomes for each year
 - Two-year Averaged Grand Summary

All of this information is also continuously available to program faculty via the CIS web site.

Part I

Metrics for Program Outcomes (a-k)

Description:

The following metrics are used to assess the program outcomes (a) – (k). Each outcome instrument is scored with a 1, 3, or a 5. The (a-k) descriptors for each metric are truncated on each table and serve only as a reminder of each outcome’s focus.

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Table E-I.1: Metric for Assessing Outcome (a)

Metric Title (a) Apply Knowledge of Math, Science, and Engineer			
Performance Criteria	Low Performance:1	Moderate Performance:3	Exemplary Performance:5
Proficient in Fundamental Concepts and Skills	· No application of statistics to analysis of data	· Minor errors in statistical analysis of data	· Correctly analyzes data sets using statistical concepts
	· No use of math software	· Some use of math software	· Uses mathematical software
	· Calculations not performed or performed incorrectly by hand	· Minor errors in calculations by hand	· Executes calculations correctly By hand
	· Mathematical terms are interpreted incorrectly or not at all	· Most mathematical terms are interpreted correctly	· Translates academic theory into engineering applications and accepts limitations of mathematical models of physical reality
	· Does not understand the application of calculus and linear algebra in solving engineering problems	· Shows nearly complete understanding of applications of calculus and/or linear algebra in problem-solving	· Shows appropriate engineering interpretation of mathematical and scientific terms
Proficient in Theoretical and Practical Relationships	· Does not appear to grasp the connection between theory and the problem	· Some gaps in understanding the application of theory to the problem and expects theory to predict reality	· Translates academic theory into engineering applications and accepts limitations of mathematical models of physical reality
	· Does not understand the connection between mathematical models and chemical, physical, and/or in engineering systems	· Chooses a mathematical model or scientific principle that applies to an engineering problem, but has trouble in model development	· Combines mathematical &/or scientific principles to formulate chemical and physical models for relevant to engineering
Proficient in basic science	Student applies basic science concepts as minimal components of work or has major misconceptions.	Student applies concepts from basic science as significant components of work with few errors.	Student applies concepts from basic science as essential components of work with virtually no conceptual errors.

Table E-I.2: Metric for Assessing Outcome (b)

Metric Title (b) Desg/Cond Exps & Anal/Intrp Data and Info			
Performance Criteria	Low Performance:1	Moderate Performance:3	Exemplary Performance:5
Conducts the design of experiments.	Has not designed experiments.	Has shown some knowledge in the design of experiments.	Has demonstrated on a regular basis the skill of designing experiments.
Operates equipment and collects data for analysis.	Has not demonstrated an interest in learning how to operate experimental equipment.	Is interested in learning how to operate experimental equipment, but has not shown high proficiency.	Quickly developed expertise in using laboratory equipment.
Compares results for experimental measurements to the literature and conducts interpretation of results in written reports.	Has shown no interest in evaluating experimental data developed in the Metallurgy labs to that found in the literature.	Resists using experimental data developed in the Metallurgy labs to that found in the literature.	Makes a major effort to compare engineering result obtain in Metallurgy labs to that found in the literature.
Is able to collect global information and to use this information in evaluation and interpretation of laboratory data	Has poor library and literature searching skills and shows no interest in improving these skills.	As adequate library and literature searching skills. Has demonstrated these skills in written laboratory reports.	Has demonstrated exemplary skill at finding quality information from the global society on Metallurgy laboratory topics.

Table E-I.3: Metric for Assessing Outcome (c)

Metric Title (c) Design a system, component, or process			
Performance Criteria	Low Performance:1	Average:3	Exemplary Performance:5
Understand the engineering design process	Demonstrates weak understanding of engineering design and decision-making process.	Demonstrates basic comprehension of major aspects of engineering design in the conversion of resources.	Demonstrates advanced comprehension of engineering design process, including optimal conversion of resources for the benefit of the human race.
Formulate possible engineering solutions	Poorly articulated statement of engineering design problem; immature strategy for solution.	Reasonable statement of engineering design problem; designs acceptable strategy for solution.	Clearly states and articulates engineering design problem; designs efficient strategy for solution.
Master the iterative process in engineering design	Completes few or none of necessary iterations in decision-making process for solution.	Completes some of the necessary iterations in decision-making process to arrive at solution.	Completes all necessary iterations in decision-making process to arrive at solution.
Recognize and observe economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability constraints in engineering design	Fails to specify materials, uses them in ways that exceed their service properties, or pays little attention to constraints.	Partially or marginally specifies material properties, uses materials in ways that unnecessarily pushes their properties, or only partially considers constraints.	Exhaustively specifies materials, uses them in ways that clearly meet their properties, and pays close attention to optimizing within all engineering constraints.

Table E-I.4: Metric for Assessing Outcome (d)

Metric Title (d) Function Well on Teams			
Performance Criteria	Low Performance:1	Moderate Performance:3	Exemplary Performance:5
Responsible Participation	Is absent from team meetings or work sessions >50% of the time	Absent occasionally, but does not inconvenience group	Routinely present at team meetings or work sessions
	Routinely fails to prepare for meetings	Prepares somewhat for group meetings, but ideas are not clearly formulated	Is prepared for the group meeting with clearly formulated ideas
Interaction Skills	Claims work of group as own or frequently blames others	Makes subtle references to other's poor performance or sometimes does not identify contributions of other team members	Shares credit for success with others and accountability for team results
	Does not willingly assume team roles	Takes charge when not in the position to lead	Demonstrates the ability to assume a designated role in the group
	Is discourteous to other group members	Is not always considerate or courteous towards team members	Is a courteous group member
Assimilation and Receptiveness Skills	Does work on his/her own; does not value team work	Occasionally works as a loner or interacts to a minor extent with extra-disciplinary team members	Cooperates with others (outside of the discipline)
	Has no knowledge of disciplines outside of metallurgical engineering	Has some knowledge of other disciplines, but gets lost in discussions with extra-disciplinary team members	Has knowledge of technical skills, issues and approaches germane to disciplines outside of metallurgical engineering

Table E-I.5: Metric for Assessing Outcome (e)

Metric Title (e) Identify, Formulate, and Solve Engineering Pro			
Performance Criteria	Low Performance:1	Moderate Performance:3	Exemplary Performance:5
Identify	Does not see the connection between theory and practical problem solving	Connects theoretical concepts to practical problem-solving when prompted	Can relate theoretical concepts to practical problem solving
	Does not realize when major components of the problem are missing	Is missing some of the pieces of the whole problem	Demonstrates understanding of how various pieces of the problem relate to each other and the whole
Formulate	Is unable to predict or defend problem outcomes	Occasionally predicts and defends problem outcomes	Can predict and defend problem outcomes
	Demonstrates solutions implementing simple applications of one formula or equation with close analogies to class/lecture problems	Demonstrates solution with integration of diverse concepts or derivation of useful relationships involving ideas covered in course concepts; however, no alternative solutions are generated	Demonstrates creative synthesis of solution and creates new alternatives by combining knowledge and information
Solve	The answer is incorrect and not checked for its reasonableness	The answer is nearly correct, but properly labeled (within reasonable and logical range of the correct answer—it's in the "ballpark")	The answer is correct and properly labeled
	No attempt at checking the obviously incorrect solution no commentary	The solution is correct, but not checked in other ways	The solution is correct and checked in other ways when it can be; the interpretation is appropriate and makes sense

Table E-I.6: Metric for Assessing Outcome (f)

Metric Title (f) Know Professional and Ethical Responsibilities			
Performance Criteria	Low Performance:1	Moderate Performance:3	Exemplary Performance:5
Carries out responsibilities in a professional and ethical manner	Receives a poor rating by the faculty on the ethics and professional practice writing in assigned subjects	Receives a satisfactory rating by the faculty on the ethics and professional practice writing in assigned subjects	Receives an excellent rating by the faculty on the ethics and professional practice writing in assigned subjects
Understands basic engineering principles and practices, in terms of professional ethics and behavior	Demonstrate little understanding of, or concern for, professional ethics in written essay and during classroom discussions.	Demonstrate basic understanding of, or concern for, professional ethics in written essay and during classroom discussions.	Demonstrate sound understanding of, or concern for, professional ethics in written essay and during classroom discussions

Table E-I.7: Metric for Assessing Outcome (g)

Metric Title (g) Communicate Effectively			
Performance Criteria	Low Performance:1	Moderate Performance:3	Exemplary Performance:5
The content of the written or oral presentation is effective.	Demonstrates poor justification for the document, makes numerous errors, cannot focus on the subject, is not following the rules of writing or speech.	The audience can understand the content and context of the document or presentation, but the document or oral presentation is not well organized.	Well organized written or oral presentation. The presentation holds the attention of the audience. The presentation is prepared at the proper level for the intended peer group.
The organization of memorandum and technical reports is consistent with styles accepted by the person's primary professional engineering society.	No effort to conform technical writing style required by the instructor.	Make an effort to follow the rules of writing, position figure and table of captions, and placement of citations within a technical report.	The student is careful organizing and writing technical reports. All figure and table captions stand-alone from the report, and references are carefully cited throughout the document.
The design of slides shows an understanding of vision limitation of the audience and the total time the presenter plans to spend on the visual aid during oral presentations.	The simple rules for audio-visual presentation are not followed.	Some understand of the font size on slides and the amount of information being transmitted per slide is apparent.	Large readable font is used, only one thought or idea is presented on a slide, and comfortable easy to read presentation colors are used.

Table E-I.8: Metric for Assessing Outcome (h)

Metric Title (h) Know the impact of engineering solutions			
Performance Criteria	Low Performance:1	Moderate Performance:3	Exemplary Performance:5
Has the broad education necessary to understanding impact of engineering solutions in global and societal context	In the global and societal practice writing in assigned subjects, students show marginal ability of applying general education knowledge to engineering problems. Work addresses a problem that directly affects global or society issues	In the global and societal practice writing in assigned subjects, students show general ability of applying general education knowledge to engineering problems. Work addresses a problem that directly affects global or society issues	In the global and societal practice writing in assigned subjects, students show outstanding ability of applying general education knowledge to engineering problems. Work addresses a problem that directly affects global or society issues
Awareness of contemporary state of knowledge and relationship to engineering solutions	Little attempt is made to link work to current issues; work has little value except as a student exercise.	Literature review demonstrates adequate knowledge of the current state of the problem; work addresses useful information or insight into of contemporary issue.	Literature review demonstrates detailed knowledge of the current state of the problem; work addresses a question at the forefront of a contemporary issue.
Know the impact of engineering on global, economic, environmental, and societal issues.	Shows little understanding of the need to remain aware of changing societal and global conditions.	Demonstrate general understanding of the need to remain aware of changing societal and global conditions.	Demonstrate clear understanding of the need to remain aware of changing societal and global conditions.

Table E-I.9: Metric for Assessing Outcome (i)

Metric Title (i) Engage in Life-Long learning			
Performance Criteria	Low Performance:1	Moderate Performance:3	Exemplary Performance:5
Ability to adapt to changing technology.	Has only limited ability to adapt to new and changing technology.	Shows reasonable flexibility and ability to make use of new and changing technology	Shows great flexibility in updating skills and making use of new and changing technology
Understanding of the need to continually update one's skills and knowledge.	Shows little awareness of, or concern for, the necessity of updating skills and continuing to learn	Shows basic awareness of the necessity of updating skills, gaining new skills, and continuing to learn throughout life.	Shows clear awareness of the necessity of updating skills, gaining new skills, and continuing to learn throughout life.

Table E-I.10: Metric for Assessing Outcome (j)

Metric Title (j) Know Contemporary Issues			
Performance Criteria	Low Performance:1	Moderate Performance:3	Exemplary Performance:5
Ability to identify basic problems and contemporary issues in engineering.	Student fails to comprehend at least some major aspects of basic problems and issues.	Student demonstrates reasonable ability to understand problems and addressing issues.	Student shows clear ability to comprehend basic problems and flexibility in addressing challenges and issues.
Application of knowledge of contemporary issues to Metallurgical Engineering	Demonstrates little ability to apply knowledge of contemporary issues to Metallurgical Engineering problems in more than narrowly defined areas.	Demonstrates reasonable ability to apply knowledge of contemporary issues to Metallurgical Engineering problems in most important areas.	Demonstrates clear ability to apply knowledge of contemporary issues to Metallurgical Engineering problems in almost all-important areas.

Table E-I.11: Metric for Assessing Outcome (k)

Metric Title (k) Use Engineering Techniques, Skills, and Tools			
Performance Criteria	Low Performance:1	Moderate Performance:3	Exemplary Performance:5
Capable of using tools such as Excel, SolidWorks, MathCAD ---	Is not using computer-based and other resources. Demonstrates an unwillingness to develop computer or library skills.	Is using computer and library resources to the extent that are presented in class handouts. Is not exploring the global context of the subject matter being presented	Is able to research, apply and articulate information beyond the information presented in the textbook and class holdouts.
Proficient in operating equipment used in the laboratory program such as the MTS machine, rolling mill, hardness tester ---	Shows no interest in learning how to operate laboratory equipment. Has not used the Virtual Laboratory web site.	Make an effort to learn how to use laboratory equipment, but is willing to let another person take charge in the group.	Comes to class with current knowledge about the equipment, and has used the laboratory equipment Virtual Laboratory to develop first hand experience in regard to vocabulary and safety.
Understands the engineering design method and can apply this method in developing solutions to engineering problems.	Has not demonstrated the concept of need as it pertains to engineering design and economics.	Has shown some understanding as to why a part is designed or redesigned for the betterment of society.	Understands all the elements of design from the beginning statement of need to placing the product on the market.

Part II

Assessment Forms

Description:

Table E-II.1:	Score Card Input Form - Sample for Outcome (a)----- Each Outcome instrument is assessed using a Score Card Input Form that is filed with the instrument documents (student work, etc.). The data from these forms is compiled on an Outcome Summary.	E-15
Table E-II.2	Outcome Summary - Sample for Outcome (a) ----- All Score Card Summaries for one year are consolidated onto the Assessment Summary	E-16
Table E-II.3	Outcome Assessment Summary ----- Outcome Assessment Summaries are used to populate the Grand Summary data base from which the outcome assessment results are rendered into many useful graphical collections.	E-17
Table E-II.4:	Outcome Review Form ----- The results of each Outcome Review (for one year) are summarized on the longitudinal Outcome Review Summary form. The completed forms for outcomes (a)–(k) are shown in Part V below.	E-18
Table E-II.5:	Outcome Review Summary Form----- The completed forms for outcomes (a)–(k) are shown in Part V below.	E-19

Table E-II.1: Outcome Assessment Score Card Input Form (Sample for Outcome (a))

Outcome Score Card		(a)	(a) Apply knowledge of math, science, and engineering			
Instrument Acd. Year: _____ Description: (Course, etc.) _____ Instrument: (Final Exam , etc.) _____		Team / Student	Proficient in Fundamental Concepts and Skills	Proficient in Theoretical and Practical Relationships	Proficient in basic science	
<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <input type="checkbox"/> Check Here if Teams </div> <div style="border: 2px solid black; padding: 10px; text-align: center;"> <p>Enter only a 1, 3, or 5</p> <p>Leave blank any column that does not apply</p> <p>Designate every EnvEng student by entering the student's initials in Column D</p> </div>		EnvEng				
		1				
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		34				
		Reviewer's Initials: _____		35		
Date: _____		36				

Table E-II.2 Outcome Assessment Score Card (Sample for Outcome (a))

Outcome Summary				<i>(a) Apply knowledge of math, science, and engineering</i>		
		Average Summary	Max			
		# Assessments	Min			
		# Averages	Ave			
Instrument	Team / Student			Proficient in Fundamental Concepts and Skills	Proficient in Theoretical and Practical Relationships	Proficient in basic science
Inst_1 <input type="checkbox"/> Check if Teams						
MET 320 - Annually (Fall)		Student	1			
. Final Exam		Student	2			
		Method 1				
Review er's Initials		<input type="button" value="Add Student"/>	Max			
		<input type="button" value="Remove All"/>	Min			
			Average			
Inst_2 <input type="checkbox"/> Check if Teams						
MATH 373 - Annually (Fall/Spring)		Student	1			
. Project Reports		Student	2			
		Method 1				
Review er's Initials		<input type="button" value="Add Student"/>	Max			
		<input type="button" value="Remove All"/>	Min			
			Average			
Inst_3 <input type="checkbox"/> Check if Teams						
MET 422 - Even years (Fall)		Student	1			
. Final Exam		Student	2			
		Method 1				
Review er's Initials		<input type="button" value="Add Student"/>	Max			
		<input type="button" value="Remove All"/>	Min			
			Average			
Inst_4 <input type="checkbox"/> Check if Teams						
MET 310 - Even years (Spring)		Student	1			
. Selected Hour Exam		Student	2			
		Method 1				
Review er's Initials		<input type="button" value="Add Student"/>	Max			
		<input type="button" value="Remove All"/>	Min			
			Average			
Inst_5 <input type="checkbox"/> Check if Team						
Other Course Work		Student	1			
. From Campus Assess Comm.		Student	2			
		Method 1				
Review er's Initials		<input type="button" value="Add Student"/>	Max			
		<input type="button" value="Remove All"/>	Min			
			Average			
Inst_6 <input type="checkbox"/> Check if Team						
General		Student	1			
. FE Exam		Student	2			

Table E-II.3: Assessment Summary form

Assessment Metric Summary							
Calendar Year		2008					
Outcome	Description	Performance Objective 1	Performance Objective 2	Performance Objective 3	Performance Objective 4		
a						Instrument Average	
#Totals/#Aves						Max	
						Ave	
						Min	
b						Instrument Average	
#Totals/#Aves						Max	
						Ave	
						Min	
c						Instrument Average	
#Totals/#Aves						Max	
						Ave	
						Min	
d						Instrument Average	
#Totals/#Aves						Max	
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e						Instrument Average	
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#Totals/#Aves						Max	
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h						Instrument Average	
#Totals/#Aves						Max	
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						Min	
i						Instrument Average	
#Totals/#Aves						Max	
						Ave	
						Min	
j						Instrument Average	
#Totals/#Aves						Max	
						Ave	
						Min	
k						Instrument Average	
#Totals/#Aves						Max	
						Ave	
						Min	

Table E-II.4: Outcome Review Form

Outcome Review Form

Met Eng

Calendar Year: _____
Outcome: (a) Apply Knowledge of Math, Science, and Engineering _____
Reviewer: _____
Date: _____

Please complete the following table and indicate if 1) any instruments were missing or incomplete and 2) if you reassessed any instrument.

<u>Course</u>	<u>Instrument</u>	<u>Missing</u>	<u>Reassessed</u>
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Review Results:

Each review always consists of two elements: curriculum results and assessment processes.

Recommendations

Curriculum Result

Perform a critical analysis on the accuracy, validity, and value of this outcome’s assessment based on the Outcome Summary. This review may also include a review of the actual assessment documents but such depth is not typically required. Note any significant differences among instruments, performance criteria, and instrument assessors. Compare the assessed performance with previous years’ performance and recommend curriculum improvements, as needed. The improvement does not need to be curriculum specific, but it would be helpful to suggest possible improvements for faculty consideration. If no improvement is needed, state that the curriculum is performing adequately. If a problem may be developing but there is inadequate evidence on which to act, note that the outcome should be watched and note the concern.

(Insert review here)

Assessment Process

Comment on the adequacy of the assessment instruments and related processes. Suggest possible changes that would improve the assessment of this outcome. Possible discussion might include such things as the adequacy of triangulation by multiple assessment methods, statistical variations from small class size, sparse student participation, etc. If the process appears to be functioning adequately, state that.

(Insert review here)

Table E-II.5 Outcome Review Summary Form

Outcome Review																													
yyyy	(-) Outcome	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 2px;">Reviewer</td> <td style="width: 50%; padding: 2px;"></td> </tr> <tr> <td style="padding: 2px;">Date</td> <td style="padding: 2px;"></td> </tr> </table>	Reviewer		Date																								
Reviewer																													
Date																													
Instruments for Review																													
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 35%; padding: 2px;">Course</th> <th style="width: 45%; padding: 2px;">Instrument</th> <th style="width: 20%; padding: 2px;">Used</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> </tbody> </table>			Course	Instrument	Used																								
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Part III

Outcome Assessment Results For all Instrument Collections up to and Including 2009

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