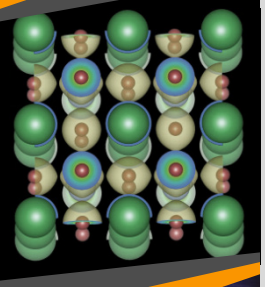
MATERIALS
SCIENCE & ENGINEERING



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ABET Presentation

to the UT Materials Science & Engineering Board of Advisors

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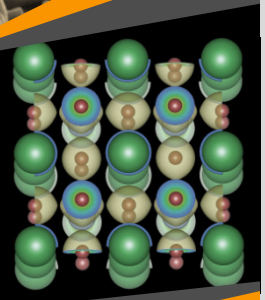
University of Tennessee, Knoxville
November 17, 2015

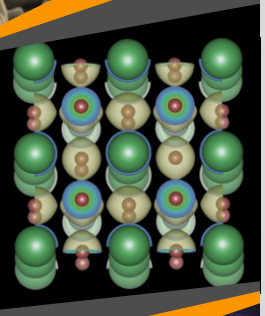


Purpose of this Presentation

The purpose of this document is to provide in the most compact form possible the essential information regarding efforts in the UT MSE department to achieve an unqualified six-year approval from the ABET* team of evaluators that will visit in Fall, 2017.

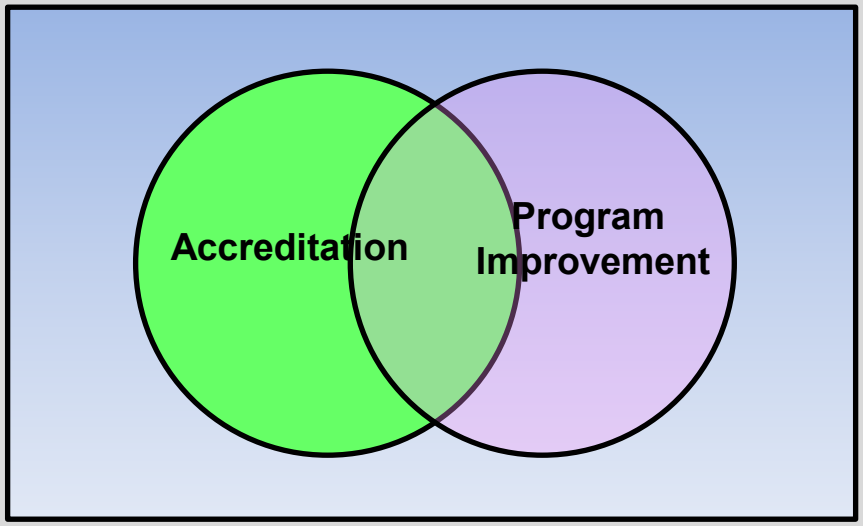
The departmental Board of Advisors is a constituent from which input must be received as part of both the ABET reporting and self-improvement processes.

*ABET = Accreditation Board for Engineering & Technology, Inc.



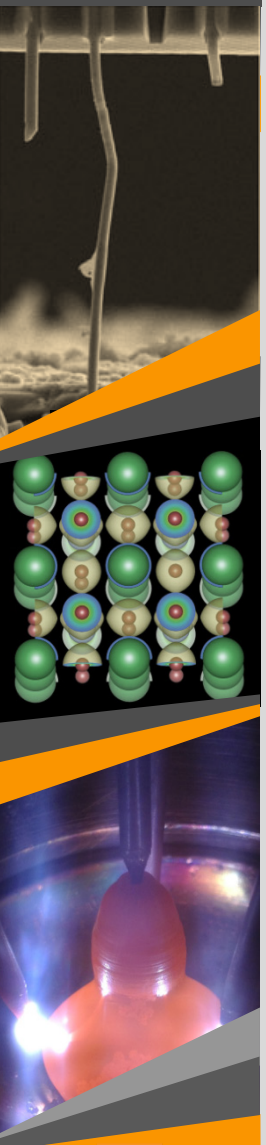
Departmental Objectives relevant to ABET

The MSE department has two objectives relevant to ABET.



- The first objective is to maintain its credentials as an accredited degree-granting program in materials science.
- The second objective is to create an effective process by which the program can continue to improve.

- The first objective is an external objective, which satisfies the requirements of ABET.
- The second objective is an internal objective, which satisfies the faculty of the UT MSE department.



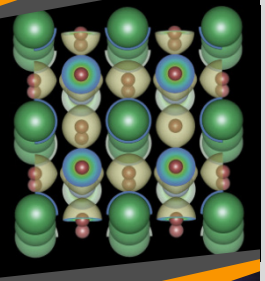
Timeline

- The ABET review process is on a six year cycle and last occurred at UT in 2011.

- The ABET evaluators will visit during the fall semester of 2017.

- The self-study report is due to ABET on July 1, 2017. (There may be earlier internal deadlines issued by the university or college.)

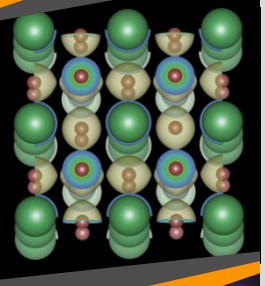
- Because data must be collected and analyzed, the 2015-2016 academic year represents the last year in which the full annual process can be completed before the self-study report is due.



MSE Departmental ABET Committee

The UTK MSE Department maintains an ABET Committee as a standing committee. As of June, 2015, the composition of the UTK MSE Departmental ABET Committee is as follows:

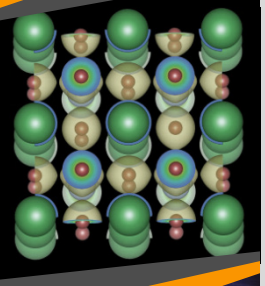
1. David Keffer (Committee Chair)
2. Claudia Rawn (Committee Member)
3. Chris Wetteland (Committee Member)
4. Martha Gale (Committee Member)
5. Veerle Keppens (Department Head and Courtesy Member)
6. Hahn Choo (Courtesy Member)



Recipe for Success

The approach that the MSE department is taking to meet its ABET goals is based on five components.

1. **Preparedness:** Read the ABET documentation and prepare a self-study report and associated supporting materials that satisfy all requirements.
2. **Communication:** Inform faculty, staff, students and other constituents of the requirements and their respective roles in meeting these requirements.
3. **Inclusiveness:** Maintain receptivity to input from faculty, staff, students and other constituents, regarding concerns and suggestions.
4. **Organization:** Provide the relevant data to the reviewers in an organized manner.
5. **Hospitality:** Host a well-organized visit from the ABET reviewers in which all constituents are able to demonstrate that they are knowledgeable and well-prepared to present in a unified way the strengths of the program.

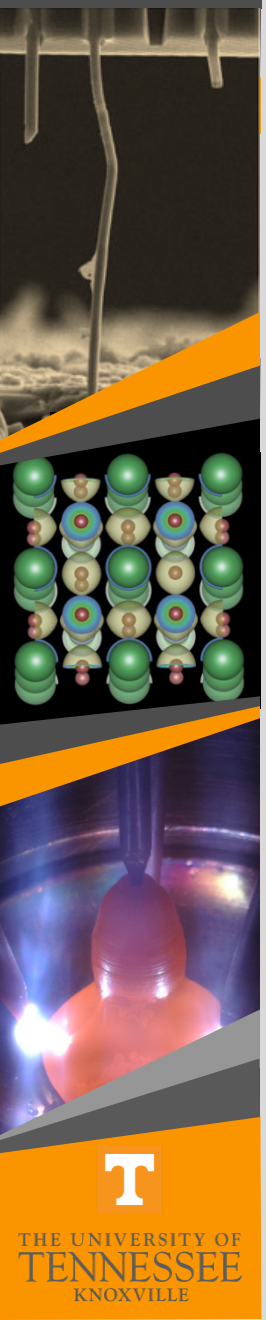


What is the ABET Self-Study Report?

A highly structured document:

BACKGROUND INFORMATION
GENERAL CRITERIA
- CRITERION 1. STUDENTS
- CRITERION 2. PROGRAM EDUCATIONAL OBJECTIVES
- CRITERION 3. STUDENT OUTCOMES
- CRITERION 4. CONTINUOUS IMPROVEMENT
- CRITERION 5. CURRICULUM
- CRITERION 6. FACULTY
- CRITERION 7. FACILITIES
- CRITERION 8. INSTITUTIONAL SUPPORT

PROGRAM CRITERIA
Appendix A – Course Syllabi
Appendix B – Faculty Vitae
Appendix C – Equipment
Appendix D – Institutional Summary



Program Educational Objectives (Criterion 2)

The educational objectives of the program for the degree of Bachelor of Science in Materials Science and Engineering are:

- Our graduates will demonstrate a thorough understanding of general engineering principles and a deep understanding of the discipline of materials science and engineering.

- Our graduates will contribute to their disciplines and society and advance to leadership roles in their chosen career field.

- Our graduates will be prepared to successfully complete competitive postgraduate education programs.

http://www.engr.utk.edu/mse/future/undergrad_objectives.html

These very broad objectives were adopted after the previous objectives were deemed a weakness during the 2011 ABET review.

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Student Outcomes (Criterion 3)

verbatim from ABET

a) an ability to apply knowledge of mathematics, science, and engineering
b) an ability to design and conduct experiments, as well as to analyze and interpret data
c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
d) an ability to function on multidisciplinary teams
e) an ability to identify, formulate, and solve engineering problems
f) an understanding of professional and ethical responsibility
g) an ability to communicate effectively
h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
i) a recognition of the need for, and an ability to engage in life-long learning
j) a knowledge of contemporary issues
k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

from UT MSE

l) an understanding of the effect of composition, synthesis, and processing methods on structure and properties, and in turn to the performance in service of all classes of materials (metals, ceramics, polymers)
m) an ability to apply statistical and computational methods for data analysis and solution of problems in materials systems
n) an ability to integrate knowledge of processing, structure, properties, and performance to solve materials selection and design problems

These very outcomes were adopted after the previous outcomes were deemed a weakness during the 2011 ABET review.

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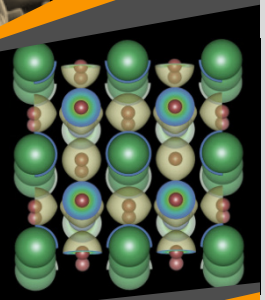

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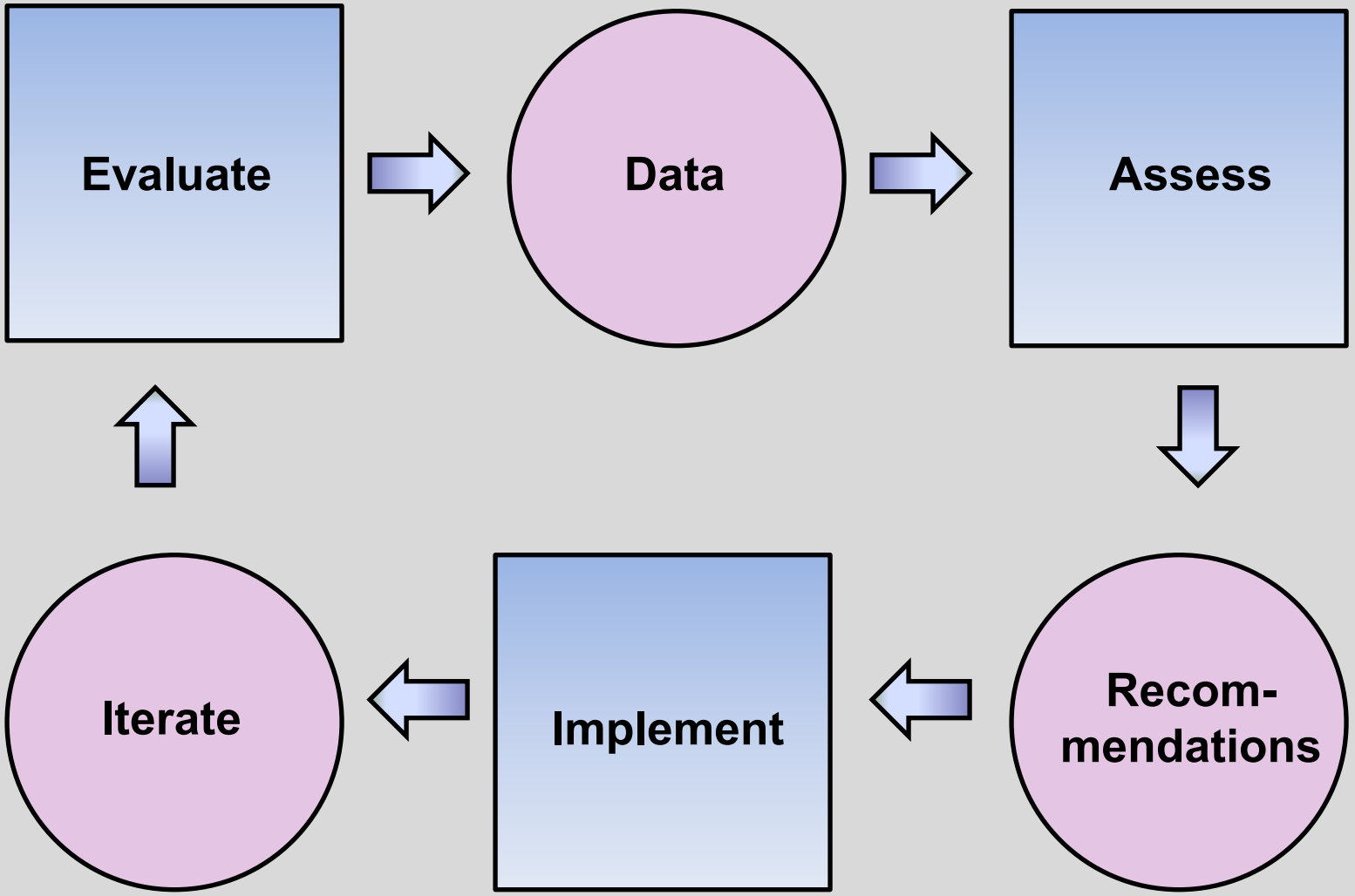
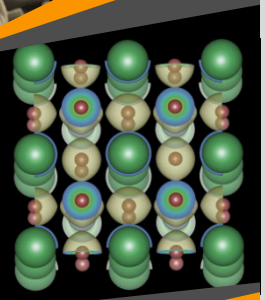
Continuous Improvement (Criterion 4)





Evaluation (Data Collection)

There are five sources from which we will collect evaluations.

1. Faculty Assessment of ABET Outcomes
2. Senior Exit Interviews
3. Alumni Survey
4. Employer Survey
5. Board of Advisors Meeting

Faculty Assessment of Student Outcomes Organized by Course

	course title	outcome 1	outcome 2	outcome 3
101	Advances in Materials Science and Engineering	**J**		
201	Introduction to Materials Science and Engineering	A		
210	Introduction to Materials Science and Engineering Laboratory	**B**	**D**	
250	Introduction to Materials Kinetics and Transport Phenomena	**K**	E	
260	Materials Engineering Thermodynamics	**A**		
290	Professional Development	**J**	**H**	**I**
300	Principles of Materials Laboratory I	**G**	B	
301	Applied Statistics and Numerical Methods	**M**		
302	Mechanical Behavior of Materials I	**A**		
304	Principles of Materials Laboratory II	**B**	D	K
320	Diffusion and Phase Transformations	A		
340	Principles of Polymeric Materials	**E**	L	
350	Principles of Electronic, Optical, and Magnetic Materials	A	K	
360	Principles of Ceramic Materials	**L**		
370	Materials Processing	**D**	**L**	J
390	Principles of Metallic Materials	**E**	A	
405	Structural Characterization of Materials	**G**	**F**	**K**
480	Materials Selection in Design	**C**	**N**	J
489	Materials Design	**N**	**F**	**C**

The courses listed include all MSE courses that appear in the 2015-16 undergraduate catalog for the showcase curriculum.
Letters in red bold indicate that the course was selected to be evaluated to meet that outcome.
Letters in black indicate relevant but unselected outcomes.

Rubrics

Example Rubric for outcome A

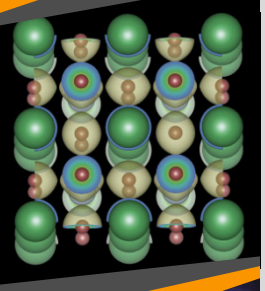
Assessment Rubric for MSE Program Learning Outcome A: An ability to apply knowledge of mathematics, science, and engineering

Course_____ Semester_____ Instructor_____ Evaluator (if different)_____

Name of Student Being Evaluated_____ Date of Evaluation_____

Metric	Work Equivalent to Level 1	Work Equivalent to Level 3	Work Equivalent to Level 5	Score (1-5 or N/A)
A.1.	Does not understand the connection between mathematical models and chemical or physical processes and systems in materials science and engineering	Chooses a mathematical model or scientific principle that applies to an engineering problem, but has trouble in model development	Combines mathematical and/or scientific principles to formulate models of chemical or physical processes and systems relevant to materials science and engineering	
A.2.	Does not understand the application of calculus and linear algebra in solving materials science and engineering problems	Shows nearly complete understanding of applications of calculus and/or linear algebra in problem-solving	Applies concepts of integral and differential calculus and/or linear algebra to solve materials science and engineering problems	
A.3.	Mathematical terms are interpreted incorrectly or not at all	Most mathematical terms are interpreted correctly	Shows appropriate engineering interpretation of mathematical and scientific terms	
A.4.	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	
A.5.	Calculations not performed or performed incorrectly	Minor errors in calculations	Executes calculations correctly	

Please attach description of assignment used for assessment.



Implementation & Highlights

Recommendations are implemented for Program Improvement

1. Significant restructuring of MSE 489, “Materials Design”.
2. Significant restructuring and upgrading of MSE laboratory courses, 210, 300 and 304
3. Creation and offering of MSE 301, “Applied Statistical and Numerical Methods”, to meet student outcome n)
4. Creation and offering of a majors-only section of MSE 201
5. Updating of ABET Evaluation and Assessment process
6. Expansion of Undergraduate Research Opportunities.

The senior design experience was deemed a weakness during the 2011 ABET review.
It has been thoroughly revised/upgraded. A presentation on this topic by Prof. Sickafus will follow.

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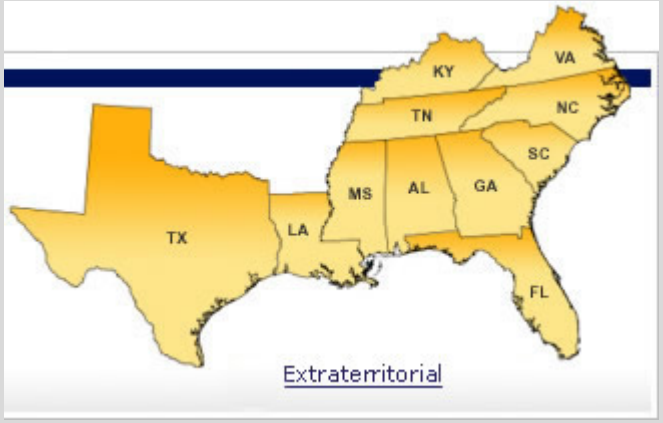
Additional Program Review Processes

ABET: national organization accredits undergraduate engineering programs only

SACS: Southern Association of Colleges and Schools
Regional organization accredits universities
Continuous evaluation (6 outcomes, a subset of ABET outcomes)



THEC: Tennessee Higher Education Commission state agency, sets the funding formulae for UT Academic Program Review for each department (10 year cycle)

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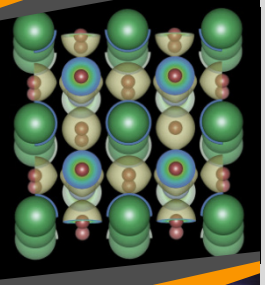

Discussion

15 minutes for presentation
15 minutes for discussion

- **Requests for Clarification?**
- **Egregious Omissions?**
- **Constructive Suggestions?**
- **Best Practices?**
- **How can BOA best provide useful feedback to the self-improvement process?**

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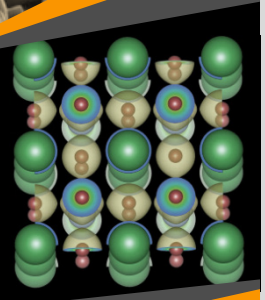

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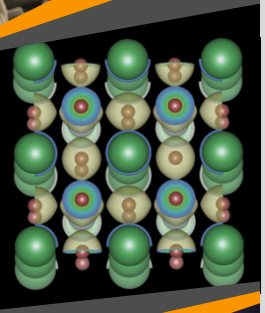
Additional Reference Slides

MATERIALS
SCIENCE & ENGINEERING



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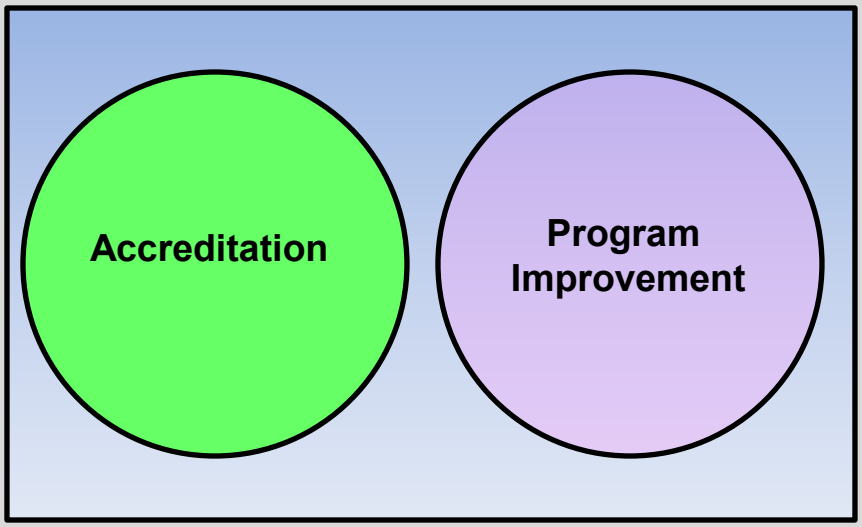
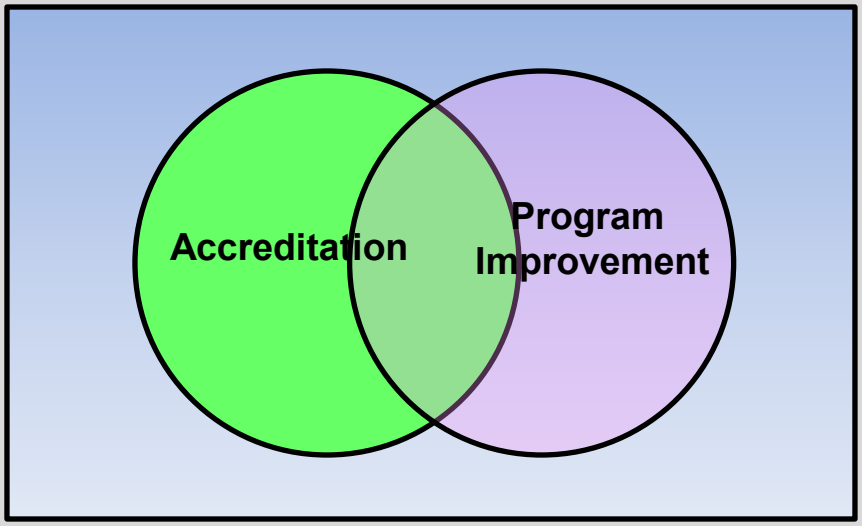
Departmental Objectives relevant to ABET



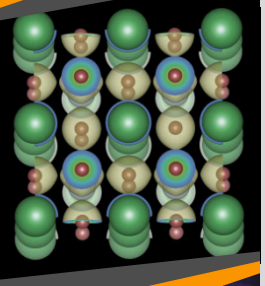


Both objectives are practically useful.

- We want to be part of an accredited MSE program.
- We want to improve the MSE program.

Many see the accreditation element as a necessary bureaucratic obstacle rather than a means of improvement.

The goal is maximize the overlap of these two elements in the ABET process.

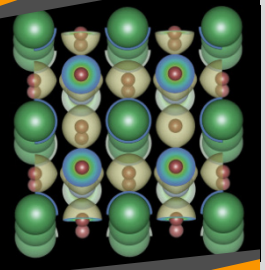


Assessment (Data Analysis and Generation of Recommendations)

The assessment of the data generated through the five inputs in the evaluation process described above is performed on an annual basis by the UTK MSE ABET Committee.

Following that meeting, the results of the assessment are presented to the UTK MSE Undergraduate Affairs Committee, another standing committee of the department, composed of a significantly larger number of MSE faculty. In this forum, both the evaluation and the assessment of the data are presented and discussed. Strengths and weaknesses are identified.

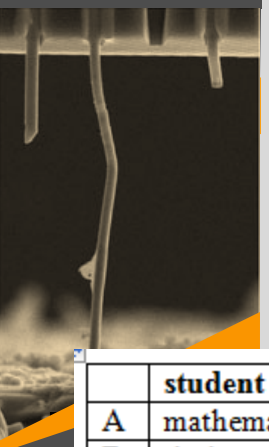
Recommendations for action are formed in this committee and forwarded to the faculty as a whole at the next faculty meeting for deliberation and implementation.



Immediate Action Items

- Because data must be collected and analyzed, the 2015-2016 academic year represents the last year in which the full annual process can be completed before the self-study report is due.

- Evaluation Item: Faculty Assessment of ABET Outcomes

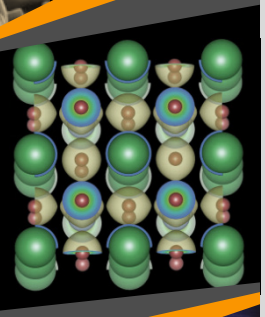


Faculty Assessment of Student Outcomes Organized by Outcome

	student outcome summary	course 1	course 2
A	mathematics, science, and engineering	260 (thermo)	302 (mechanical behavior)
B	design and conduct experiments	210 (intro lab)	304 (materials lab II)
C	design a system, component, or process	480 (materials selection)	489 (senior design)
D	multidisciplinary teams	210 (intro lab)	370 (materials processing)
E	solve engineering problems	340 (polymeric materials)	390 (metallic materials)
F	professional and ethical responsibility	405 (structural character.)	489 (senior design)
G	communicate effectively	300 (materials lab I)	405 (structural character.)
H	global, economic, environmental, and societal context	290 (professional develop)	
I	engage in life-long learning	290 (professional develop)	
J	contemporary issues	101 (intro seminar)	290 (professional develop)
K	use tools for engineering practice	250 (kinetics & transport)	405 (structural character.)
L	materials processing/structure/property relationships	370 (materials processing)	360 (ceramic materials)
M	statistical and computational methods	301 (statistics and numerical)	
N	materials selection and design problems	489 (senior design)	480 (materials selection)

Faculty Assessment of Student Outcomes Organized by Semester (2015-2016) and Responsible Faculty Member

semester	course	outcome 1	outcome 2	outcome 3	responsible faculty member
Fall, 2015	201 (intro. to materials lecture)	-	-	-	N.A.
Fall, 2015	210 (intro. to materials lab)	B	D	-	Wetteland
Fall, 2015	300 (materials lab I)	G	-	-	Wetteland
Fall, 2015	301 (statistics and numerical)	M	-	-	Keffer
Fall, 2015	320 (diffusion & phase transfom.)	-	-	-	N.A.
Fall, 2015	340 (polymeric materials)	E	-	-	Wang
Fall, 2015	360 (ceramic materials)	L	-	-	Xu
Fall, 2015	405 (structural character.)	F	G	K	Rawn
Fall, 2015	480 (materials selection)	C	N	-	Lundin
Spring, 2016	101 (intro seminar)	J	-	-	Rawn
Spring, 2016	250 (kinetics & transport)	K	-	-	Fawkes
Spring, 2016	260 (thermo)	A	-	-	Ramki
Spring, 2016	290 (professional develop)	H	I	J	Choo
Spring, 2016	302 (mechanical behavior)	A	-	-	Liaw
Spring, 2016	304 (materials lab II)	B	-	-	Wetteland
Spring, 2016	350 (electronic materials)	-	-	-	N.A.
Spring, 2016	370 (materials processing)	D	L	-	Bhat
Spring, 2016	390 (metallic materials)	E	-	-	Choo
Spring, 2016	489 (senior design)	C	F	N	Lundin



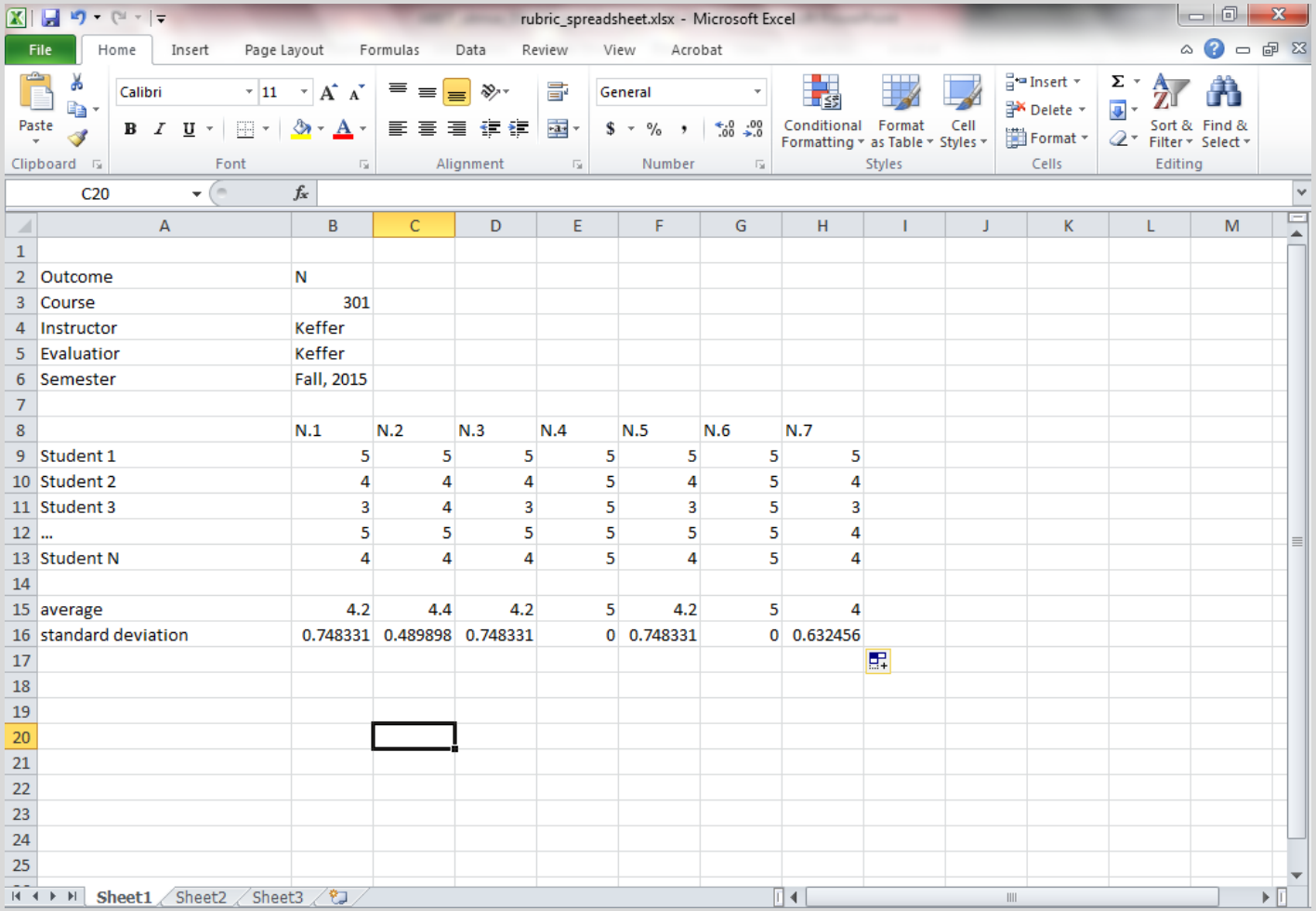
Rubrics

A rubric for each outcome (filled out by faculty for every student)

List of ABET Student Outcomes (a) through (n) .....
Assessment Rubric for MSE Program Learning Outcome A:.....
Assessment Rubric for MSE Program Learning Outcome B:.....
Assessment Rubric for MSE Program Learning Outcome C:.....
Assessment Rubric for MSE Program Learning Outcome D:.....
Assessment Rubric for MSE Program Learning Outcome E:.....
Assessment Rubric for MSE Program Learning Outcome F (NEW): .....
Assessment Rubric for MSE Program Learning Outcome G (Oral):.....
Assessment Rubric for MSE Program Learning Outcome G (Written):.....
Assessment Rubric for MSE Program Learning Outcome H:.....
Assessment Rubric for MSE Program Learning Outcome I (NEW): .....
Assessment Rubric for MSE Program Learning Outcome J (NEW): .....
Assessment Rubric for MSE Program Learning Outcome K (NEW):.....
Assessment Rubric for MSE Program Learning Outcome L (NEW): .....
Assessment Rubric for MSE Program Learning Outcome M (NEW): .....
Assessment Rubric for MSE Program Learning Outcome N:.....

Two things must be provided by faculty

1. Spreadsheet recording results of rubric



	A	B	C	D	E	F	G	H	I	J	K	L	M
1													
2	Outcome	N											
3	Course	301											
4	Instructor	Keffer											
5	Evaluatior	Keffer											
6	Semester	Fall, 2015											
7													
8		N.1	N.2	N.3	N.4	N.5	N.6	N.7					
9	Student 1	5	5	5	5	5	5	5					
10	Student 2	4	4	4	5	4	5	4					
11	Student 3	3	4	3	5	3	5	3					
12	...	5	5	5	5	5	5	4					
13	Student N	4	4	4	5	4	5	4					
14													
15	average	4.2	4.4	4.2	5	4.2	5	4					
16	standard deviation	0.748331	0.489898	0.748331	0	0.748331	0	0.632456					
17													
18													
19													
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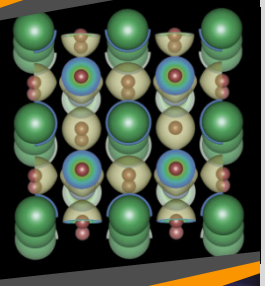
24													
25													

Please no paper copies of rubrics!



Two things must be provided by faculty

2. Student Examples

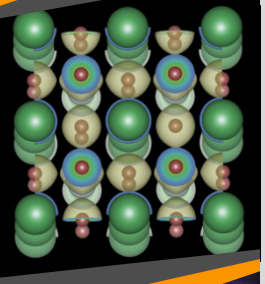
For each item on the rubric, you must provide student examples that demonstrate what constituted a "1" (if any), "2", "3", "4" or "5" on the rubric.

Therefore, at the beginning of the semester, you must identify one question on an exam or homework that you will use to evaluate each item on each rubric assigned to you.

You must turn in a copy of the relevant assignment for each student for each item on the rubric.

Turn this into Martha.

Deadline for spreadsheets and student work are the day student grades are due. (Otherwise they will be lost.)



Reference Materials

Materials stored online at

http://utkstair.org/clausius/docs/abet_mse_2017/

or

http://tinyurl.com/p9j23nx

- ABET Slides from MSE Retreat (08/17/2015)
- ABET Preparation document (07/30/2015)
- Student Outcome Rubrics (07/14/2015)
- Sample Rubric Result Spreadsheet (08/13/2015)