CRITERION 4. CONTINUOUS IMPROVEMENT

A. Program Educational Objectives

a. Assessment processes

Because we have few graduates, we assess the attainment of our program educational objectives by administering an alumni survey. The survey is attached in Appendix G. The survey is administered annually to those who have graduated three years prior (e.g. in Fall 2010, all students who graduated in 2007, either in May or December, were surveyed). Only the past two years of data are included in this report because the PEO's were changed in 2009. An alumni survey was also administered in 2007 for the previous set of PEO's. The survey is done on-line through Surveymonkey. We have got about 50% response rate during the two rounds of the survey.

b. Expected level of attainment:

PEO 1 **Be employed as a practicing engineer in fields such as design, research, development, testing, and manufacturing**: Students may choose an alternate career path and may also choose to quit their career path for personal reasons. Likewise, the past few years have imparted a difficult economic period. Thus we would have not been surprised to see unemployed students. Interestingly, all the respondents to the survey were employed as practicing engineers.

PEO2 **Engage in lifelong self-directed learning to maintain and enhance professional skills**: In the first three years of one's career there may not be many shifts in a person's direction, requiring significant changes in one's technical preparation. Our probe for this PEO is principally focused on enrollment in a certificate or degree program for continuing education, and also participation (membership) in a technical society, a professional societies generally focus on continuing education through publications and meeting participation. We would like to see all (100%) of our students participating in professional organizations, even those who may head off a traditional career path. It is not necessary to obtain any advanced degree to obtain satisfactory employment in materials engineering, so we do not have any quantitative expectations for enrolling in a Master's program.

PEO 3 **Conduct themselves as ethical and responsible professionals as well as articulate the environmental, safety and economic impacts of their work on society**: Professionalism is necessary for working with others in a safe and productive manner. This PEO is focused on professionalism, with a special emphasis on ethics and environmental health and safety. It was determined that assessment of ethical behavior is difficult, but it is important for our program to emphasize the importance of it even though it is not assessed. It is possible to probe their contributions with regard to environmental health and safety, on the other hand. The pertinent

student outcomes to this PEO include technical skills but a particular requirement of mastering outcomes 4, 6 and 8.

PEO 4 **Demonstrate leadership skills in the workplace**: A leader must be technically competent, exhibit good communication skills and be thorough in their awareness of new trends in the field, a good professional, and a good a team player. Thus, all of the outcomes are important for leadership skills.

c. Results and analysis of the evaluation of PEO's.

Nine (9) Materials Engineering graduates were polled from the 2006 and 2007 graduating classes (the complete class of students from each year). Five (5) students responded to the survey. Although it is difficult to know if the five respondents were representative of the whole group, we can compare their final overall GPA's with those of the entire class of students. The respondents had an average GPA of 2.85 with a standard deviation of 0.44, while the average GPA of the whole group of graduates was 2.91 with a standard deviation of 0.40. Thus, the students who responded have approximately the same average GPA as the whole group.

PEO I: Graduates were asked information regarding their current employment status to determine if the first PEO was being met

"Within 3 years of graduation, Materials Engineers are able to be employed as a practicing engineer in fields such as design, research, development, testing, and manufacturing"

The survey probed the employment status of the 2006 and 2007 graduates. All of the respondents were employed at the following companies:

- JSR Microelectronics Inc.
- Lockheed Martin
- Applied Materials
- BAE Systems, Inc.
- Evolv Development Management and Construction

The respondants listed their job titles as:

- Thin Film Deposition Technician
- Technology Specialist
- Materials Engineer
- Characterization Technologist
- Project Engineer

The average reported time in this current position was approximately 2 years. The duration was partly due to their having been promoted from their initial position and in other cases due to changing their employer.

Figure 4-3 shows a summary of the appropriate self-reported job descriptions. The entry for "other" was for a respondent whose responsibilities involved Real Estate Development and Construction

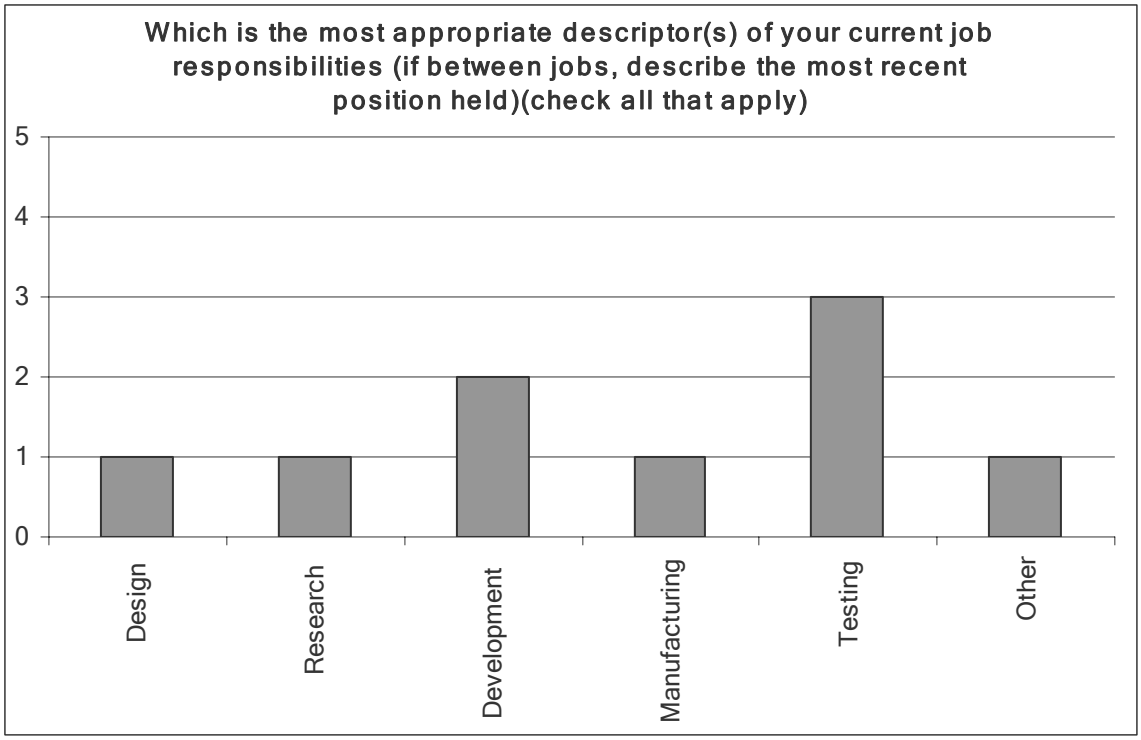

Figure 4-3. Response to "Which are the most appropriate descriptor(s) of your job responsibilities (check all that apply):" response from 5 graduates from the 2006 and 2007 graduating classes.

PEO II: Questions regarding continuing education were posed to determine if the students were demonstrating engagement in lifelong learning, as described in the PEO:

II. Within 3 years of graduation, Materials Engineers are able to engage in lifelong self-directed learning to maintain and enhance professional skills.

From the 2006 and 2007 graduates, of the five respondents, three (3) are participants in professional or technical societies. Respondents were members of

- American Society of Materials (ASM)
- Society of Women Engineers (SWE)
- Society of Plastic Engineers (SPE)

None of the respondents have enrolled in graduate degrees or certificate programs. While more than half the students were members of professional societies, the sample size is very small. The benefits of professional society participation may be greater as one moves ahead in years, but regardless it seems to be a point that needs to be better emphasized to our currently enrolled students.

PEO III: To help students identify behaviors that would indicate they have attained the third PEO, a set of options were provided for their response. The third PEO is:

"III. Within 3 years of graduation, Materials Engineers are able to conduct themselves as ethical and responsible professionals as well as articulate the environmental, safety and economic impacts of their work on society. "

Specifically, the options provided to them included:

In your place of employment, have you had the opportunity to apply the skills you learned at SJSU regarding **environmental health and safety**, including to **(check all that apply)**

i. Implement existing corporate practices or develop improved practices for environmental waste management.
ii. Contribute to team discussions focused on the development of a new, or modification of an existing product or process with regards to safe work practices.
iii. Contribute to team discussions focused on the development of a new, or modification of an existing product or process with regards to process safety.
iv. Elucidate and document the environmental impacts of one or more products or processes or some aspect of the process
v. Other (please specify) _____

The respondents answered this first question that addresses the third PEO, as shown in **Table 4-1**.

Table 4-1: Response to question about environmental health and safety practices.

Options	#responses
Implement existing corporate practices or develop improved practices for environmental waste management.	**3**
Contribute to team discussions focused on the development of a new, or modification of an existing product or process with regards to safe work practices.	**5**
Contribute to team discussions focused on the development of a new, or modification of an existing product or process with regards to process safety.	**4**
Elucidate and document the environmental impacts of one or more products or processes or some aspect of the process	**0**

All of the respondents have had the opportunity to integrate safety into their job responsibilities. Over half had to consider the environmental impact of work.

Table 4-2 also shows the responses to the second question related to PEO III, which were as follows:

> In your place of employment, have you had the opportunity to apply the skills you learned at SJSU regarding engineering **economics**, including to
> **(check all that apply)**
>
> i. Contribute to the development of a new product or process that can increase the revenues for your company
> ii. Contribute to discussions among employees that result in effective cost cutting measures at the place of employment
> iii. Other (please specify)_____

Table 4-2: Responses to question about practice of engineering economics at place of employment.

Options	#responses
Contribute to the development of a new product or process that can increase the revenues for your company	**1**
Contribute to discussions among employees that result in effective cost cutting measures at the place of employment	**3**

Over half of the respondents have been involved in decisions that have had a positive impact on the economics of their jobs. Since all the respondents are employed at private commercial companies, it is an inherent part of everyone's job to be economically responsible. All the respondents may not have considered this when responding to the survey.

The fourth PEO is,

PEO IV: "Demonstrate leadership skills in the workplace."

As distinguished from someone who is a manager or in charge of a group or project, the following specific examples of the practice of leadership skills in the workplace were provided on the survey:

In your place of employment, have you demonstrated **leadership skills**, including to: (check all that apply)

i. Contribute to company strategic decisions through your work and/or participation in team planning and execution
ii. Apply effective listening skills in team interactions
iii. Make an oral presentation to your coworkers/supervisors
iv. Solve technical problems, including timely trouble shooting, product or process development
v. Motivate others toward a common goal
vi. Present alternative strategies to problem solving from others on the team in a non-confrontational way
vii. Contribute to the professional development of one or more employees at your place of work through mentorship or peer-peer guidance.
viii. Demonstrate your interest in the work of others at your place of employment by inquiring about their projects and plans
ix. Other (please describe)_____

Table 4-3 summarizes the responses to leadership skills questions. All respondents state that they have had several opportunities to demonstrate leadership.

Table 4-3: Responses to question about demonstration of leadership skills in the workplace.

Options	#responses
Contribute to company strategic decisions through your work and/or participation in team planning and execution	2
Apply effective listening skills in team interactions	4
Make an oral presentation to your coworkers/supervisors	5
Solve technical problems, including timely trouble shooting, product or process development	4
Motivate others toward a common goal	5
Present alternative strategies to problem solving from others on the team in a non-confrontational way	3
Contribute to the professional development of one or more employees at your place of work through mentorship or peer-peer guidance.	2
Demonstrate your interest in the work of others at your place of employment by inquiring about their projects and plans	2

Following the questions related to the four PEO's and including a list of the PEO's, the survey polled the appropriateness of the PEO's directly by asking the question: "In regards to these objectives, please indicate one of the following:

- I agree that this is the appropriate set of objectives
- The objectives should be changed (space provided for recommendations)

The respondents answered unanimously both years that this is the appropriate set of objectives. This result agreed with the poling of employers who attended the annual student conference day event as well as the Industrial Advisory Board who met on March 16, 2011.

The final page of the survey probes the graduate's sense of their professional preparedness from attending the undergraduate Materials Engineering program at San Jose State. All five

responded to the statement: "Overall, compared to my co-workers, I feel that my engineering education at San Jose State University prepared me well for my career." The question had a Likert scale offering relative options of neutrality and disagreement. Of the five (5) respondents three (3) "completely agreed" and two "partially agreed" with the statement

There was one general comment in which the respondent stated that the hands on laboratory experience was a strong point of the program.

d. Summary of results: Evaluation by PEO

PEO1: "Within 3 years of graduation, Materials Engineering graduates are able to be employed as a practicing engineer in fields such as design, research, development, testing, and manufacturing"

All of the survey respondents were employed at the time of the survey. All five (5) graduates polled have demonstrated their ability to secure employment in a technical field. Based on the results of the survey PEO 1 there are no suggested programmatic changes required related to PEO1.

PEO II. "Within 3 years of graduation, Materials Engineering graduates are able to engage in lifelong self-directed learning to maintain and enhance professional skills."

Three of the five respondents indicated that they are members of technical or professional societies but none indicated that they have pursued any further education/training. This would argue that more could be done in the undergraduate curriculum to foster a general value for education and impress upon our students the need to be continually refining their skills. Although this group has only been 3 to 4 years in their fields it would be appropriate to be actively engaged in professional society activities and/or to further their formal education through certificate or other programs. This was discussed at a department ABET retreat and has begun to be implemented in some of the core courses. Students are now required to attend professional meeting and seminars as part of the course experience in MatE 198A/B with the intent that these experiences will illustrate to students the need to continue learning after graduation

PEO III. "Within 3 years of graduation, Materials Engineering graduates are able to conduct themselves as ethical and responsible professionals as well as articulate the environmental, safety and economic impacts of their work on society."

As explained above, we are not directly assessing the ethical aspect of this PEO because as pointed out in a recent ASEE paper on engineering ethics, it is difficult to correlate a student's response to questions on a test and their actual ethical decision making in the workplace when faced with a difficult decision. The fact that it cannot be assessed does not reduce the importance we put on that aspect of our program or the emphasis we give it with our students.

Based on their responses, we can see that the group has demonstrated the capacity of contributing in the EHS and economic aspects of their companies. Based upon the responses

in Figure 4-3 and Table 4-1 the respondents jobs involve more aspects of EHS than economics. The majority of respondents are involved in development and testing, which is consistent with the stronger response of being more involved with safety issues. At present, no curricular changes will be implemented based on the results for this PEO.

PEO IV**:** "Demonstrate leadership skills in the workplace."

During both of the years the students have responded positively to demonstrating specific leadership skills in the workplace. Based on these responses, no programmatic changes will be implemented.

Overall summary: All of the students responded that they felt they were prepared well as compared with their colleagues at their places of employment. The one written comment suggested that more emphasis be put on writing and oral presentations. Since AY 2006/2007 we have required students to present a poster of their design projects at a local ASM meeting prior to their formal presentation at Student Conference Day. Additionally since the previous ABET review we have implemented a set of progressive writing assignments in one lab course (MatE153) and have incorporated more written project assignments and oral presentations in the core curriculum courses (MatE 115, MatE 152, and MatE 155). Since the graduates who were surveyed would not have had this experience yet we expect to see the results in the next alumni survey. We have also modified the requirements of MatE198A. Students now submit four written assignments and give an oral project feasibility report.

B. Student Outcomes

B.1. Listing and description of the assessment processes and frequency

Our assessment process has gone through several updates since the ABET 2000 was put in place. Since the previous review in 2005, we have also made a significant change starting in 2008. This change was caused by our department ABET facilitator attending the PEV training followed by the IDEAL workshop. Prior to this time, we did do course assessment and collect data in our courses and it was periodically reviewed, but it was not used for programmatic modifications. Additionally the faculty had too many PECs linked to the student outcomes. This proved to be impractical for the faculty to successfully manage. Finally, many of the courses that we had previously identified to be used for assessment were taught by part time faculty and collecting data was difficult. Previously, we primarily used the data collected at Student Conference Day and also input from the alumni to make updates to the curriculum and program policies.

Currently, all of the full-time program faculty participate in the assessment process. Student outcomes are assessed in pertinent courses and some of them are assessed at our Student Conference Day on an annual basis. The number of PECs linked to the student outcomes has been reduced to a more manageable number (from 24 to 16). This change in PEC linked to the SO was completed in Fall 2009. Only two part time faculty are now required to create course assessment reports. The matrix that maps student outcomes to specific courses was developed during the CME department retreat (Table 4-4). The entries that are shaded are the courses

where the SO is being evaluated. Specifically, the program evaluation criteria (PEC) associated with the SO is evaluated. PECs are evaluated on exam or quiz questions, homework questions, oral presentations, papers or projects and in some cases by survey. The goal was to have at least one direct assessment method for each of the outcomes. At the beginning of the summer and during the winter break, faculty complete a simple report that can be found in Appendix H for the outcomes they are responsible for assessing. However, there is no consistency between faculty regarding how the assessment of their assigned outcomes is carried out. Specifically, some faculty do not use rubrics for their assessment. The details of the assessment of each outcome can be found in Appendix E. Additionally, only the faculty assigned to the outcome make the determination of how many students have met the performance criterion. No cross evaluation by separate faculty is carried out. In these ways our assessment process can still be improved.

Seniors present their capstone design projects at Student Conference Day. Industry professionals, alumni and emeritus faculty attend, along with junior and senior students and the program faculty. The visitors (not including the other undergraduate students) are invited to "evaluate" our students' presentations. Each presentation is 20 minutes with sufficient time for questions by the visitors, faculty and other students. The evaluators are all given booklets with the abstract of the presentations and a set of questions to assess how well the students met the listed criteria. The criteria are a subset of the performance criteria that are also evaluated in courses. The data from all of these evaluations is then compiled and discussed by the faculty at a summer retreat. The students also assemble a poster of their projects that is presented to interested evaluators during breaks and lunch time. The poster session gives the evaluators additional time to probe students about their knowledge and contribution to the project (in the case of team projects).

In addition to the input we get during the Student Conference Day, observations about the program and curriculum made by program faculty are discussed during ABET retreats – we have one every summer and winter break for one day each. We discuss the latest assessment results and make decisions about possible curricular changes that would be appropriate based on the results.

B.2. The expected level of attainment for each of the student outcomes

Faculty who assess their outcomes identify what is the minimum acceptable level of performance for each of the outcomes. This is different for each professor and for each outcome. For some of the outcomes, a specific rubric is assembled that describes what mark is given based on the student performance on that outcome. It is desired that 100% of the students meet at least the minimum acceptable level of performance on each of the criteria. While this does not happen in reality, it enables the faculty to identify and implement different pedagogical strategies with the aim of improving the student performance.

B.3 Summaries of the results of the evaluation process and an analysis illustrating the extent *to which each of the student outcomes is being attained*

Table 4-4: Performance criteria for assessment of student outcomes: Levels of instruction in Materials Engineering courses.

Performance Criteria	MatE 115	MatE 141	MatE 151	MatE 153	MatE 154	MatE 155	ChE 161	ChE 162	MatE 143	MatE 144	MatE 191	MatE 152	MatE 185	MatE 186	MatE 195	MatE 198A/B	Engr 100W	SCD
1.1 Utilize the structure-properties relationship to predict the properties of a material.	1	**3**		2	2				2	2	1	2	2	2	3	3		
1.2 Select the materials and properties appropriate for a specific application.				1	2	**3**							2	2	2	3		
1.3 Apply thermodynamics and kinetics in the process design of materials system in order to produce desired structure and properties.	1		2		**3**							3						
2.1 Select appropriate materials characterization tools, utilize the tool safely, and interpret experimental results.		2		1					**3**	2	1				2	3		**3**
2.2 Design and analyze appropriate experiments to measure or optimize specific engineering properties, incorporating statistical procedures.				1	1	1	2	2			1		2		2	**3**		**3**
3.1 Select and evaluate appropriate materials and processing methods based on desired performance.					1	2					1		2	2	**3**	3		**3**
4.1 Contribute unique expertise to a multifaceted team		**3**		**3**		2						2						
5.1 Assess needs, formulate problem statement, structure and evaluate solutions in solving real-world materials engineering problems.	1				1				1	1		**3**	2	2	2	**3**		**3**
6.1 Formulate and address ethical issues which arise in solving engineering problems and in the workplace.						2	**1**									**3**		
7.1 Communicate effectively through formal and informal written and oral means.	**3**	2	2	1	2	2	2	2	1	1	1	2	2	2	2	**3**	**3**	**3**

Performance Criteria	MatE 115	MatE 141	MatE 151	MatE 153	MatE 154	MatE 155	ChE 161	ChE 162	MatE 143	MatE 144	MatE 191	MatE 152	MatE 185	MatE 186	MatE 195	MatE 198A/B	Engr 100W	SCD
8.1 Optimize materials engineering products and processes to positively impact global and societal issues.	1				1	**3**	3					2	2	2		**3**		
9.1 Recognize that materials engineering is diverse and continuously evolving and that finding solutions may involve exploring new knowledge.	1	2		2	2	**3**			1	1		2	2	2	2	3		
9.2 Uncover, critically evaluate, and synthesize knowledge from multiple sources.	1	2	1	1	2	2			1	1		**3**	2	2	2	3		
10.1 Demonstrate use of materials engineering in emerging applications.	**2**			1	2	2						2	**3**		2	3		
11.1 Utilize modern tools and techniques to alter, characterize, and measure materials properties and to design processes according to accepted standards.		2		1	2	2			**3**	2	2		2	2	2	3		
11.2 Demonstrates advanced proficiency in pertinent software.						2		2		2		**3**	2		2	3		

B.3.1 **Assessment of student outcomes in courses by faculty**

The information is presented here to show the performance criteria that are used to assess each of the 11 student outcomes for the program (Table 4-5). The level of performance identified for each performance criterion as it is taught in a given course is on a 3 point scale based on Bloom's Taxonomy. Specifically, Level One covers both Blooms levels One (*knowledge*) and Two (*understanding*). Likewise, Level Two on our list covers Blooms levels Three (*application)* and Four (*analysis)*, and Level Three covers Blooms levels Five (*synthesis)* and Six (*evaluation)*. The levels were identified by the faculty teaching the course and then approved by all the faculty at an ABET retreat in Winter of 2010. The mapping of the level of performance for each criterion as they are addressed in the core courses is shown in Table 4-4 The entries that are shaded indicate the courses in which the criteria are assessed.

Table 4-5: Mapping of Student Outcomes to Performance criteria. (Small case letters in parenthesis are the ABET identifications of (a-k)

Student Outcome	Performance Criteria
1 (a) Ability to apply knowledge of mathematics, science and engineering	1.1 Utilize the structure-properties relationship to predict the properties of a material.
	1.2 Select the materials and properties appropriate for a specific application.
	1.3 Apply thermodynamics and kinetics in the process design of materials system in order to produce desired structure and properties.
2 (b) Ability to design/conduct experiments and analyze/interpret data	2.1 Select appropriate materials characterization tools, utilize the tool safely, and interpret experimental results.
	2.2 Design and analyze appropriate experiments to measure or optimize specific engineering properties, incorporating statistical procedures.
3 (c) Ability to design system, component or process to meet desired needs	3.1 Select and evaluate appropriate materials and processing methods based on desired performance.
4 (d)Ability to function on multi-disciplinary teams	4.1 Contribute unique expertise to a multifaceted team
5 (e) Ability to identify, formulate and solve engineering problems	5.1 Assess needs, formulate problem statement, structure and evaluate solutions in solving real-world materials engineering problems.

Student Outcome	Performance Criteria
6 (f)Understanding of professional and ethical responsibility	6.1 Formulate and address ethical issues which arise in solving engineering problems and in the workplace.
7 (g)Ability to communicate effectively	7.1 Communicate effectively through formal and informal written and oral means.
8 (h)Understand the impact of engineering solutions in a global/societal context	8.1 Optimize materials engineering products and processes to positively impact global and societal issues.
9 (i)Recognition of the need for and an ability to engage in life-long learning	9.1 Recognize that materials engineering is diverse and continuously evolving and that finding solutions may involve exploring new knowledge.
	9.2 Uncover, critically evaluate, and synthesize knowledge from multiple sources.
10 (j)Knowledge of contemporary issues	10.1 Demonstrate use of materials engineering in emerging applications.
11 (k)Ability to use the techniques, skills and modern tools necessary for engineering practice	11.1 Utilize modern tools and techniques to alter, characterize, and measure materials properties and to design processes according to accepted standards.
	11.2 Demonstrates advanced proficiency in pertinent software.

A summary of the *average* levels of achievement of the student outcomes is shown in the following table (Table 4-6). These numbers represent the % of students achieving the outcomes on all the assignments included for the latest year assessed. Since most of the core courses that used in the assessment process are offered only once a year, with the exception of MatE 153 and MatE 143, assessment is done every time the course is offered. Data for past performance for each PEC is reported in Appendix E. Since the new PEC were defined in 2009 assessment for each PEC was done at least twice. For more details on the assignments given on each outcome please refer to Appendix E, where the results for each Student Outcome is described and data from all the PEC evaluation is presented.. Table 4-6 shows the courses in which the outcomes were assessed, the specific performance criteria and the percent of students who met the performance criteria.

Table 4-6: Average % of students that met the performance criteria in the past review cycle

	Performance Criteria	MatE 111515	MatE 141	MatE 151	MatE 153	MatE 154	MatE 155	ChE 161	ChE 162	MatE 143	MatE 144	MatE 191	MatE 152	MatE 185	MatE 186	MatE 195	MatE 198A/B	Engr 100W	SCD
1.1	Utilize the structure-properties relationship to predict the properties of a material.		**75%**																
1.2	Select the materials and properties appropriate for a specific application.						**75%**												
1.3	Apply thermodynamics and kinetics in the process design of materials system in order to produce desired structure and properties.					**86%**													
2.1	Select appropriate materials characterization tools, utilize the tool safely, and interpret experimental results.									**100%**									**33%**
2.2	Design and analyze appropriate experiments to measure or optimize specific engineering properties, incorporating statistical procedures.																**100%**		**33%**
3.1	Select and evaluate appropriate materials and processing methods based on desired performance.															**100%**			**33%**
4.1	Contribute unique expertise to a multifaceted team		**100%**		**100%**														
5.1	Assess needs, formulate problem statement, structure and evaluate solutions in solving real-world materials engineering problems.												**50%**				**100%**		**67%**
6.1	Formulate and address ethical issues which arise in solving engineering problems and in the workplace.							**88%**									**100%**		
7.1	Communicate effectively through formal and informal written and oral means.	**100%**															**100%**	**100%**	**83%**
8.1	Optimize materials engineering products and processes to positively impact global and societal issues.						**86%**										**100%**		
9.1	Recognize that materials engineering is diverse and continuously evolving and that finding solutions may involve exploring new knowledge.						**50%**												
9.2	Uncover, critically evaluate, and synthesize knowledge from multiple sources.												**87%**						

	Performance Criteria	MatE 111515	MatE 141	MatE 151	MatE 153	MatE 154	MatE 155	ChE 161	ChE 162	MatE 143	MatE 144	MatE 191	MatE 152	MatE 185	MatE 186	MatE 195	MatE 198A/B	Engr 100W	SCD
10.1	Demonstrate use of materials engineering in emerging applications.	**100%**												**100%**					
11.1	Utilize modern tools and techniques to alter, characterize, and measure materials properties and to design processes according to accepted standards.									**100%**									
11.2	Demonstrates advanced proficiency in pertinent software.												**70%**						

4.1.2. Student Conference Day assessment of student outcomes

Another component of our evaluation of Student Outcomes involves the direct evaluation of students at our annual Student Conference Day (SCD) event. Each year engineering practitioners visit and observe presentations of students on their senior design projects. The visitors serve as evaluators and are presented with a rubric for the evaluation of the presentations.

SCD rating from a scale of **1 to 5**

5 = Exceed the objective
4 = Meets the objective
3 = Addresses the objective but misses minor issues
2 = Addresses the objective but misses key issues
1 = Fails to meet the objective

The CME department Student Conference Day (SCD) is a part of the capstone Senior Design course (MatE198A/B). The projects are a mixture of team and individual projects. Each project was presented to a panel of industry reviewers. Two teams and four individual projects were assessed by 8 to 18 industry evaluators for SCD 2010. Industry evaluators assessed five Performance Criteria (PC) which are linked to four Student Outcomes (PO). Table 4-7 below shows the relationship between the student outcomes and the performance criteria.

Table 4-7: Relationship between SO and PEC for Student Conference Day

2 (b)Ability to design/conduct experiments and analyze/interpret data	2.1 Select appropriate characterization methods and interpret experimental results of materials characterization tools.
	2.2 Design, conduct and analyze an appropriate experiment to measure materials properties using statistical procedures.
3 (c)Select and evaluate appropriate materials and processing methods based on desired performance	3.1 Evaluate and select appropriate materials and processing methods based on desired performance.
5 (e) Ability to identify, formulate and solve engineering problems	5.1 Assess needs, formulate problem statement, structure solutions and identify role of materials engineering in solving real-world problems.
7 (g) Ability to communicate effectively	7.1 Give an effective oral presentation.

Table 4-8 shows the average results for the teams/individual as well as for the entire class for SCD 2010.

Table 4-8: Results from SCD 2010

	Assessment Statement	Nimori & Bringuier	T. Chen	Vu & Yeung	H. Nguyen	Pandya	Fesshatzion	Overall
	# of Evaluators	18	14	17	8	10	10	
2 (a)Ability to design/conduct experiments and analyze/interpret data	2.1 Select appropriate characterization methods and interpret experimental results of materials characterization tools.	*3.25*	*3.14*	*3.97*	*3.00*	4.30	4.65	**3.72**
	2.2 Design, conduct and analyze an appropriate experiment to measure materials properties using statistical procedures.	*3.33*	*3.07*	*3.74*	*3.00*	4.10	4.25	**3.58**
3 (c) Select and evaluate appropriate materials and processing methods based on desired performance	3.1 Evaluate and select appropriate materials and processing methods based on desired performance.	*3.83*	*3.32*	*3.93*	*3.75*	4.05	4.33	**3.87**
5 (e) Ability to identify, formulate and solve engineering problems	5.1 Assess needs, formulate problem statement, structure solutions and identify role of materials engineering in solving real-world problems.	4.17	*3.59*	*3.88*	4.09	4.11	4.44	**4.05**
7 (g) Ability to communicate effectively	7.1 Give an effective oral presentation.	4.35	*3.41*	4.18	4.12	4.40	4.65	**4.18**

A score of 4 or better indicates that the team met the PC. Individual students and the teams had difficulty completely meeting the outcomes assessed. Italicized and underlined results are scores where students address the outcome but had some minor issues. Written comments provided by each reviewer indicate the exact nature of the weaknesses. A detailed discussion of the results and written comments are provided in Appendix E along with the Student Outcomes Assessment analysis

MatE Actions/Recommendations of SCD Results

The instance of scores less than 4.0 is an issue with the content of the student's oral presentation. In particular for SCD 2010 the entire class had difficulty keeping to the timeline of the class assignments of MatE 198A/B. The assignments in MatE 198A/B are the basis for the student presentations in SCD. The instructor was aware of this issue and worked with the students/teams to ensure that these outcomes were met in the Final project report. Some course-level requirements in the Senior Design class to ensure students stay on the given time line may be appropriate but no major curriculum changes will be undertaken.

Documentation and maintenance of results

The assessment results are (1) collected from the faculty for course assessment and tabulated by the department student assistant for the student conference day data, and (2) organized and initially evaluated by the department facilitator and presented at the semi-annual department retreat for review and action. The data are stored on the computer of the department chairperson. We have just started storing the reports and raw data on Google docs for improved access to all the data by the faculty.

C. Continuous Improvement

Using our old student outcome list and old PEO list, based on the alumni survey that was conducted prior to our interim review, no program changes were identified as necessary. Student conference day results confirmed the faculty observations in the courses and in short, no changes were made. Using our new set of student outcomes and PEO's, however, we have identified some changes as discussed below.

1. Changes based on assessment of PEO's

No changes were needed based on the results of the survey given in 2007 or 2009. However, the survey of Fall 2010 given to the students who graduated in 2007 it was noticed in individual comments recommended that additional emphasis should be given to written and oral communication skills. This comment mirrors the results obtained from the SCD 2010 data. Additional writing assignments have been incorporated into MatE 115, MatE 152, MatE 153, and MatE 155. Also, MatE 191 which is a small lab class, utilizes repeated revisions of reports to further enhance students writing and editing skills. Additionally better enforcement of the timeline of written assignments in MatE 198A/B will adopted to improve the quality of the work submitted. Finally while the Fall 2010 survey indicated that students are participating in some life long learning activities in the form of professional societies, the faculty believes that this area should be improved. Faculty are encouraging students to attend professional meeting and seminars as part of the course experience in MatE 198A/B with the intent that these experiences will illustrate to students the need to continue learning after graduation

2. Changes based on evaluation of student outcomes.

Student Outcome 3: "Ability to design system, component or process to meet desired needs" is assessed only in one course in the program. This was not noticed until recently when this report was being prepared. While the exercise in MatE 195 to assess this outcome has been met by all the students over the past two years, emphasis on the MatE198A/B assignment on justifying project design requirements will used to provide an additional evaluation point. Additionally the requirements that all assessed assignments in MatE 198A/B are mandatory in order to pass the course will be implemented starting Fall 2011. Currently each assignment is only worth a portion of the course grade. It is currently possible not to turn in one of these assignments and pass the class. Since the number of MatE students is very small it is critical that we get every student to turn in assignments that are used for assessment purposes.

Student Outcome 4: "Function effectively on multi-disciplinary teams" has been assessed in the MatE 141 as an in-class exercise and in MatE 153 as a team lab assignment. While the MatE 141 assessment tool required students to become an expert in a specific area in x-ray diffraction and lead the rest of the team the analysis of the assignment in that area no real measurable data

was collected. Anecdotal observations from the instructor were reported. In the future a more quantitative measure of this assignment will be performed. The MatE 153 assignment assessed was more a measure of total teamwork than functioning on a multi-disciplinary team. The quality of the report was assessed. In the future, the assessment will focus on evaluating the students' contribution to the project in terms of their unique expertise/role as a team member.

D. Additional Information

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

Student Outcome 1: Ability to apply knowledge of mathematics, science and engineering

SO (1) is supported throughout the curriculum by building on the fundamental math, physics and chemistry sequences as well as the lower division engineering classes (Engr10: Introduction to Engineering, EE98: Circuits, CE99: Statics). The entire MatE curriculum requires application of math and science to problems in Materials Engineering. SO (1) is expressed specially in the three (3) PECs below and the achievement of these PECs is assessed in various courses as shown in Table 4-4. Figure Table E-27 below summarizes the assessment results for the PECs linked to SO1. The level at which each PEC was evaluated, type of instrument used to assess the PEC, and the percentage of the students that met the PEC are listed.

Table E-27: SO1 Summary

Student Outcome 1		Performance Criteria	MatE 141	MatE 154	MatE 155
Ability to apply knowledge of mathematics, science and engineering	1.1	Utilize the structure-properties relationship to predict the properties of a material.	Level: 3 HW Prob (100%) Exam Prob (100%)		
	1.2	Select the materials and properties appropriate for a specific application.			Level: 2 Report Paper (100%) Oral Present (71%)
	1.3	Apply thermodynamics and kinetics in the process design of materials system in order to produce desired structure and properties.		Level: 2 Lab Expt (86%) Exam Prob (100%)	

SO1 (PEC 1.1): Utilize the structure-properties relationship to predict the properties of a material.

MatE 141 (Level 3)

Assignment: Homework assignment and an exam problem that asked the students to calculate the expected planes to diffract and the intensity of the peaks based on the crystal structure and an exam question that required students to determine diffraction angle of a material.

Mastery: For both assignments, the students must identify the proper crystal structure of the material and at a minimum set up the structure factor calculations properly based on that crystal structure (a score of 75%).

Results:

- Spring 2010 - All students met the requirements of this PEC for the HW and exam question.

The instructor noted that students had more difficulty with the mathematics of the HW assignment than with the actual concepts related to crystallography. Efforts will be made in Spring 2011, to break the homework problems up into smaller, more frequent assignments and to embed the calculations and problems into case studies and projects in order to increase participation in the activities.

No changes required at the classroom level.

SO1 (PEC 1.2): Select the materials and properties appropriate for a specific application.
MatE 155 (Level 3)
Assignment: Term report (Spring 2011) and a group oral presentation (Spring 2010).
Mastery: Students are required to correctly identify the three (3) main areas of product design (design, material selection and control) and correctly discuss one of the three areas. A score of 80% or greater
Results:

- Spring 2011 - All of the students met the PEC at the required level for the written report.
- Spring 2010 - Three (3) of four (4) teams met the 80% criteria for the group oral presentation.

Assessment tool was changed from 2010 to 2011 to determine individual student performance. For the next round of assessment (Spring 2012), individual performance will be assessed. Overall no changes required at the classroom level in terms of course curriculum.

SO1 (PEC 1.3): Apply thermodynamics and kinetics in the process design of materials system in order to produce desired structure and properties.
MatE 154 (Level 3)
Assignment: Lab experiment and an exam problem.
Mastery of lab experiment: Successfully prepare optical samples, correctly measured grain size, and presented plots of hardness versus time, grain size versus time and correlation of the hardness versus grain size with only minor errors in the graphs.
Results:

- Spring 2010 – 6 of 7 students met the criteria (86%)
- Spring 2009 – 6 of 8 students met the criteria (75%)
- Spring 2008 – 8 of 10 students met the criteria (80%)

Exam problem: The individual scores for the specific exam problem addressing this PEC was not recorded.
For the next round of assessment (Spring 2011) the scores for the specific problem of the exam and the criteria for meeting the PEC will be presented. Overall no changes required at the classroom level in terms of course curriculum.

Recommendation:
At present, no curricular changes will be implemented based on the assessment of this Student Outcome. However in the next round of assessment (Spring 2011) the scores for the specific problem of the exam and the criteria for meeting the PEC will be presented.

Student Outcome 2: Ability to design/conduct experiments and analyze/interpret data

SO 2 is supported in the MatE curriculum through a number of lecture and laboratory courses; MatE 25, MatE 141, MatE 153, MatE 54, MatE 155, ChE 161, ChE 162, MatE 143, MatE 144, MatE 191, MatE 185, MatE 195, and MatE 198A/B. The laboratory courses involve conducting experiments and analyzing and interpreting data. The lecture courses discuss how to properly design a set of experiments to meet a particular objective. The opportunity to design experiments is offered in the elective class MatE 129 and is a critical component of MatE 198A/B. This outcome was assessed in MatE 143, MatE 198A/B and SCD as two performance criteria (Table E-28).

Table E-28: SO2 Summary

Student Outcome 2		Performance Criteria	MatE 143	MatE 198A/B	SCD
Ability to design/conduct experiments and analyze/interpret data	2.1	Select appropriate materials characterization tools, utilize the tool safely, and interpret experimental results.	Level: 3 Presentation (100%) Lab Practicel (100%)		Level: 3 Industry Survey (33%)
	2.2	Design and analyze appropriate experiments to measure or optimize specific engineering properties, incorporating statistical procedures.		Level: 3 Final Report (100%)	Level: 3 Industry Survey (33%)

SO2 (PEC 2.1): Select appropriate materials characterization tools, utilize the tool safely, and interpret experimental results.

MatE 143 Level 3

Assignment: Oral presentation/ lab practical.

Mastery: Demonstrated the ability to operate the SEM and EDX and make cursory interpretations of the images. (Score of 80%).

Results:

- All students met the objective in Fall 2010.
- All students met the objective in Fall 2009.

No changes required at the classroom level.

Student Conference Day (Level 3)

This criterion was evaluated as part of the SCD oral presentation to industry reviewers. The reviewers were asked to rate how well the students addressed the statement *"Select appropriate characterization methods and interpret experimental results of materials characterization tools".*

The scale used was:

5 = Exceed the objective

4 = Meets the objective

3 = Addresses the objective but misses minor issues

2 = Addresses the objective but misses key issues
1 = Fails to meet the objective
This requirement was evaluated as part of the SCD oral presentation (Spring 2010). Only two out of six students met this requirement based upon industry reviewers.
The results are summarized below in Table E-29:

Table E-29: SCD PEC 2.1 Results

Assessment Statement	Nimori & Bringuier	T. Chen	Vu & Yeung	H. Nguyen	Pandya	Fessehatzion	Overall
# of Evaluators	18	14	17	8	10	10	
Select appropriate characterization methods and interpret experimental results of materials characterization tools.	*3.25*	*3.14*	*3.97*	*3.00*	4.30	4.65	**3.72**

The written reviewers' comments stated that the students/teams selected the appropriate tools/methods. However, the reviewers found weakness in the students' ability to completely justify the selection process.

SO2 (PEC 2.2): Design and analyze appropriate experiments to measure or optimize specific engineering properties, incorporating statistical procedures.

MatE 198A/B (Level 3)
Assignment: Students final report.
Mastery: Defend/justify their experimental procedures, clearly identify dependent and independent variables, and discuss how to process data statistically.
Results:

- All students in Spring 2010 met this requirement.
- All students in Spring 2009 met this requirement.

No changes required at the classroom level.

Student Conference Day (Level 3)
This criterion was evaluated as part of the SCD oral presentation to industry reviewers. The reviewers were asked to rate how well the students addressed the statement *"Design, conduct and analyze an appropriate experiment to measure materials properties using statistical procedures".*
The scale used was:
5 = Exceed the objective
4 = Meets the objective
3 = Addresses the objective but misses minor issues
2 = Addresses the objective but misses key issues
1 = Fails to meet the objective
This requirement was evaluated as part of the SCD oral presentation (Spring 2010). Only two out of six students met this requirement based upon industry reviewers.
The results are summarized below in Table E-30

Table E-30: SCD PEC 2.2 Results

	Assessment Statement	Nimori & Bringuier	T. Chen	Vu & Yeung	H. Nguyen	Pandya	Fessehatzion	Overall
	# of Evaluators	18	14	17	8	10	10	
Ability to design/conduct experiments and analyze/interpret data	Design, conduct and analyze an appropriate experiment to measure materials properties using statistical procedures.	*3.33*	*3.07*	*3.74*	*3.00*	4.10	4.25	**3.58**

The written reviewers' comments indicate that the evaluations were also based upon the quality of the data collected. In some cases the students' projects concluded that there original hypothesis was incorrect. In all of the cases where their hypothesis was proved to be false the data was very noisy and difficult to analyze. While this data indicates that the students did not present an acceptable DOE and statistical analysis, the review of the final project report indicates that the students understood the process of DOE and statistical analysis.

Recommendation:

At present, no curricular changes will be implemented based on the assessment of this Student Outcome. However in the next round of assessment (Spring 2011) for SCD students will be told that their presentation must include a justification of characterization methods and more emphasis on data analysis.

Student Outcome 3: Ability to design system, component or process to meet desired needs

SO 3 is supported in the MatE curriculum through a number of classes including MatE 25, MatE 154, MatE 155, MatE 185, MatE 186, MatE 191, MatE 195, and MatE 198A/B. Each of these courses has a design assignment that requires students evaluate a product/material in terms of specific material performance parameters. This outcome is assessed in MatE 195 (Mechanical Behavior of Materials) and in the SCD survey (Table E-31).

Table E-31: SO3 Summary

Student Outcome 3		Performance Criteria	MatE 195	SCD
Ability to design system, component or process to meet desired needs	3.1	Select and evaluate appropriate materials and processing methods based on desired performance.	Level: 2 Lab Expts (100%)	Level: 3 Industry Survey (33%)

SO3 (PEC 3.1): Select and evaluate appropriate materials and processing methods based on desired performance.

MatE 195 (Level 2)

Assignment: This criteria was evaluated by the testing methods and data results section of a lab report studying materials performance

Mastery: Students were expected to successfully conduct all required material testing (included impact, tensile, hardness, heat treatment, and bend test) and at a minimum correctly present the data obtained from each test.

Results:

- Fall 2010 - All students met this objective
- Fall 2009 - All students met this objective

Student Conference Day (Level 3)

This criterion was evaluated as part of the SCD oral presentation to industry reviewers. The reviewers were asked to rate how well the students addressed the statement *"Evaluate and select appropriate materials and processing methods based on desired performance".*

The scale used was:

5 = Exceed the objective
4 = Meets the objective
3 = Addresses the objective but misses minor issues
2 = Addresses the objective but misses key issues
1 = Fails to meet the objective

The results are summarized in (Table E-32)

Table E-32: SCD PEC 3.1 Results

	Assessment Statement	Nimori & Bringuier	T. Chen	Vu & Yeung	H. Nguyen	Pandya	Fessehatzion	Overall
	# of Evaluators	18	14	17	8	10	10	
Select and evaluate appropriate materials and processing methods based on desired performance	Evaluate and select appropriate materials and processing methods based on desired performance.	*3.83*	*3.32*	*3.93*	*3.75*	4.05	4.33	**3.87**

Only 33% (two out of six) earned an average score that indicates that they met the objective. Written comments from the reviewers indicate that all students with the exception of one (score 3.32) were very close to meeting the objective and that they simply lacked enough detail. Given that the students only have 20 minutes to present their project it is to be expected that some details are omitted from the presentation.

More emphasis will be put into justifying material selection for the next SCD.

No changes required at the classroom level.

Recommendation:

At present, no curricular changes will be implemented based on the assessment of this Student Outcome.

Student Outcome 4: Ability to function on multi-disciplinary teams

SO 4 is supported in the MatE curriculum in MatE 141, MatE 153, MatE 155, and MatE 152. The PEC stated below is designed to provide MatE students with the elements of professionalism needed to function on multidisciplinary teams in the workplace. There are group projects within the MatE program, as well as with ChE students in group projects in shared courses within the department. The outcome is assessed in two courses in the curriculum: Mate 141 and MatE 153 (Table E-33).

Table E-33: SO4 Summary

Student Outcome 4		Performance Criteria	MatE 141	MatE 153
Ability to function on multi-disciplinary teams	4.1	Contribute unique expertise to a multifaceted team	Level: 3 InClass Assign(100%)	Level: 3 Presentation (100%)

SO4 (PEC 4.1): Contribute unique expertise to a multifaceted team

MatE 141 Level 3

Assignment: Assessed in an in-class exercise where students were grouped in teams requiring each person to become an expert in a particular technique of diffraction. Prior to the in-class exercise students were all assigned a specific diffraction technique and asked to read the textbook section and online tutorials for that technique. Each team was given a worksheet to complete that required each team member to lead/explain/teach the portion of the worksheet as the "expert".

Mastery: The instructor evaluated the students' performance anecdotally while observing each team interacting in the classroom.

Results

- Spring 2010- Results were anecdotal. All students participated in the activity. Students were uncomfortable being the expert on the team. Not all students were able to teach the others on their team. Also, some students did not come to class prepared to talk about their technique.

In Spring 2011, the assignment will be improved by giving and collecting a more formal homework assignment to make sure all students come prepared and grading the complexity of the answers the teams are able to produce.

MatE 153 (Level 3)

Assignment: Final team lab assignment. The teams are multi-disciplinary teams of different engineering majors. In the final lab, they do a design experiment using either solar cells or LEDs. The teams present an oral presentation of their results. Teamwork is assessed in the rubric.

Mastery: For successful mastery of this criterion, students must identify their unique component of knowledge on the project and articulate it effectively through an oral communication medium (clear, well organized, professional looking slides and confident oral delivery).

Results:

- Fall 2010 – All students have met the criteria

- Spring 2010 – All students have met the criteria
- Spring 2009 – All students have met the criteria

While all student met this criterion, future assessment will focus on evaluating the students contribution to the project in terms of their unique expertise/role as a team member.

Recommendation:

The assessment indicates that MatE students function well in teams. The assessment assignments used need to be improved and modified to evaluate how a student's ability to contribute to a team as an expert in a specific facet of the project. The assessment should also evaluate the students understanding that a successful team requires each team member to have a unique skill that will make the team perform in a synergistic manner.

Student Outcome 5: Ability to identify, formulate and solve engineering problems

SO 5 is addressed in several courses in the program: MatE 115, MatE 154, MatE 143, MatE 144, MatE 152, MatE 185, MatE 186, MatE 195, and MatE 198A/B. This outcome builds on the fundamental concepts used in the lower division core courses. Progressing through the program students are required to solve more complex engineering problems. PEC 5.1 was assessed in MatE 152, MatE 198A/B and SCD (Table E-34).

Table E-34: SO5 Summary

Student Outcome 5		Performance Criteria	MatE 152	MatE 198A/B	SCD
Ability to identify, formulate and solve engineering problems	5.1	Assess needs, formulate problem statement, structure and evaluate solutions in solving real-world materials engineering problems.	Level: 2 HW Prob (50%) Exam (80%)	Level: 3 Final Report (100%)	Level: 3 Industry Survey (67%)

SO5 (PEC 5.1): Assess needs, formulate problem statement, structure and evaluate solutions in solving real-world materials engineering problems.

MatE152 (Level 3) PEC 5.1 was assessed in MatE 152 by homework assignment and exam problem.

Homework assignment: Involved several mathematical examples where the students had to evaluate the manufacturing settings given to determine which mathematical diffusion model was appropriate.

Mastery: Students were expected to successfully analyze the manufacturing setting to choose the appropriate boundary conditions and solution (constant source or constant dose solutions to Fick's second law) and then set up the calculation properly (utilize the correct equations).

Results:

Previously, in **Spring 2009. 75%** of the students met the criteria on the homework assignment. The drop in performance in **Spring 2010 to 50%** is believe to be due to some students not allotting adequate time and effort into the homework problems. In Spring 2011, an alternative to the homework format will be established.

Exam problem: Involved students successfully modeling a diffusion application.

Results:

- Spring 2009 75% overall exam score
- Spring 2010 75% overall exam score

In both semesters individual performance on the exam problem was not recorded. While students performed well on the exam overall, it is difficult from this assessment tool to evaluate the PEC 5.1. The Spring 2011 assessment of this PEC will involve a direct assessment of a specific exam problem

MatE 198A/B (Level 3)

Assignment: Written assignment. Students were asked to construct a problem statement as the first step for designing their senior projects.

Mastery: The assignment required students to clearly state their projects goals, objectives, and constraints.
Results

- Fall 2009 all student have successfully met the criteria.
- Fall 2010 all student have successfully met the criteria.

No changes required at the classroom level.

SCD Assessment
Assignment: Oral final project presentation. Students were given 20 minutes to present their Senior Design project to a panel of industry reviewers. Reviewers were asked to evaluate the students ability to formulate and solve and engineering problem.
Mastery: This criterion was evaluated as part of the SCD oral presentation to industry reviewers. The reviewers were asked to rate how well the students addressed the statement *"Assess needs, formulate problem statement, structure and evaluate solutions in solving real-world materials engineering problems".*
The scale used was:
5 = Exceed the objective
4 = Meets the objective
3 = Addresses the objective but misses minor issues
2 = Addresses the objective but misses key issues
1 = Fails to meet the objective
The individual results are summarized below
This requirement was evaluated as part of the SCD oral presentation (Spring 2010). Four out of six students met this requirement based upon industry reviewers.
The results are summarized below in (Table E-35).

Table E-35: SCD PEC 5.1 Results

	Assessment Statement	Nimori & Bringuier	T. Chen	Vu & Yeung	H. Nguyen	Pandya	Fessehatzion	Overall
	# of Evaluators	18	14	17	8	10	10	
Ability to identify, formulate and solve engineering problems	Assess needs, formulate problem statement, structure solutions and identify role of materials engineering in solving real-world problems.	4.17	*3.59*	*3.88*	4.09	4.11	4.44	**4.05**

Written comments by the reviewers suggest that all students did meet the PEC objective. Comments on the two presentations that did not score above 4.0 stated that the needs, problem formulation and evaluation were adequate. The comments suggested that students consider additional possible needs and that the evaluation criterion be expanded to consider a broader scope problem.
Recommendation:
At present, no curricular changes will be implemented based on the assessment of this Student Outcome.

Student Outcome 6: Understanding of professional and ethical responsibility

SO6 (PEC 6.1): Formulate and address ethical issues which arise in solving engineering problems and in the workplace.

This outcome is addressed in the following courses in the program: MatE 155, ChE 161, and MatE 198A/B in terms of the performance evaluation criterion listed above (6.1). The results are summarized in Table E-36.

Table E-36: SO6 Summary

Student Outcome 6		Performance Criteria	ChE 161	MatE 198A/B
Understanding of professional and ethical responsibility	6.1	Formulate and address ethical issues which arise in solving engineering problems and in the workplace.	Level:1 Exam Question (88%) Level: 1 Paper (88%)	Level: 3 Homework (100%) Level: 3 Chapter assignment (100%)

ChE 161 (Level 1) This outcome with two assignments.

Assignment 1: Memorize the 6 fundamental cannons of the NSPE code of ethics.

Mastery: Students needed to write and explain four out of six cannons correctly

Results

- Fall 2009 88% of all students met the criteria.
- Fall 2010 88% of all students met the criteria.

Assignment 2: Write a paper about one of 3 case studies provided in class.

Mastery: Students needed to identify all ethical and describe all ethical issues in the case study. The descriptions of the issues were allowed to have minor errors.

Results

- Fall 2009 88% of all students met the criteria.
- Fall 2010 88% of all students met the criteria.

MatE 198A/B (Level 3) Assessed with two homework assignments.

Assignment 1: Required the students to analyze a real-world engineering case related to ethics.

Mastery: Identify the engineering ethical issues and describe any solutions presented in the case study and offer possible alternative solutions.

Results

- Fall 2009 four of five students met the criteria
- Fall 2010 all three students met the criteria

Assignment 2: Chapter of broader considerations which included ethics, safety, legal, social and environmental impacts associated with their project.

Mastery: The chapter had to identify any ethical, safety or legal issues related to their project. Students were also expected to provide a description of any issues identified with only minor errors.

Results

- Spring 2010: Four of Six met the criteria
- Spring 2011: All three met the criteria

Recommendation:

At present, no curricular changes will be implemented based on the assessment of this Student Outcome. However the assignments used In MatE 198A/B will be mandatory for students to submit for successful completion of the course

Student Outcome 7: Ability to communicate effectively

SO7 (PEC 7.1): Communicate effectively through formal and informal written and oral means.
Most MatE courses require writing and oral presentation as is evident in Table 4-4. Students receive detailed feedback on their assignments and faculty note marked improvement in the students ability to communicate effectively as they progress through the curriculum.
This outcome was assessed in MatE 115, MatE 198A/B, Engr100W and SCD (Table E-37).

Table E-37: SO7 Summary

Student Outcome 7		Performance Criteria	MatE 115	MatE 198A/B	Engr 100W	SCD
Ability to communicate effectively	7.1	Communicate effectively through formal and informal written and oral means.	Level: 3 Poster/Project (100%)	Level: 3 Reports (100%) Presentaitons (100%)	Level: 2 Entire Course (100%)	Level: 3 Industry Survey (83%)

MatE 115 (Level 3)

Assignment: Students must choose a topic in the National Academy of Engineer's Grand Challenges and research the materials science and engineering issues involved.
Mastery of PEC: Students must have a well written, well organized report with minimal typos and grammatical errors.
Results

- Fall 2008:
    - 11 out of 11 met the criteria for the executive summary of the written report
    - 10 out of 11 met the criteria for the poster.
- For Fall 2009: 3 out of 3 met the criteria for the executive report, literature review and poster.
- For Fall 2010: 3 out of 3 met the criteria for the executive report, literature review and poster.

MatE 198A/B (Level 3)

Assignment 1: Students to analyze a real-world engineering case related to ethics. Write a case study report.
Mastery of PEC: Students must correctly identify the ethical issues in the case study and clearly summarize the results of the study with minimal grammatical errors
Results:

- Fall 2009 five of five students met the criteria
- Fall 2010 all three students met the criteria

Assignment 2: Students write a chapter of broader consideration for Senior Design Final Report
Mastery of PEC: Minimal grammatical errors. Explanation of consideration must be clearly presented.
Results

- Spring 2010: Six of six students met the criteria

- Spring 2011: Both students that submitted the chapter met the criteria. The student that did not submit the chapter met the criteria in the final report.

Engr100W (Level 2): This technical report writing class requires students to write various papers to demonstrate their writing capabilities.
Assignment: Final written paper assignment
Mastery: All students must score 8 or better (out of 12) on the written assignment. This is a standardized score specifically for Engr100W.
Results
All students meet the criteria every year.
Student Conference Day (Level 3)
Assignment: Oral final project presentation. Students were given 20 minutes to present their Senior Design project to a panel of industry reviewers. Reviewers were asked to evaluate the students ability to orally communicate.
Mastery: This criterion was evaluated as part of the SCD oral presentation to industry reviewers. The reviewers were asked to rate how well the students addressed the statement *"Give an effective oral presentation".*
The scale used was:
5 = Exceed the objective
4 = Meets the objective
3 = Addresses the objective but misses minor issues
2 = Addresses the objective but misses key issues
1 = Fails to meet the objective
The individual results are summarized below in Table E-38.

Table E-38: SCD PEC 7.1 Results

	Assessment Statement	Nimori & Bringuier	T. Chen	Vu & Yeung	H. Nguyen	Pandya	Fessehatzion	Overall
	# of Evaluators	18	14	17	8	10	10	
Ability to communicate effectively	Give an effective oral presentation.	4.35	*3.41*	4.18	4.12	4.40	4.65	**4.18**

Spring 2010: The average result from the Industry reviewers indicated that they thought five (5) out of the six (6) oral presentations met the objective.
Recommendation:
At present, no curricular changes will be implemented based on the assessment of this Student Outcome.

Student Outcome 8: Understand the impact of engineering solutions in a global/societal context

SO8 (PEC 8.1): Optimize materials engineering products and processes to positively impact global and societal issues.

Students should be able to analyze a solution to a technical problem beyond a simple analytical solution. Students should also consider the broader impact to engineering solutions. This concept is addressed in the following courses: MatE 115, MatE 152, MatE 154, MatE 155, ChE 161, MatE 185, MatE 186, and MatE 198A/B.

This outcome is assessed in MatE 155, and MatE 198A/B as PEC 8.1 (Table E-39).

Table E-39: SO8 Summary

Student Outcome 7		Performance Criteria	MatE 155	MatE 198A/B
Understand the impact of engineering solutions in a global/societal context	8.1	Optimize materials engineering products and processes to positively impact global and societal issues.	Level: 2 Exam Prob (86%) Exam Prob (15%)	Level: 3 Homework (100%) Level: 3 Chapter assignment (100%)

MatE 155 (Level 3)

Assignment 1: Two Examination problems that have students evaluate products in terms of global and societal impact.

Mastery: Students must show a minimum understanding of the impact of global or societal issues and recommend possible improvements in the product with respect to global and societal impact.

Results:

Spring 2010-Exam Problem 1: Six out of seven students met the criteria

Spring 2010-Exam Problem 2: one out of seven students met the criteria.

This exam problem's scope was to large to accurately evaluate the global and societal impact. The instructor realized that this problem was poorly designed and will reword problem for the future.

MatE 198A/B (Level 3)

Assignment: Chapter of broader considerations which included ethics, safety, legal, social and environmental impacts associated with their project.

Mastery: The chapter had to identify any social or environmental issues related to their project. Students were also expected to provide a description of any issues identified with only minor errors.

Results:

- Spring 2010: Six of six students met the criteria
- Spring 2011: Both students that submitted the chapter met the criteria. The student that did not submit the chapter met the criteria in the final report.

Recommendation:

At present, no curricular changes will be implemented based on the assessment of this Student Outcome. It was the decision of the faculty to start collecting and assessing this SO in MatE 155 this year. After evaluating the SO to Course matrix it was noted that this outcome was only being assessed in one place (Summer 2009 ABET retreat). We will continue to assess this outcome in these two courses.

Student Outcome 9: Recognition of the need for and an ability to engage in life-long learning

The two PEC that address this criteria involve the skill of finding information on one's own using appropriate available resources and utilizing and participating in ongoing professional development. These two PECs are addressed in many courses in the curriculum (Table 4-4). The PECs are assessed in MatE 155 and 152 (Table E-40).

Table E-40: SO9 Summary

Student Outcome 9		Performance Criteria	MatE 155	MatE 152
Recognition of the need for and an ability to engage in life-long learning	9.1	Recognize that materials engineering is diverse and continuously evolving and that finding solutions may involve exploring new knowledge.	Level: 3 HW Prob (50%)	
	9.2	Uncover, critically evaluate, and synthesize knowledge from multiple sources.		Level: 3 Lit Review (100%)

SO9 (PEC 9.1): Recognize that materials engineering is diverse and continuously evolving and that finding solutions may involve exploring new knowledge.

MatE 155 (Level 3)

Assignment: Homework assignment in which students were asked to examine a case study, or set of cases that require the measurement of a material property that previously was not required by the product design. This assignment was done differently over the past two years. Spring 2011 this was done as a team assignment. Spring 2010 this was done as an individual assignment.

Mastery: Students/teams identify the new material property requirement and comment on why this new requirement is necessary for the product.

Results:

- Spring 2011: One out of two teams (2 students out of four) met the criteria. It should be noted that one team did not even turn in the assignment.
- Spring 2010: Using an aggregate average 87% of the students met the criteria

SO9 (PEC 9.2): Uncover, critically evaluate, and synthesize knowledge from multiple sources.

MatE 152 (Level 3)

Assignment: Literature review of a nucleation or phase transformation phenomena of the student's choice

Mastery: Students must have found at least three *relevant* published journal articles, properly reference them, and critically evaluate the content of the paper.

Results

- Spring 2008: Four out of five students
- Spring 2009: Assignment not given due to student comments from S08 of to many assignments
- Spring 2010*: Eleven out of eleven students

*Assignment was reinstated because the instructor felt the students didn't not fully synthesize the material from the class

Recommendation:

At present, no curricular changes will be implemented based on the assessment of this Student Outcome.

Student Outcome 10:Knowledge of contemporary issues

SO10 (PEC 10.1): Demonstrate use of materials engineering in emerging applications.

The concept of using utilizing materials in new engineering applications is addressed in many of the courses in the curriculum. This outcome is assessed specifically as PEC 10.1 in MatE 115 and MatE 185 (Table E-41).

Table E-41: SO10 Summary

Student Outcome 10		Performance Criteria	MatE 115	MatE 185
Knowledge of contemporary issues	10.1	Demonstrate use of materials engineering in emerging applications.	Level: 2 Poster/Project (100%)	Level: 2 Project/Present (100%)

MatE 115 (Level 3)

Assignment: Students must choose a topic in the National Academy of Engineer's Grand Challenges and research the materials science and engineering issues involved and create a poster and complete a written project report.

Mastery: Articulate the basic materials science issue relevant to this technology, briefly describe an overview of the relevant industry, and discuss the societal implications of the technology (75% for report, presentation, and poster)

Results:

- Fall 2008: Eleven out of eleven student met the poster criteria. Ten out of eleven met the written report criteria. No presentations were assessed
- Fall 2009: Three out of three met all three assessment measurements (poster, presentation, report) criteria.
- Fall 2010: Five out of five met all three assessment measurements (poster, presentation, report) criteria.

MatE 185 (Level 3)

Assignment: Presentation and written report on a materials application. Application is slectd from a list given to the students by the instructor. Students work in teams of two to complete the assignment.

Mastery: Criteria is based upon the rubric shown below in Table E-42.

Table E-42: Grading Rubric

Scoring Attribute	**1** Unacceptable	**2** Marginal	**3** Proficient	**4** Excellent	Score 1 to 4
Topic selection and scope	Topic was too broad for this length talk.	Major difficulty with scope fitting the time.	Some difficulty with the scope fitting the allotted time.	Topic selection was focused and fit the allotted time.	

Clarity of Introduction	Introduction did not identify the topic being presented or suggest the scope.	Topic was clear but the scope to be covered was not clear.	Introduction left minor questions of scope.	Introduction left no doubt about topic or scope being covered.	
Information Content	Organization was not clear and data or figures did not support the main points.	Presenter had organized points. Some data or figures did not fit well.	Presenter had well organized points. Most data or figures fit and supported main points well.	Presenter made well organized points and used good data or figures to support the main points.	
Presentation design	Slides were difficult to read and the figures were difficult to interpret. Background confusing.	Slides were difficult to read or figures were difficult to interpret. Background somewhat confusing.	Format was readable. Most photos or figures were helpful. No confusion from background.	Format was easy to read and the figures or photos added interest to the talk. No confusion from background.	
Pacing and Delivery	Talk was too short or too long. Problems in verbal expression of ideas were significant.	Pacing was too fast or too slow. Some minor problems in clarity of verbal expression of ideas.	Good pacing to finish on time. Some hesitation in verbal statements but the meaning was clear.	Smooth flowing verbal style with good pacing and finished on time.	

Mastery of the criteria is an overall score of 75 using the rubric.

Results:

- Fall 2009: Ten out of ten students (four teams) (100%)
- Fall 2008: 18 out of 19 students (six teams) (95%)

Recommendation:

At present, no curricular changes will be implemented based on the assessment of this Student Outcome.

Student Outcome 11:Ability to use the techniques, skills and modern tools necessary for engineering practice

To meet this criteria student must be provided with opportunities to use the techniques and tools in which to develop their skill. For Materials Engineers, the elements we have identified are (i) tools for characterization of structure and properties; and (ii) computing and communication tools. The faculty has identified two PECs to address this outcome and it is assessed in two courses (MatE 143, and MatE 152) (Table E-43).

Table E-43: SO11 Summary

Student Outcome 11		Performance Criteria	MatE 143	MatE 152
Ability to use the techniques, skills and modern tools necessary for engineering practice	11.1	Utilize modern tools and techniques to alter, characterize, and measure materials properties and to design processes according to accepted standards.	Level 3 Lab assignment (100%)	
	11.2	Demonstrates advanced proficiency in pertinent software.		Level:2 Computer Project (70%)

SO11 (PEC 11.1): Utilize modern tools and techniques to alter, characterize, and measure materials properties and to design processes according to accepted standards.

MatE 143 (Level 3)

Assignment: Laboratory report explaining how to operate the SEM and obtain specified material properties

Mastery: Students must show correct and safe usage of SEM with an emphasis on using the tool settings in variable modes to get certain materials properties.

Results

- Fall 2010: Eleven out of eleven student (100%)
- Spring 2010: Seven out of eight students (88%)

SO11 (PEC 11.2): Demonstrates advanced proficiency in pertinent software.

MatE 152 (Level 3)

Assignment: Engineering memo explaining a theoretically generated phase diagrams and a model of diffusion.

Mastery: Develop a set of structured complex mathematical functions in Excel (or similar program) in such a manner to perform accurate calculations for multiple variables, and generate professional looking plots that clearly represent the results.
Results:

- Spring 2009: Ten out twelve students (83%)
- Spring 2010: Eleven out of twelve students. (92%)

Recommendation:
At present, no curricular changes will be implemented based on the assessment of this Student Outcome.

Appendix F: Department Lower Division and Junior Core Policy

CME Lower Division and Junior Core Policy

The CME faculty established a Lower Division Core, Junior Core and a Senior Core over the time period Fall 2001 to Spring 2003. These GPA requirements were enacted through course pre-requisites and are reflected in the catalogue. However the overall Lower Division and Junior Core requirements were not easy for students to see and were not presented in Advising documents or on the Website in an easily accessible location.

In Spring 2005 the faculty agreed to include the following requirements on all relevant advising documents including those posted on the CME Website. The final wording as presented below was passed by unanimous vote of the faculty at the faculty meeting on January 18, 2006.

Department of Chemical and Materials Engineering San José State University Core GPA Requirements

The Lower Division Core for Chemical and Materials Engineering majors The Lower Division Core is defined as the following set of courses or their equivalents taken at other colleges:

Math 30, 31, 32 and 133A

Chemistry 1A and 1B

Physics 50, 51 and 52 or Physics 70 and 71

MatE25, CE99, Engr10 and EE98

The Lower Division Core (LD Core) must be satisfied with a GPA of 2.0 or better in order to graduate. The following portion of the Lower Division Core must be satisfied with course grades of C- or better in order to enroll in the Junior Core: Phys 51 and Phys 52, or Physics 72; Math 33, 32 and Math 133A, Chem 1A and Chem 1B.

In addition MatE majors must also complete MatE 25 with a C- or better in order to enroll in the Junior Core.

The Junior Core for Chemical Engineering Majors ChE majors must satisfy the Lower Division Core before enrolling in the Junior Core classes. The Junior Core consists of a 2.0 average in {ChE 115, ChE 151, ChE 160A, ChE 162 and ChE 190} and E100W. Students receiving a grade less than C- in a Junior Core course may have to repeat the course. The Junior Core must be satisfied in order to enroll in Senior Core courses.

The Junior Core for Materials Engineering Majors MatE majors must satisfy the Lower Division Core before enrolling in the Junior Core classes. The Junior Core consists of a 2.0 average in {MatE 115, MatE 141, MatE 151, MatE 153, MatE 154 and MatE 155} and E100W. Students receiving a grade less than C- in a Junior Core course may have to repeat the course. The Junior Core must be satisfied in order to enroll in Senior Core courses.

The Senior Core for Chemical Engineering Majors ChE majors must satisfy the Junior Core before enrolling in the Senior Core classes. The ChE Senior Core consists of {ChE 161L, 162L, 165, 185, 160B, and 158}.

The Senior Core for Materials Engineering Majors MatE majors must satisfy the Junior Core before enrolling in the Senior Core classes. The MatE Senior Core consists of {MatE 195, 198A, 198B, 185, and 152}.

Appendix G: Alumni Survey Questionnaire

San Jose State University
College of Engineering
Chemical Engineering Alumni Survey

Demographic Information					
Name					
Address					
Phone		Email			
Employer Name					
Employer Address					
Present Job Title				Years at this title	
Previous Positions				Years at this position	
Year of SJSU graduation					

Job Information

Which are the most appropriate descriptor(s) of your job responsibilities (check all that apply):

- □ Design
- □ Research
- □ Development
- □ Manufacturing
- □ Testing
- □ Other (please specify)

Career Growth

Advanced Degree or Certificate Programs

Have you been enrolled in a graduate program? □ yes If yes: □ full-time □ part-time
□no If no: skip to Certificates question

Program of enrollment	List institutions attended:	List # courses enrolled
□ M.S. □ MBA □ MEng □ Ph.D. □ Other_____		List # of courses completed

Did you complete the degree? □ yes □no

If you did not complete the degree, what is your expected graduation date?

Have you been in enrolled in certificate or other company training programs? □ yes □no

- If yes, list those programs you enrolled in and also those you have completed.

Are you currently a member of any professional societies? □ yes □no

- If yes, list all societies for which you have an active membership status.

Program Educational Objectives are defined as career and professional accomplishments that are to be achieved within the first few years of graduation. The Objectives for our Chemical

Engineering program are to produce graduates who, within 3 years of graduation, are able to:

I. Be employed as a practicing engineer in fields such as design, research, development, testing, and manufacturing;

II. Engage in lifelong self-directed learning to maintain and enhance professional skills.

III. Conduct themselves as ethical and responsible professionals as well as articulate the environmental, safety and economic impacts of their work on society.

IV. Demonstrate leadership skills in the workplace.

In regards to these objectives above, please indicate one of the following below:

☐ I agree that this is the appropriate set of objectives

(OR)

☐ The objectives should be changed. Please indicate recommended changes in the space below.

Additional Questions

a. In your place of employment, have you had the opportunity to apply the skills you learned at SJSU regarding **environmental health and safety**, including to

(check all that apply)

_____i. Implement existing corporate practices or develop improved practices for environmental waste management.

_____ii. Contribute to team discussions focused on the development of a new, or modification of an existing product or process with regards to safe work practices.

_____iii. Contribute to team discussions focused on the development of a new, or modification of an existing product or process with regards to process safety.

_____iv. Elucidate and document the environmental impacts of one or more products or processes or some aspect of the process

_____v. Other (please specify)

_____

_____

b. In your place of employment, have you had the opportunity to apply the skills you learned at SJSU regarding engineering **economics**, including to

(check all that apply)

____i. Contribute to the development of a new product or process that can increase the revenues for your company

____ii. Contribute to discussions among employees that result in effective cost cutting measures at the place of employment

____iii. Other (please specify)_____

_____

c. In your place of employment, have you demonstrated **leadership skills**, including to:

(check all that apply)

____i. Contribute to company strategic decisions through your work and/or participation in team planning and execution

____ii. Apply effective listening skills in team interactions

____iii. Make an oral presentation to your coworkers/supervisors

____iv. Solve technical problems, including timely trouble shooting, product or process development

____v. Motivate others toward a common goal

____vi. Present alternative strategies to problem solving from others on the team in a non-confrontational way

____vii. Contribute to the professional development of one or more employees at your place of work through mentorship or peer-peer guidance.

____viii. Demonstrate your interest in the work of others at your place of employment by inquiring about their projects and plans

____ix. Other (please describe)_____

_____

General Feedback

Overall, compared to my co-workers, I feel that my engineering education at San Jose State University prepared me well for my career.

☐ Completely disagree ☐ Partially disagree ☐ Neutral ☐Partially Agree ☐ Completely Agree

In the space below, please provide any general comments you have about the program, faculty, facilities, or your overall experience at SJSU. In particular, we would be interested in what you see as the program strengths and any suggestions you have for improvement. (Use back if necessary)

Appendix H: Template for faculty to complete for outcomes assessment

Outcome: **[Replace next line with your SO to be reviewed]**
1.0 Ability to apply knowledge of mathematics, science and engineering

(Course Learning Outcome (Performance Criterion)) Analyze systems through material and energy balances models

Performance criteria (level X) [State the level assessed 1,2 or 3]

[Insert your Performance Criterion here]
1.2 Select the materials and properties appropriate for a specific application.

Assignment: **[Replace example below with a description of you assignment used to assess the Performance Criterion here]**
problems on first midterm and/or final in MatE 115 that specifically require the development and solution of material properties.

Grading strategy/rubric:
[Describe your evaluation criteria and assigned score necessary to met the riteria here]
Each calculation that is correctly done (numerically correct answer) is given full credit. The solution is divided into individual calculations. If an error is made early in the calculation but the remainder is correctly done, they get credit for the correctly done calculations even though the numbers don't match the actual solution. Students who fail to meet the criteria most often either don't know where to start or get stuck early on, and so 60% represents a solution that has a lot correct in it and may be almost complete but with some calculation errors.

(Present your data as table or plot including #students evaluated in course and % of students meeting criterion on the assignment)

Additional information explaining the assessment:

Recommendation: [Example]
Strategy for Fall '10 is to (a) reduce the total course content and spend more class time on solution for material properties. (b) give quizzes instead of the homework assignments because the students have the solutions to the text book.