College of Engineering
&
Computer Science

Department of Ocean and Mechanical Engineering

Continuous Improvement Plan

Mechanical Engineering Undergraduate Curriculum

Plan for the Assessment and Continuous Improvement of the
Mechanical Engineering Undergraduate Curriculum
Department of Ocean and Mechanical Engineering
Florida Atlantic University
April 4, 2001 (latest modification 9/09)

The Mechanical Engineering program is accredited by the Accreditation Board for Engineering and Technology (ABET) and the Southern Association of Colleges and Schools (SACS). Both of these organizations have moved towards the requirement of a Continuous Improvement Program (CIP) for the curriculum and the progress of the students. The department has responded to these requirements in the following manner:

1. The establishment of a mission statement for the department.
2. The establishment of educational objectives for the department.
3. The development of program educational outcomes for student performance.
4. A mapping of the program educational outcomes to the educational objectives.
5. A mapping of the contents of each required course in the curriculum to the program educational outcomes.
6. The establishment of faculty course review groups with responsibility for particular sequences of courses in the program.
7. The development of a common course syllabus for each course that specifies the expected student outcomes for the course and relates them to the program educational outcomes.
8. The development of means of assessment for each of the intended course and program educational outcomes.
9. A means of providing feedback from the assessment tools to the Department ABET/SACS committee.
10. The forwarding of the recommendations of the ABET/SACS committee to the faculty at large, for decisions regarding adjustments or changes that are necessary to insure continuous improvement of the Mechanical Engineering program.

Each of these ten steps will be presented or discussed in detail. A flowchart has also been developed to show the linking of the different segments of the Continuous Improvement Program, which is presented in Appendix 1. The Educational Objectives established for the department will be reviewed by the ABET/ SACS Committee and the Department Advisory Committee every two years.

1. Mission Statement of the Mechanical Engineering Program

   The mission of the Mechanical Engineering program is to provide students with the fundamental background necessary for an active career in mechanical engineering, and to continue their education through post-graduate studies; to conduct basic and applied research; and to provide service to the engineering profession and to the community.

2. Educational Objectives for the Mechanical Engineering Program (revised 9/08)

   Within three to five years of graduation, graduates are expected to exhibit the following professional characteristics:

   A. Career Contribution and Advancement: Through their ability to solve engineering problems, meaningful design and hands-on experiences, critical thinking skills, and training in teamwork and communication, graduates will make significant contribution to their chosen field and advance professionally in mechanical engineering or allied disciplines.
   B. Professionalism: Graduates will act with both professional and social responsibility in their career field, including a commitment to protect both occupational and public health and safety, and apply ethical standards related to the practice of engineering.
   C. Life-Long Learning: Graduates will understand that their undergraduate education was just the beginning of their training, and will continue to develop their knowledge and skills through progress toward or completion of graduate education, and/or professional development through short courses or seminars, and/or professional certification, and/or participation in professional societies.

3. Program Educational Outcomes for Student Performance (revises 11/08)

   The program will meet the above objectives by establishing the following educational outcomes for student performance. These outcomes will be assessed using various evaluation procedures discussed in section 8 below.

   At the time of graduation, the students will attain the following:

   a. an ability to apply knowledge of mathematics, science, and engineering.
   b. an ability to design and conduct experiments, as well as 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, 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.

4. The mapping of the Mechanical Engineering program educational outcomes to the educational objectives is presented in Appendix 2.

5. The mapping of each required course in the Mechanical Engineering program to the program educational outcomes is presented in Appendix 3.

6. Five faculty Review Committees have been established with the responsibility for certain sequences of courses. These committees develop and maintain the common course syllabus for each course. They establish the prerequisites and corequisites for each course, the topics to be included and the expected course outcomes. These committees are responsible for addressing the feedback received from the surveys and assessment results and forwarding recommendations for change to the courses in their sequence of the curriculum to the Department ABET/SACS committee. They review their course sequence every year in the fall.

7. A common course syllabus has been developed for each required course in the Mechanical Engineering curriculum. These are posted on the internet on the Mechanical Engineering web page at www.me.fau.edu. The syllabi are maintained by the faculty Review Committees and updated as necessary each year based on evaluation of the assessment data.

8. The following assessment tools have been developed and are in use by the Mechanical Engineering Program:
   a. A Course Comment Form submitted by each faculty member for his/her courses at the end of the semester (example in Appendix 4-1). This form allows each faculty member to provide their input as to the achievement of the specified course outcomes that particular semester. It also allows comments on the preparedness of the students for the course, and the progress of the students in the course. The purpose is to highlight both positive and negative observations. The forms are reviewed by the Review Committees, with a summary statement provided to the ABET/SACS committee chair. This information is forwarded for discussion at a faculty meeting with any recommendations for change being voted on and put into effect.
   b. A Student Survey Form for each course (example in Appendix 4-2). This form is given to the students to rate their personal achievement on the published outcomes for the course. A rating scale of 1 to 5 (5 highest) is used for each outcome with an overall average of the outcomes reported for the course. This information is used to construct a Control Chart for the department to summarize and follow the progress of the student survey averages for courses. The goal is that 80 percent of the courses will achieve a 3.5 on the 5.0 scale. The chair meets with the faculty member to discuss a course that does not meet this level. The results of the Student Survey Forms are forwarded to the appropriate Review Committee for evaluation. Course outcomes are updated or changed, as is course material and emphasis, to improve the performance of the course.
   c. Faculty evaluation forms from Engineering Design and Design Project. These evaluation forms are prepared by the faculty teaching these courses, evaluating

the performance of the students on the senior design projects and presentations. A rubric has been developed to help with the evaluation by the faculty (Appendix 4-3, Assessment of Performance Rubric for Senior Design) The goal is for 70% of the teams to achieve a 7.0 on a scale of 10.0 for each of the four areas of performance (Technical Content of the Project, Writing Skills, Oral Presentation Skills, and Teaming Skills).

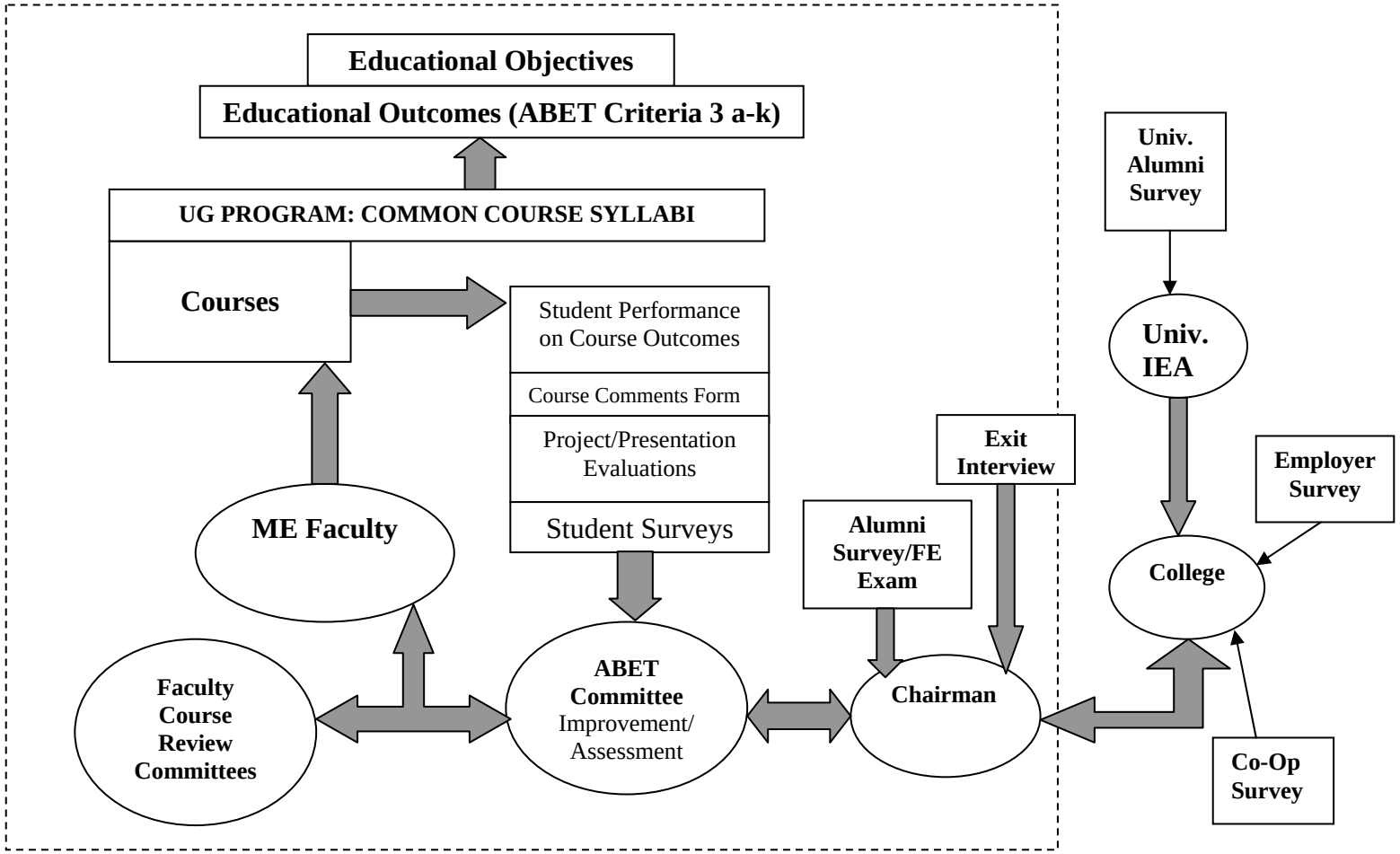
d. A peer review form used by the students in Engineering Design and Design Project to evaluate the performance of their design team members on the senior design project (example in Appendix 4-4). The faculty teaching the courses review and evaluate each student's contribution to their project based on the responses of the team members and include this information in (c.) above.
e. A Student Performance on Course Outcomes form for each course showing the average performance of the students in the course for each specified course outcome based on assignments. The data from column 1 are used to assess the program Educational Outcomes. An example is shown in Appendix 4-5. The goal is for each course outcome to be rated at 3.5 or greater on a 5.0 point scale. The form also shows the results of the student survey of outcomes for the course (column 2), and the faculty course comments form results for the course (column 3) for comparison.
f. A Summary of Student Performance spreadsheet. This table correlates the data for each course outcome from the Student Performance on Course Outcomes forms (Appendix 4-5) with the appropriate program a-k outcomes (there is a sheet for each a-k outcome). These data are used to assess the overall average student performance on the program educational outcomes. An example for outcome "a" is presented in Appendix 4-6. The goal is for each outcome to be rated at 3.5 or greater on a 5.0 point scale. The results are reviewed by the ABET/SACS committee and presented to the faculty.
g. A summary report from the Chairman of the Department of Ocean and Mechanical Engineering on the results of the following surveys (when available):
    1. University alumni survey
    2. Department alumni survey
    3. Coop survey (conducted by the College of Engineering)
h. A summary report from the Chairman of the Department of Ocean and Mechanical Engineering on the results of the exit interviews with graduating students. Each semester the Chairman of the department meets with the graduating students in a discussion group. The students also fill out a questionnaire. A summary of the meeting is written and presented to the faculty by the chair for discussion. Any recommendations for change are voted on by the faculty in a meeting and put into effect.
i. A summary report from the results of student performance on the Fundamentals of Engineering examination. Taking this exam is optional for the students, but they are able to earn two credit hours of Technical Elective by passing the exam.

9. The ABET/SACS committee reviews all of the assessment data. The committee evaluates the results and makes recommendations to the faculty for action based on its review.

10. The recommendations of the ABET/SACS committee will be acted upon in a faculty meeting as deemed appropriate. Course or curriculum changes will be forwarded to the faculty Review Committees for implementation.

APPENDIX 1
ASSESSMENT AND CONTINUOUS IMPROVEMENT PLAN

PROCESS FLOW CHART



Appendix 2 – Mapping of the Program Educational Outcomes to the Educational Objectives

	Outcome a	Outcome b	Outcome c	Outcome d	Outcome e	Outcome f	Outcome g	Outcome h	Outcome i	Outcome j	Outcome k
Objective A - Career Preparation: Through their ability to solve engineering problems, meaningful design and hands-on experiences, critical thinking skills, and training in teamwork and communication, graduates will make significant contribution to their chosen field and advance professionally in mechanical engineering or allied disciplines.	X	X	X	X	X		X				X
Objective B – Professionalism: Graduates will act with both professional and social responsibility in their career field, including a commitment to protect both occupational and public health and safety, and apply ethical standards related to the practice of engineering.						X		X		X	
Objective C – Life-Long Learning: Graduates will understand that their undergraduate education was just the beginning of their training, and will continue to develop their knowledge and skills through progress toward or completion of graduate education, and/or professional development through short courses or seminars, and/or professional certification, and/or participation in professional societies.									X		

Appendix 3
Mapping of ME Courses to Educational Outcomes

Program Educational Outcomes	EGN 1002 Fundamental of Engr.	EGS 1111C Eng. Graphics	EGM 3510 Statics	EGM 3400 Dynamics	EGM 3524 Strength of Materials	EGM 3521 Engineering Materials I	EML 3100 Thermodynamics I	EML 3701 Fluid Mechanics	EML 3523C Experiment Methodology	EML 4380 System Dynamics	EML 4142 Heat Transfer	EML 4127 App. Therm. Fluid Engr.
Outcome a:	X	X	X	X	X	X	X	X	X	X	X	X
Outcome b:									X			
Outcome c:	X									X		X
Outcome d:	X											
Outcome e:	X	X	X	X	X	X	X	X	X	X	X	X
Outcome f:	X											
Outcome g:	X		X	X	X	X	X	X	X			X
Outcome h:	X											
Outcome i:	X											
Outcome j:	X					X						X
Outcome k:	X	X	X	X	X	X	X	X	X	X	X	X

Appendix 3
Mapping of ME Courses to Educational Outcomes

Program Educational Outcomes	EML 2538 Comp. App. In ME I	EML 4534 Comp. App. In ME II	EML 4500 Machine Design I	EML 4262 Machine Design II	EML 4521 Engineering Design	EML 4551 Design Project	EML 4730 Mechanical Engineering Lab	MAP 4306 Engineering Mathematics II	STA 4032 Probability & Statistics for Engineers	EGM 4045 Electro-Mechanical Devices	General Education Courses	Math/ Comp/ Phy/ Chem Courses
Outcome a:	X	X	X	X	X	X	X	X	X	X		X
Outcome b:							X					
Outcome c:			X	X	X	X				X		
Outcome d:					X	X						
Outcome e:	X	X	X	X	X	X	X	X	X	X		
Outcome f:					X	X					X	
Outcome g:	X		X		X	X	X				X	
Outcome h:					X	X					X	
Outcome i:					X	X						
Outcome j:					X	X					X	
Outcome k:	X	X	X	X	X	X	X	X	X	X		X

Appendix 4
Evaluation Sheets and Surveys

Appendix 4-1 - Mechanical Engineering Program
Faculty Course Comments Form

Course Number and Title:_____
Semester Taught:_____
Instructor:_____
Prerequisites:_____

This form is to be used at the end of the semester to make comments about your experiences with the students in your class. Please make any comments that you feel are appropriate about positive or negative observations.

- Do you feel that the students had the necessary background from the prerequisite courses that they needed? Was remedial work necessary?

- Do you feel that they progressed throughout the semester as you planned?

- Please use the following 0 to 3 scale to rate your coverage of topics/skills of each outcome.

3 – Ample time to cover the topic/technical content of the outcome or the specified skills.

2 – Adequate time to cover the topic/technical content of the outcome or the specified skills.

1 – Limited time to cover the topic/technical content of the outcome or the specified skills.

0 – Did not cover the topic/technical content of the outcome or the specified skills.

Outcome 1:

_____

Outcome 2:

_____

Outcome 3:

_____

Outcome 4:

_____

Outcome 5:

_____

Please rate the overall class achievement of the course outcomes for your course using the following 0 to 5 scale.

5 – Students exhibited complete understanding of the technical content of the outcome or the specified skills and showed confidence in applying the techniques or skills.

4 – Students exhibited considerable understanding of the technical content of the outcome or the specified skills and showed an ability to apply the techniques or skills with few mistakes.

3 – Students exhibited a partial understanding of the technical content of the outcome or the specified skills but showed limited ability to apply the techniques or skills, often committing minor mistakes.

2 – Students exhibited little understanding of the technical content of the outcome or the specified skills and had difficulty in applying the techniques or skills to engineering problems.

1 – Students exhibited no understanding of the technical content of the outcome or the specified skills and were unable to apply them to engineering problems.

0 – Did not cover the information specified in the outcome in the class.

Outcome 1:

_____

Outcome 2:

_____

Outcome 3:

_____

Outcome 4:

_____

Outcome 5:

_____

Appendix 4-2
Mechanical Engineering Program
Student Survey of Course Outcomes

Course Number and Title:_____
Semester Taught:_____
Instructor:_____

Please use this form to rate your personal feelings of achievement of the published outcomes for the course as listed below. The following 0 to 5 rating scale should be used in assessing your achievement of the outcomes. This information will be presented for review to the ABET/SACS committee at the end of each semester. The committee will evaluate performance of the specified outcomes by the students and make recommendations for changes as appropriate.

5 – Complete understanding of the technical content of the outcome or the specified skills and a confidence in applying the techniques to engineering problems.

4 – Good understanding of the technical content of the outcome or the specified skills and an ability to apply the techniques to engineering problems.

3 – Adequate understanding of the technical content of the outcome or the specified skills and some ability to apply the techniques to engineering problems.

2 – Marginal understanding of the technical content of the outcome or the specified skills and some difficulty in applying the techniques to engineering problems.

1 – No understanding of the technical content of the outcome or the specified skills.

0 – Did not cover the information specified in the outcome in the class.

Outcome 1:

_____

Outcome 2:

_____

Outcome 3:

_____

Outcome 4:

_____

Outcome 5:

_____

Appendix 4-3
Assessment of Performance Rubric for
Senior Design Sequence (ED & DP)

	10	8	6	4	0
Technical Content of Project	**C**omplete understanding of the technical content of the design project. **D**emonstrates an excellent solution to the problem. **E**xcellent use of engineering tools to propose, design, or construct the project. **D**emonstrates the appropriate interdisciplinary nature of the project. **D**emonstrates the appropriate level of technical difficulty of the project.	**G**ood understanding of the technical content of the design project. **D**emonstrates an appropriate solution to the problem. **G**ood use of engineering tools to propose, design, or construct the project. **D**emonstrates the appropriate interdisciplinary nature of the project. **D**emonstrates the appropriate level of technical difficulty of the project.	**S**atisfactory understanding of the technical content of the design project. **D**emonstrates an acceptable solution to the problem. **S**atisfactory use of engineering tools to propose, design, or construct the project. **M**inimal interdisciplinary nature of the project. **M**inimal level of technical difficulty of the project.	**P**oor understanding of the technical content of the design project. **U**nsuccessful design solution to the problem. **P**oor use of engineering tools to propose, design or construct the project. **L**ack of interdisciplinary nature of the project. **U**nacceptable level of technical difficulty.	**U**nsatisfactory performance on the technical content of the project.
Writing Skills	**E**xcellent presentation of project problem statement with appropriate information to support the solution. **E**xcellent report organization and clear progression of text. **C**onsistently follows rules of standard English using effective language and	**G**ood presentation of project problem statement with adequate information to support the solution. **G**ood report organization with good progression of the text with few lapses. **G**enerally follows rules of standard English using effective language and vocabulary.	**S**atisfactory presentation of project problem statement with limited information to support the solution. **S**atisfactory report organization with some problems in progression of text. **G**enerally does not follow rules of standard English with limited vocabulary.	**P**oor presentation of the project problem statement, lacking information to support the solution. **P**oor report organization with problems in progression of text. **D**oes not follow rules of standard English with inappropriate use of language and vocabulary.	**U**nsatisfactory performance on the project written report.

	vocabulary.				
Oral Presentation Skills	**E**xcellent oral presentation skills. **C**lear and concise speech. **E**xcellent preparation of presentation materials. **E**xcellent interaction with the audience.	**G**ood oral presentation skills. **G**ood ability to orally present the project to the audience. **G**ood presentation materials. **G**ood interaction with the audience.	**S**atisfactory oral presentation skills. **R**easonable public speaking skills. **R**easonable preparation of presentation materials. **R**easonable interaction with the audience.	**P**oor oral presentation skills. **L**ack of public speaking skills. **P**oor preparation of presentation materials. **P**oor interaction with the audience.	**U**nsatisfactory performance on the oral presentation.
Teaming Skills	**E**xcellent team dynamics and assignment of leadership. **E**qual levels of responsibility between team members. **E**xcellent distribution of the project workload.	**G**ood team dynamics exhibiting acceptable leadership skills. **E**quitable distribution of project responsibility. **G**ood cooperation in sharing of the project workload.	**S**atisfactory team dynamics with demonstration of some leadership by members. **A**dequate distribution of project responsibility. **A**dequate cooperation in sharing of the project workload.	**P**oor team dynamics with little leadership exhibited. **P**oor distribution of project responsibility. **L**ittle cooperation between team members in sharing of project workload.	**U**nsatisfactory team performance with group member infighting and lack of cooperation.

Faculty evaluating the performance of the senior design sequence may use odd ratings (9,7,5) when they feel the performance is in between the specified levels shown in the table.

Appendix 4-4
Mechanical Engineering Program
EML 4521/4551 Engineering Design & Design Project

Peer Evaluation Form

This form is to be used for evaluating the performance and the effort of yourself and your teammates in the group project identified below. The evaluation is based on dividing up among your team members the total points of 5N, with N being the number of team members (e.g., 20 points for 4-member team etc). You are to assign an appropriate score to each team member, according to your evaluation of all members in your team, as if you are sharing these 'bonus' points among yourselves (e.g., 6, 5, 4, 5 points to members 1, 2, 3, 4 of a 4-member team respectively). Your evaluation along with your teammates' will be kept confidential and will be seen only by the instructors in computing your grade.

Project Title: _____

Date: _____

Evaluation: (Use total points of 20, 25, or 30 as per the number of teammates in your team. You must divide/use up all of the points.)

Names	Points
Member 1 (self): _____	_____
Team member 2: _____	_____
Team member 3: _____	_____
Team member 4: _____	_____
Team member 5: _____	_____
Team member 6: _____	_____

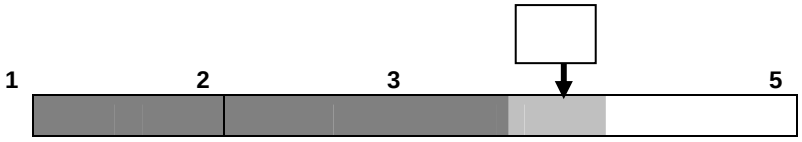
Appendix 4-5
EGM 3521 Engineering Materials I
Fall 2007
Student Performance on Course Outcomes

Outcome	Assignment	Course Assignment Assessment Ave (5pt max)	Student Survey Assessment Ave (5pt max)	Faculty Assessment Ave (5pt max)
1	HW 3,4,8,9,10,11,12,13 Test 1,2,3			
2	HW 4,8,10,11,12,13 Test 1,2,3			
3	HW 10,11,12,13 Test 2,3			
4	Essays (4)			

Course Outcomes: (letters in parentheses indicate correlation of the outcome with the appropriate ABET Criterion a-k)

1. The student will understand how the internal structure of a material controls the properties. (a,e,k)
2. The student will understand how slip is responsible for permanent deformation in metals and how this influences the mechanical properties of the material. (a,e,k)
3. The student will understand the relationship of temperature and time in a thermal treatment used to alter the properties of a material. (a,e,k)
4. The students will be able to write technical essays summarizing laboratory procedures and demonstrations of materials testing and manufacturing topics. (g)

Appendix 4-6
Summary of Student Performance on Program Educational Outcomes a-k



Program Outcome (a)

An ability to apply knowledge of mathematics, science, and engineering

Based on scale of 1-5

Summary of Student Performance Data						**Average =**	**3.81**
Contributing Courses	**Course Outcomes**							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
EGN 1102 Fundamentals of Engineering		4.10		4.00		4.00		
EGS 1111C Engineering Graphics	4.04	4.03	4.03	4.33				
EML 2538 Computer Applications in ME I	4.26							
EGM 3510 Statics	3.70	3.70	3.46	3.21	3.21			
EML 3100 Thermodynamics I		3.90	3.90					
EGM 4045 Electro-Mechanical Devices	3.20	3.75	3.35					
EML 3701 Fluid Mechanics	2.50	3.10	3.10					
EGM 3400 Dynamics	3.72	3.72	3.72	3.78				
EGM 3524 Strength of Materials	3.68	3.69	3.50	3.86				
EML 4534 Computer Applications in ME II	3.15	3.15	3.80	3.05	3.80			
EML 4142 Heat Transfer	4.30	4.20	4.10	4.30				
EML 4380 System Dynamics								
EGM 3521 Engineering Materials I	4.44	4.43	4.46					
EML 3523C Experimental Methodology	4.45	4.25	4.00					
EML 4127 Applied Thermal/Fluid Engr	3.40	3.60	3.20	4.50				
EML 4500 Machine Design I	3.55	3.60	3.40	3.70				
EML 4262 Machine Design II								
EML 43730L ME Laboratory		3.76						
EML 4521 Engineering Design	4.24	4.24						
EML 4551 Design Project	3.86	3.86						
EML 4350 FEM Technical Elective	4.20	4.19	4.28	4.20				