



ABET 2005 OFF-SITE

SUMMARY

MECHANICAL ENGINEERING

October 2005

EXECUTIVE SUMMARY

On September 27, 2005 Mechanical Engineering held its bi-annual (March & September) ABET off-site to review the ME assessment plan, to review collected assessment data, and to make recommendation for improvements. The following summarizes the discussions and comments:

1. ABET looks to program to provide:
 - a. Evidence of student learning
 - b. Measurement of student learning
 - c. Continuous program improvement
 - i. Assessment processes with documented results applied for program improvement.
2. Evidence is the key to accreditation and faculty evaluation of student work is the key to providing evidence.
3. A student self-assessment survey does not provide qualitative evidence of skills and knowledge.
4. As a result of the 2003 ABET visit, the number of Program Outcomes (a-k, l-s) were consolidated to a manageable number as to not overburden the faculty and the system with collecting duplicate data. Appendix A provides a summary of the new ABET 2009 program outcomes discussed at the Winter 2004 ABET off-site and also discussed at the Spring 2004 ME Industry Advisory Board (IAB meeting).
 - a. As a process of continuous improvement, we will review these outcomes on an on-going basis.
5. A suggestion was presented to expand the Program Educational Objectives (PEO) to include an assessment of our graduates' ability to "hit the ground running" and contribute to their employers success (Appendix B).
 - a. Although not discussed, perhaps PEO #7 can be re-written as: *"Are able to contribute to the success of their employers upon graduation, and are prepared for positions of Leadership in business and industry (requires approval).*
 - b. Although the Alumni Survey is the only current tool for assessment of PEO's, we can leverage co-op survey data for **graduating seniors** and provide useful data for PEO #7, i.e.:
 - i. #6: Exhibited leadership qualities
 - ii. #7: Exhibited sound judgment when making decisions
 - iii. #9: Exhibited a degree of accountability for work assigned
 - iv. #14: Provided creative concepts and ideas relative to the improvement of group practices.

6. ME's 2003 ABET self-study included a minimum of qualitative course level student performance data. As such, there was significant discussion regarding the assessment of ABET outcomes as compared to the assessment of course learning objectives as the best strategy to satisfy ABET without overburdening the faculty.
 - a. While it's true ABET requires data showing assessment of Program Outcomes, only assessing outcomes and not focusing on a '*process of continuous improvement*' will result in a weakness or deficiency. As such considering that program outcome improvements/corrections can only be achieved at the course level, a critical assessment plan component requires course level assessment of student achievement of course learning objectives. This is necessary to show a process of continuous improvement and to close the loop.
 - b. It's true that student achievement of course learning objectives is not a guarantee of achievement of program outcomes. As such, is the reason why the syllabus for every ME course show the contribution from each course learning objective to the achievement of more global program outcomes. Also the following additional tools are used for assessment of student achievement of program outcomes:
 - i. Supervisor's Evaluation of Co-op Experience (Has questions specifically relating to ABET outcomes—University Supplied)
 - ii. Supervisor's Evaluation of Senior Thesis (Has questions specifically relating to ABET outcomes—University Supplied)
 - iii. National Education Benchmark Inc. (EBI) Survey (Has questions specifically relating to ABET outcomes—University Supplied)
 - iv. Senior Design Course Portfolio

Evaluations by co-op employers provide excellent qualitative assessment from key constituents. When combined with student EBI survey data and faculty assessment of senior design course portfolios provide the validation and triangulation ABET encourages. This is perhaps one of the strongest components of the ME 2003 assessment strategy.

ME ASSESSMENT ELEMENTS

The primary focus of the assessment off-site was to streamline assessment to avoid over-complexity and to ensure sustainability. The key strategies are:

1. Prioritize Outcomes and Tools
 - a. Not every outcome every term
 - b. Not every course every term
2. Schedule Assessment
3. Sample Student Work
4. Embedded Assessment
5. Faculty Accountability
6. Provide a Clear Timetable

The assessment matrix presented below is a proposed summary of assessment tools, timing, responsibility, and is presented in a three (3) tier format. The three tiers represent assessment of program educational objectives, program outcomes, and assessment of course learning objectives. Note that it's important to sample student work in both A and B section.

The 5-column assessment reporting tool was used in the 2003 ABET self-study and provides a uniform format across programs. Appendix C has examples of the 5-column reporting tool for program outcome A (i.e. an ability to apply knowledge of mathematics, science and engineering) and B (i.e. an ability to design and conduct experiments, as well as, to analyze and interpret data). Also note the need to specify a performance standard or metric for each outcome.

ASSESSMENT STRATEGY MATRIX

TOOL	ASSESSMENT ELEMENT	TIMING	RESPONSIBILITY	REPORTING FORMAT
Alumni Survey	Program Educational Objectives	Every Three Years	Hoff	5-Column Format
Supervisor Co-Op Evaluation Survey - Seniors	Program Educational Objectives	Each Summer Term	Hoff	5-Column Format
Supervisor Co-Op Evaluation Survey - ALL	Program Outcome	Each Spring Term		5-Column Format
Supervisor Senior Thesis Survey	Program Outcome	Each Spring Term		5-Column Format
Senior EBI Survey	Program Outcome	Each Spring Term	Zang	5-Column Format
Senior Design Portfolio	Program Outcome	Each Summer/Spring Terms	M. El-Sayed, Kowalski, Ramadan, Tavakoli	5-Column Format
CAE/Mechanics Course Level Final Exam/Project	Course Learning Objectives	Each Winter/Spring Terms		5-Column Format
Energy Systems Course Level Final Exam/Project	Course Learning Objectives	Each Summer/Fall Terms		5-Column Format
Dynamics Systems Course Level Final Exam/Project	Course Learning Objectives	Each Fall/Winter		5-Column Format

ASSESSMENT vs. GRADES

There is perhaps value in discussing the difference between “assessment” and course “grades”. Grading represents a composite evaluation of student performance, while assessment represents an evaluation of individual intended outcomes. As such, using overall composite student grades as an assessment measure is problematic. This does not prohibit use of exam grades for assessment, only that:

- Exam questions should be linked to course learning objectives if exam grades are to be used for assessment of student achievement.
- Course learning objectives should be written as a set of broad primary targets (5-6), with as many specific sub-targets as necessary. Expressing objectives as broad primary targets minimizes the effort to link course learning objectives to program outcomes (PO's) and also significantly reduces the work load required to structure exams questions linked to course learning objectives. The work load is reduced since multiple exam questions covering several sub-targets can be linked to a single course learning objective, as the case with certain exam questions with several steps. Consider the learning objectives for MECH-210 below:

Course Learning Objectives:

1.0 Model a real physical system of particles for force analysis [ME PO's]

- 1.1 Given the drawing or sketch of a physical system, students will be able to draw free body diagrams and determine the resultant or equilibrant forces acting on the simplified physical system.

2.0 Analyze a system of particles for static equilibrium [ME PO's]

- 2.1 The students will be able to apply the trigonometric rules to various problems concerning the static equilibrium of a system of particles.
- 2.2 The students will be able to apply vector methods to various problems concerning the equilibrium of a system of particles.
- 2.3 The students will be able to conceptualize concurrent force systems and parallel force systems.
- 2.4 The students will be able to understand the principle of transmissibility.
- 2.5 The students will be able to use free body diagrams to solve the static equilibrium of system of particles.

3.0 Model and Analyze the system of rigid bodies in static equilibrium using Newton's laws [ME PO's]

- 3.1 Given external force vectors acting on a system of rigid bodies, students will be able to determine resultant forces and moments using vector concepts.
- 3.2 Given the type of support and connectivity in a system of rigid bodies in equilibrium (i.e. trusses or frames with pin-joints or rigid supports.),

students will be able to fully analyze the force system using Newton's laws.

- 3.3 Given loads acting on planar linkages and mechanisms (machines), students will be able to determine the internal reactions at the joints.
- 3.4 Given loads on a planar system (i.e. a beam), the student will be able to determine reaction forces and moments.
- 3.5 Given contact conditions and loads, students will be able to understand the concepts of the coefficient of friction and the frictional force.
- 3.6 Given a general distributed load, students will be able to determine the equivalent concentrated load and its location.

FINAL EXAM COURSE LEVEL ASSESSMENT TOOL

Appendix D provides three steps to showcasing student achievement of both course learning objectives and program outcomes. The final format is pie charts showing a breakdown percentage of student achievement in the range of 0-93%, 93%-86%, 85%-77%, 75%-70%, and < 70%. Although these are grades, they are linked to individual course learning objectives and/or program outcomes which is precisely what ABET is seeking, and will help to improve our program which is of more importance.

APPENDIX A

REVISED ABET OUTCOMES

Holiday Inn—Gateway

Winter 2004

A Streamlined Assessment Process

Revised List of Program Outcomes (PO's)

Definition: A program outcome is an ability/skill/attribute of graduates at the time of graduation.

Plan: Revise and condense the list of Program Outcomes (PO's). Also, generate and distribute a statement of interpretation of these outcomes so that what we are trying to assess is understood by everyone.

Rationale: The ME program currently has a list of nineteen outcomes. The first eleven are a set dictated by ABET. Many of the outcomes beyond EC2000's a -- k can be folded into a -- k. These additional outcomes were generated to express unique attributes of our ME graduates and satisfy specific program outcomes as stated by ASME. Better (coherent) assessment can be done on a smaller list as long as a -- k are encompassed. The recent ABET visit focused on processes and preliminary data. The next visit is anticipated to focus on sustaining the assessment process through sound metrics. It is “metrics” (degree of achievement) that is expected to be under the microscope.

a) An ability to apply knowledge of mathematics, science and engineering.	a) An ability to apply knowledge of mathematics, science and engineering.
b) An ability to design and conduct experiments, as well as to analyze and interpret data.	b) An ability to design and conduct experiments, as well as to analyze and interpret data.
c) An ability to design a system, component, or process to meet desired needs.	c) An ability to design a system, component, or process to meet desired needs.
d) An ability to function on multi-disciplinary teams.	d) An ability to function on multi-disciplinary teams.
e) An ability to identify, formulate and solve engineering problems.	e) An ability to identify, formulate and solve engineering problems.
f) An understanding of professional and ethical responsibility.	f) An understanding of professional and ethical responsibility.
g) An ability to communicate effectively.	g) An ability to communicate effectively.
h) The broad education necessary to understand the impact of engineering solutions in a global and societal context.	h) The broad education necessary to understand the impact of engineering solutions in a global and societal context.
i) A recognition of the need for, and an ability to engage in life-long learning.	i) A recognition of the need for, and an ability to engage in life-long learning.
j) A knowledge of contemporary issues.	j) A knowledge of contemporary issues.
k) An ability to use the techniques, skills and modern engineering tools necessary for engineering practice.	k) An ability to use the techniques, skills and modern engineering tools necessary for engineering practice.
l) An ability to work professionally in both thermal and mechanical systems areas including the design and realization of such systems.	l) An ability to work professionally in both thermal and mechanical systems areas including the design and realization of such systems. Keep: Per ASME
m) A competence in the use of computational mathematics tools and systems analysis tools germane to the world of engineering. ⁽¹⁾	Eliminate (see box above for outcome "k") - This PO, "m", is embodied in outcome "k" and can be argued that "k" covers "m" although "m" is more specific on the tools and techniques.
n) A competence in experimental design, automatic data acquisition, data analysis, data reduction, and data presentation, both orally and in the written form. ⁽²⁾	Eliminate This PO, "n", is expressed in two outcomes above, namely outcome "b" and outcome "g".
o) A competence in the use of computer graphics for design	Eliminate

communication and visualization. ⁽³⁾	This PO, "o", is embodied in outcome "k" although "o" is explicitly addressing design communication tools.
p) A knowledge of chemistry and calculus based physics with a depth in at least one of them.	m) A knowledge of chemistry and calculus based physics with a depth in at least one of them. Keep: Per ASME
q) An ability to manage engineering projects including the analysis of economic factors and their impact on the design. ⁽⁴⁾	Eliminate This outcome, "q", is covered in outcomes "c" and "d". It is expected that project management is an activity carried out by teams as they design systems or components. The other aspect of economic factors impacting the design is covered in capstone courses (Senior Design Courses)
r) An ability to understand the dynamics of people both in a singular and group setting. ⁽⁵⁾	Eliminate This outcome "r" is covered in outcome "d" as a component of having an ability to function on multi-disciplinary teams.
s) A competence in the analysis of inter-disciplinary mechanical/electrical/hydraulic systems. ⁽⁶⁾	n) A competence in the analysis of inter-disciplinary mechanical/electrical/hydraulic systems. Keep: This outcome is truly a unique attribute. However, we practically rely on two courses in the ME curriculum to satisfy it - a potentially difficult outcome for meeting assessment metrics on a course level.

- (1) This PO is quite similar to PO “k.” Results on this outcome from the Program Exit Survey and on that for “k” are consistent. For example, in their program exit survey, students were asked to reflect on their whole ME educational experience and report to what extent the program helped achieve this particular PO. 99% of responses fell in the average and above average categories for outcome “k” and 94% for outcome “m.”
- (2) This PO was intended to address unique features of our program. It is a multi-faceted outcome with a number of specific skills and abilities. Additionally, this outcome is quite similar to outcomes “b” and “g.” Results on this PO from the all tools indicate high levels (in the upper 90’s) and correspond well with results obtained on outcomes “b and g”.
- (3) 95 % of the responses on the Program Exit Survey fell in the categories of average and above average. This outcome was intended to address a strong unique feature to our program since the faculty members in the Design Communication Thread have invested a substantial effort (time and resources) in providing the latest design platforms at an early stage in students’ academic careers. It can be argued that this attribute is embedded in outcome "k".
- (4) ME Students at Kettering University are known for having desires to become managers or hold supervisory jobs. This PO was generated to address such need and determine if we are providing required skills in that area. Survey data from multiple tools as well as students’ work in Senior Design Project courses show that this outcome is being achieved. The ME Faculty will work on consistently addressing this outcome and validating its achievement. It is also believed that this outcome is covered outcomes "c" and "d".
- (5) This is an outcome that is very challenging to measure and assess/validate achievement. Survey data from multiple tools as well as students’ work in Senior Design Project courses show that this outcome is being achieved. It can be argued that this outcome is covered outcome "d".
- (6) This PO was generated to exhibit how the ME Program helps ME Students work across disciplines and expand their set of skills beyond mechanical systems. This PO is primarily addressed in Introduction to Mechatronics Design (MECH 232) and Dynamic Systems I and II (MECH 330 and 430). In the future, the new course (MECH 231 – Signal Analysis for Mechanical Engineers) will also contribute to the achievement of this PO. Also, 91% of the responses on the Program Exit Survey fell in the categories or average and above average. Students’ work validates such achievement. Another tool may be needed to further correlate assessment data. Assessment continues in the form of continuous monitoring of the results from various tools.

APPENDIX B

Program Educational Objectives

ABET 2009 Educational Objectives

The Department of Mechanical Engineering produces graduates who:

- Are knowledgeable in the effective use of modern problem solving and design methodologies.
- Understand the implications of design decisions in the engineering marketplace.
- Are effective engineers, i.e. ones who are able to formulate and analyze problems, to think creatively, communicate effectively, synthesize information, and work collaboratively.
- Have an appreciation and an enthusiasm for life-long learning.
- Perform effectively on teams engaged in continuous improvement activities in engineering and business processes.
- Practice professionally and ethically in the field of Mechanical Engineering.
- Are prepared for positions of leadership in business and industry.

APPENDIX C

5-Column Reporting Tool

KETTERING FIVE COLUMN ASSESSMENT FORM

Academic Program Mission and Educational Objectives	Academic Program Outcome	Assessment Methods and Performance Standards	Assessment Results	Use of Assessment Results
<p>Mission Statement:</p> <p>The academic mission of Mechanical Engineering is to develop and prepare applied mechanical engineers, multi-discipline leaders, and technical managers for a global and diverse market. This mission is accomplished in an academic and cooperative environment that promotes scholastic performance, sound engineering fundamentals, strong design experiences, and personal professional integrity. The Department of Mechanical Engineering encourages and fosters team participation, creative thinking, a competitive spirit, and professional activities.</p> <p>Program Educational Objectives:</p> <p>The Department of Mechanical Engineering strives to produce graduates who:</p> <ol style="list-style-type: none"> 1. Are knowledgeable in the effective use of modern problem solving and design methodologies. 2. Understand the implications of design decisions in the engineering marketplace. 3. Are effective engineers, i.e. ones who are able to formulate and analyze problems, think creatively, communicate effectively, synthesize information, and work collaboratively. 4. Have an appreciation and an enthusiasm for life-long learning. 5. Perform effectively on teams engaged in continuous improvement activities in engineering and business processes. 6. Practice professionally and ethically in the field of Mechanical Engineering. 7. Are prepared for positions of Leadership in business and industry. 	<p>A. An ability to apply knowledge of mathematics, science and engineering.</p>	<p>A1. 80% of the mechanical engineering students responding to the Kettering University Student's Evaluation of CO-OP Work Term and COOP Program Survey will 'Strongly Agree' or 'Agree' to the statement 'Kettering University prepared me in the following co-op competencies: Ability to apply knowledge of mathematics, science, and engineering.'</p> <p>A2. 80% of the supervisors of mechanical engineering students responding to the Kettering University Supervisor's Evaluation of CO-OP Work Experience Survey indicate 'Strongly Agree' or 'Agree' to the statement 'The student has demonstrated the ability to apply knowledge of mathematics, science, and engineering.'</p> <p>A3. 80 % of the mechanical engineering students responding to The College Student Report indicate 'Very Much' or 'Quite a Bit' to the question 'During the current school year, to what extent has your coursework emphasized the following mental activities? Applying theories or concepts to practical problems or in new situations.'</p> <p>A4. An average score of 85 will result when student portfolios in the ME Capstone classes are sampled and evaluated by a panel of faculty using the ME Capstone Evaluation Sheet with no component having an average of less than 7.0 on the 1 to 10 scale utilized.</p>	<p>94.6% of those responding to the Kettering University Supervisor's Evaluation of CO-OP Work Experience Survey indicated 'Strongly Agree' or 'Agree' to the statement 'Demonstrated the ability to apply knowledge of mathematics, science, and/or engineering.'</p> <p>100% of those responding to the Mechanical Engineering Program Exit Survey indicated 'Average' or above to the statement 'Reflecting on the ME as a whole, please rate the contribution the WHOLE Educational Experience in helping you achieve the following ME Program education outcome: Ability to apply knowledge of mathematics, science, and engineering.'</p> <p>95.8% of those responding to the Kettering University Senior Thesis Project: Faculty Advisor's Evaluation indicated 'Strongly Agree' or 'Agree' to the statement 'Demonstrated the ability to apply knowledge of mathematics, science, and/or field of major.'</p> <p>99.0 % of those responding to the Kettering University Senior Thesis Project: Employer Advisor's Evaluation indicated 'Strongly Agree' or 'Agree' to the statement 'Demonstrated the ability to apply knowledge of mathematics, science, and field of major'</p>	<p>No Action Required, Continue to Monitor</p>

KETTERING FIVE COLUMN ASSESSMENT FORM

Academic Program Mission and Educational Objectives	Academic Program Outcome	Assessment Methods and Performance Standards	Assessment Results	Use of Assessment Results
<p>Mission Statement:</p> <p>The academic mission of Mechanical Engineering is to develop and prepare applied mechanical engineers, multi-discipline leaders, and technical managers for a global and diverse market. This mission is accomplished in an academic and cooperative environment that promotes scholastic performance, sound engineering fundamentals, strong design experiences, and personal professional integrity. The Department of Mechanical Engineering encourages and fosters team participation, creative thinking, a competitive spirit, and professional activities.</p> <p>Program Educational Objectives:</p> <p>The Department of Mechanical Engineering strives to produce graduates who:</p> <ol style="list-style-type: none"> 1. Are knowledgeable in the effective use of modern problem solving and design methodologies. 2. Understand the implications of design decisions in the engineering marketplace. 3. Are effective engineers, i.e. ones who are able to formulate and analyze problems, think creatively, communicate effectively, synthesize information, and work collaboratively. 4. Have an appreciation and an enthusiasm for life-long learning. 5. Perform effectively on teams engaged in continuous improvement activities in engineering and business processes. 6. Practice professionally and ethically in the field of Mechanical Engineering. 7. Are prepared for positions of Leadership in business and industry. 	<p>B. An ability to design and conduct experiments, as well as to analyze and interpret data.</p>	<p>B 1. 80% of the mechanical engineering students responding to the Kettering University Student's Evaluation of CO-OP Work Term and COOP Program Survey will 'Strongly Agree' or 'Agree' to the statement 'Kettering University prepared me in the following co-op competencies: Ability to design and conduct experiments, as well as to analyze and interpret data.'</p> <p>B2. 80% of the supervisors of mechanical engineering students responding to the Kettering University Supervisor's Evaluation of CO-OP Work Experience Survey indicate 'Strongly Agree' or 'Agree' to the statement 'The student has demonstrated the ability to design and conduct experiments, analyze and interpret data.'</p> <p>B3. 80% of the mechanical engineering students responding to the EBI Engineering Student Survey indicate 'moderately' and above on the question 'To what degree did your engineering education enhance your ability to</p>	<p>95.7% of the Faculty Advisors responding to the Kettering University Senior Thesis Project: Faculty Advisor's Evaluation indicated 'Strongly Agree' or 'Agree' to the statement 'Demonstrated the ability to conduct experiments, analyze and interpret data.'</p> <p>91.0% of those responding to the EBI Engineering Student Survey indicated 'moderately' and above on the questions 'To what degree did your engineering education enhance your ability to design experiments'</p> <p>94.8 % of those responding to the EBI Engineering Student Survey indicated 'moderately' and above on the questions 'To What degree did your engineering education enhance your ability to conduct experiments'</p> <p>96.1 % of those responding to the EBI Engineering Student Survey indicated 'moderately' and above on the questions 'To what degree did your engineering education enhance your ability to analyze and interpret data.'</p> <p>98% of those responding to the Mechanical Engineering Program Exit Survey indicated 'Average' or above to the statement 'Reflecting on the ME as a whole, please rate the contribution the WHOLE</p>	<p>No Action Required, Continue to Monitor</p>

APPENDIX D

FINAL EXAM

COURSE LEVEL ASSESSMENT TOOL

STEP 0
COURSE COORDINATOR

- A. MATRIX LINKING ABET OUTCOMES A-K,L-N
TO COURSE LEARNING OBJECTIVES**

- B. MATRIX LINKING COURSE LEARNING
OBJECTIVES TO EXAM QUESTIONS**

#1

Course Learning Objectives	ABET													
	a	b	c	d	e	f	g	h	i	j	k	l	m	n
1	20%	70%	0%	0%	0%	0%	0%	0%	0%	0%	0%	50%	0%	0%
2	50%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
3	30%	0%	0%	0%	0%	0%	50%	0%	0%	0%	0%	0%	0%	0%
4	0%	30%	0%	0%	0%	0%	0%	0%	70%	0%	0%	0%	0%	30%
5	0%	0%	0%	50%	0%	0%	0%	0%	0%	0%	0%	0%	0%	70%
6	0%	0%	50%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

#2

Questions	Course Learning Objectives					
	1	2	3	4	5	6
1	100%	0%	0%	0%	0%	0%
2	0%	50%	0%	0%	0%	0%
3	0%	0%	100%	0%	0%	0%
4	0%	0%	0%	50%	0%	50%
5	0%	0%	0%	0%	70%	30%
6	0%	50%	0%	40%	0%	0%

Table 1 - Links ABET Outcomes to Course Learning Objectives
 Table 2 - Links Course Learning Objectives to the Questions
 Table 3 - Links Questions to the ABET Outcomes

#3

Questions	ABET													
	a	b	c	d	e	f	g	h	i	j	k	l	m	n
1	20%	70%	0%	0%	0%	0%	0%	0%	0%	0%	0%	50%	0%	0%
2	25%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
3	30%	0%	0%	0%	0%	0%	50%	0%	0%	0%	0%	0%	0%	0%
4	0%	15%	25%	0%	0%	0%	0%	0%	35%	0%	0%	0%	0%	15%
5	0%	0%	15%	35%	0%	0%	0%	0%	0%	0%	0%	0%	0%	49%
6	25%	12%	0%	0%	0%	0%	0%	0%	28%	0%	0%	0%	0%	12%

Key to ABET Outcomes

- a) An ability to apply knowledge of mathematics, science and engineering.
- b) An ability to design and conduct experiments, as well as to analyze and interpret data.
- c) An ability to design a system, component, or process to meet desired needs
- d) An ability to function on multi-disciplinary 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 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.
- l) An ability to work professionally in both thermal and mechanical systems areas including the design and realization of such systems.
- m) A knowledge of chemistry and calculus based physics with a depth in at least one of them.
- n) A competence in the analysis of inter-disciplinary mechanical/electrical/hydraulic systems.

STEP 1

ENTER STUDENT GRADES FOR EACH QUESTION

Faculty Grade Entry

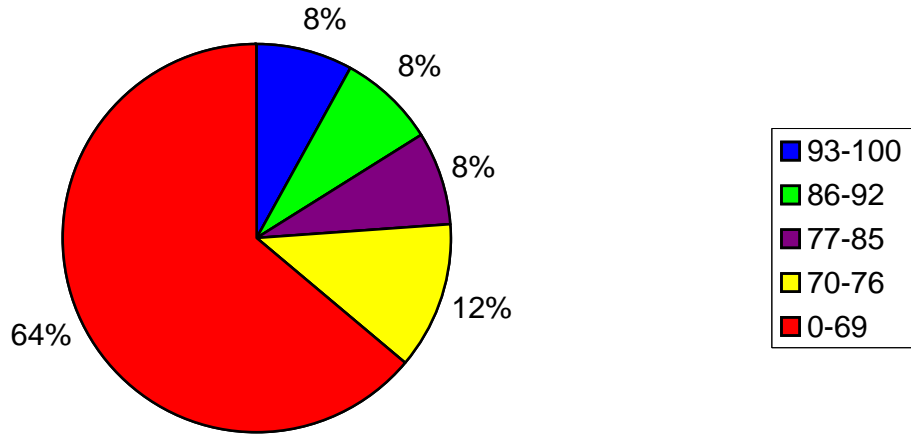
		Questions					
S t u d e n t s		1	2	3	4	5	6
	1	20	18	16	15	12	8
	2	12	17	14	12	12	10
	3	10	18	20	10	12	5
	4	18	20	16	8	5	5
	5	10	20	18	12	10	8
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	27	15	14	12	5	8	5
	28	17	17	14	7	12	18
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	33	14	17	12	12	12	8

STEP 2

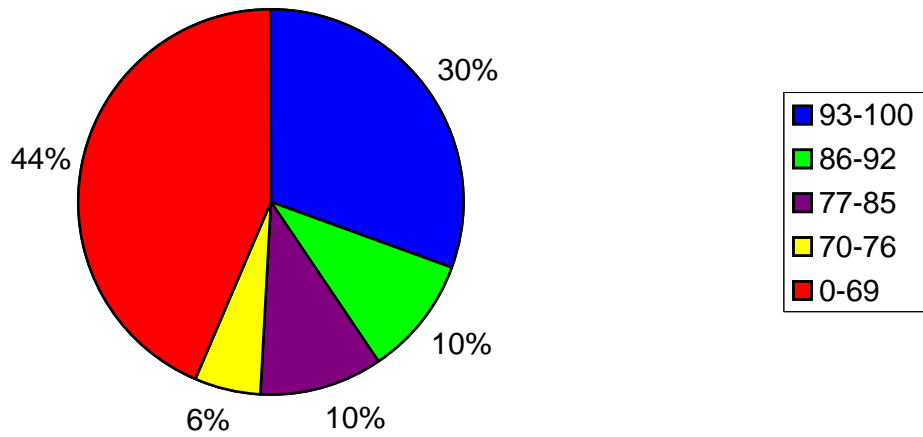
COMPARE PIE CHARTS FOR STUDENT
ACHIEVEMENT OF **COURSE LEARNING
OBJECTIVES** TO ESTABLISHED
METRIC OR RUBRICK

Course Learning Objectives

CLO 1

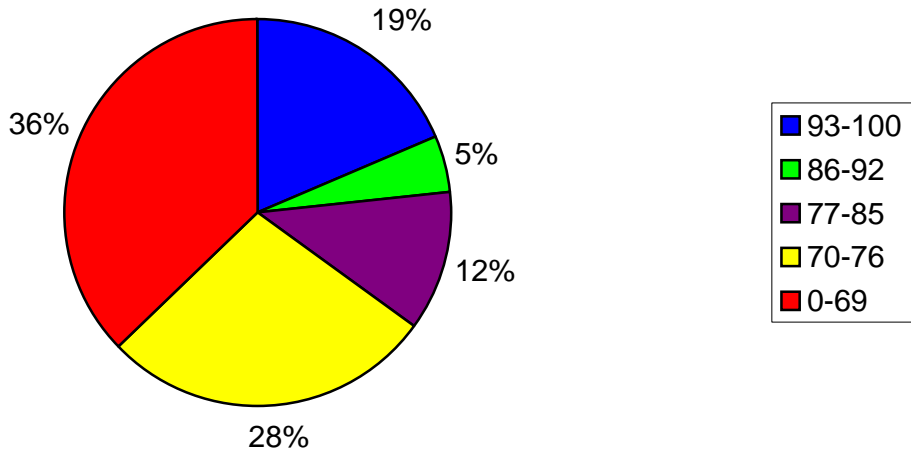


CLO 2

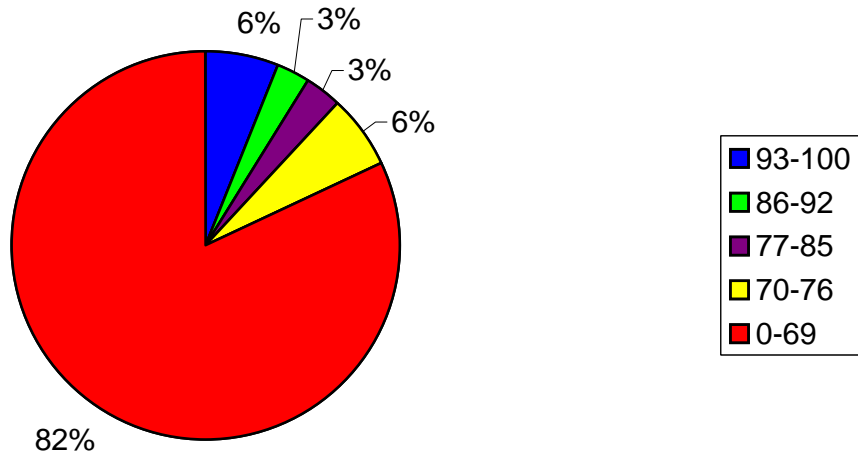


Course Learning Objectives

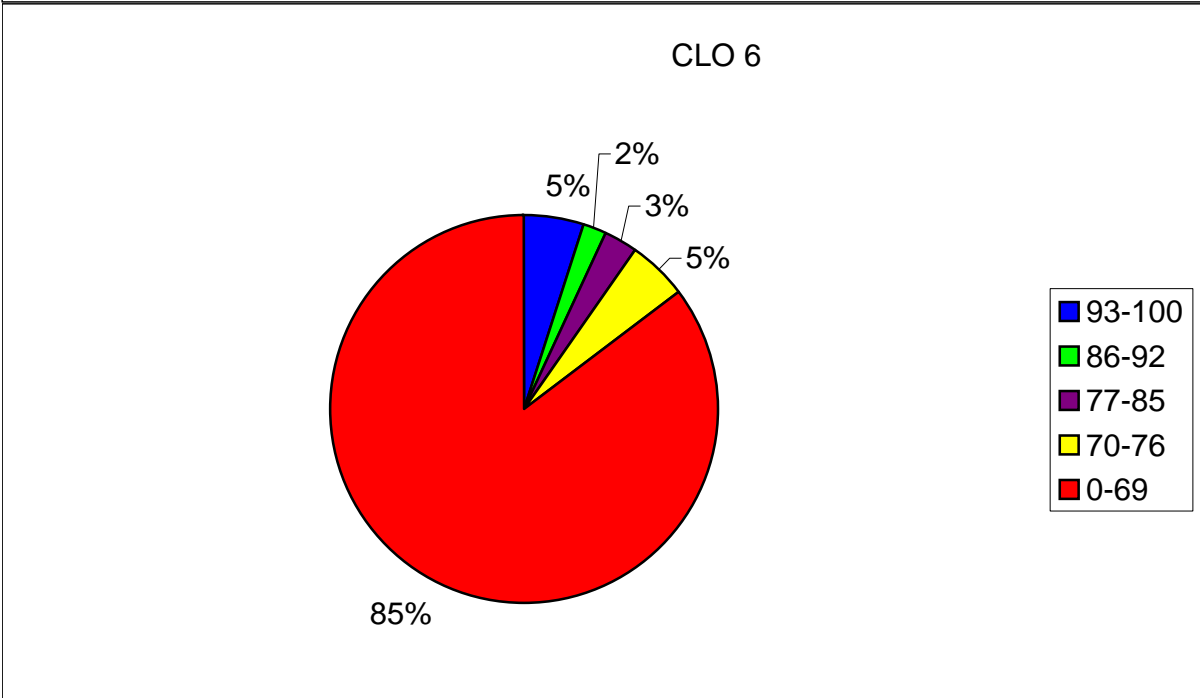
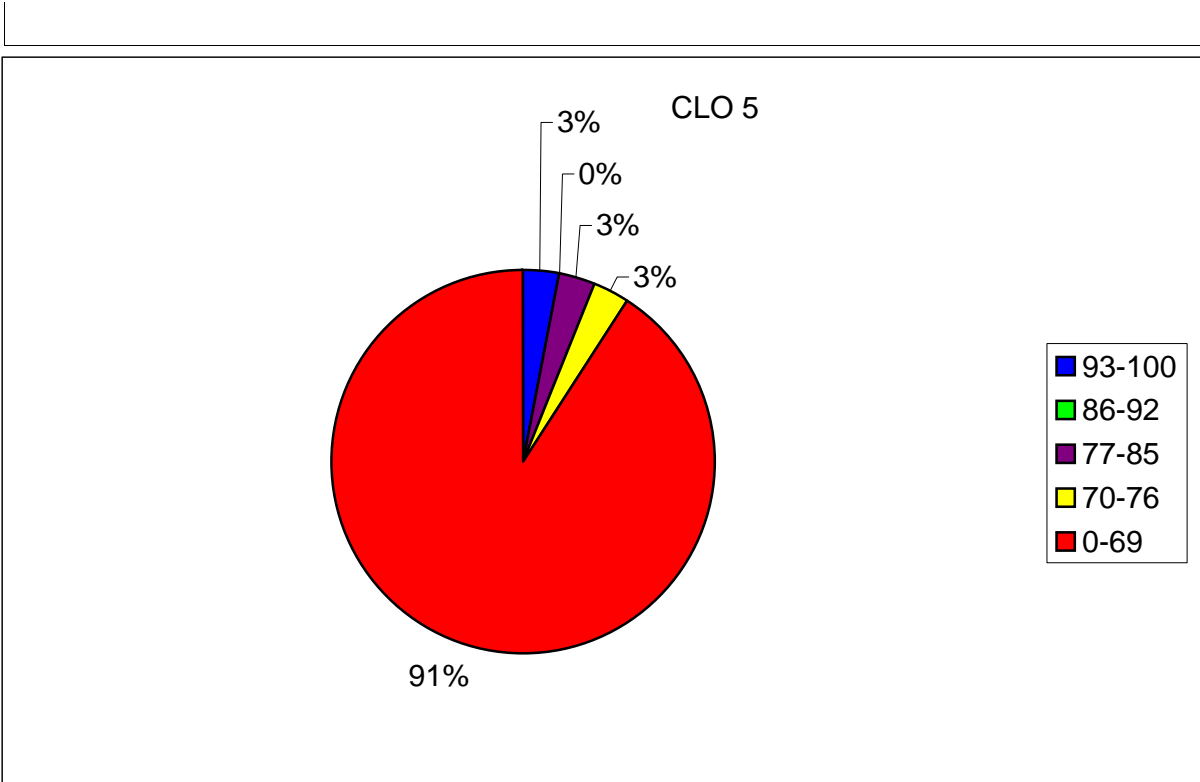
CLO 3



CLO 4



Course Learning Objectives



Course Learning Objectives

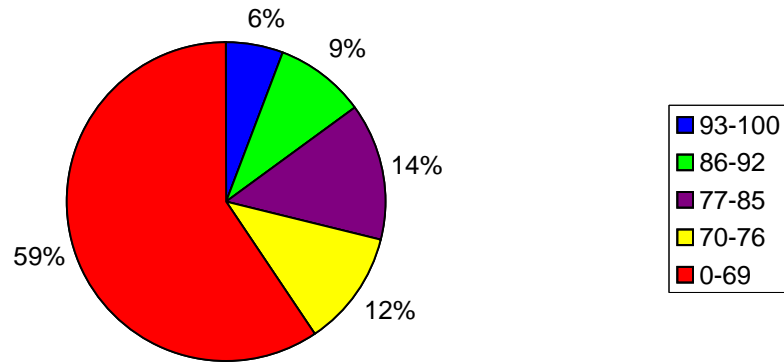
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STEP 3

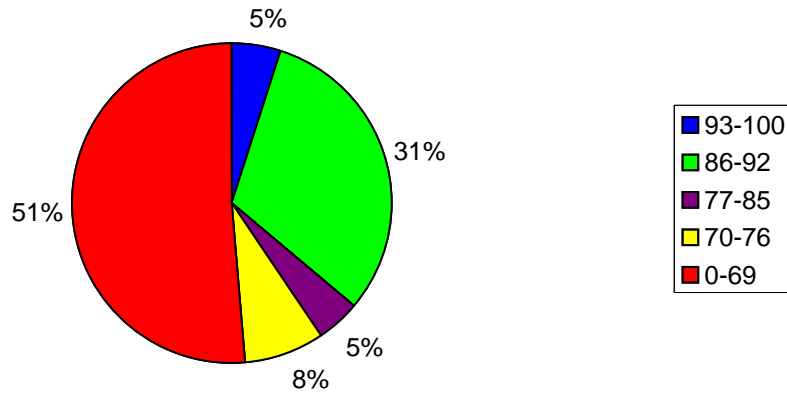
COMPARE PIE CHARTS FOR STUDENT
ACHIEVEMENT OF **PROGRAM OUTCOMES**
TO ESTABLISHED METRIC OR RUBRICK

ABET Program Outcomes

Outcome A

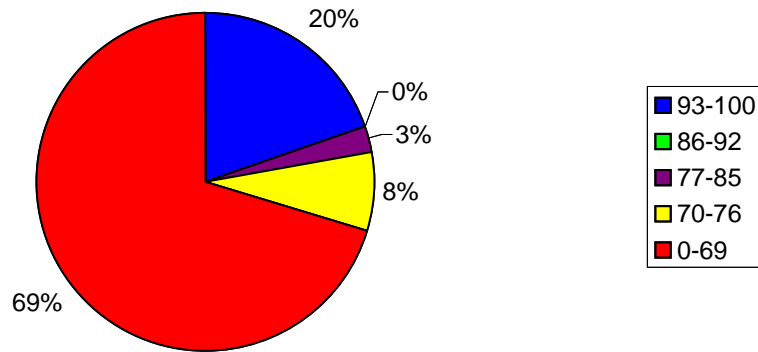


Outcome B

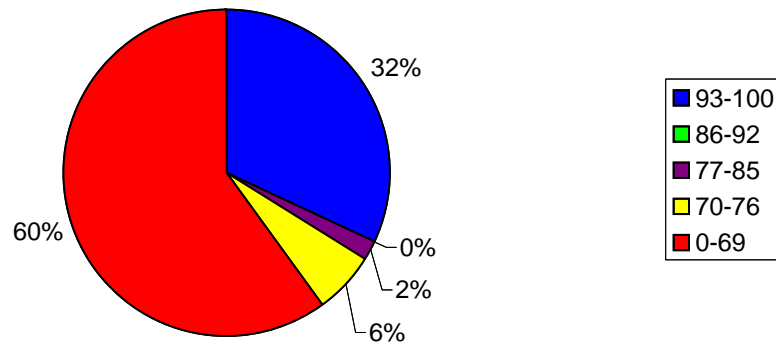


ABET Program Outcomes

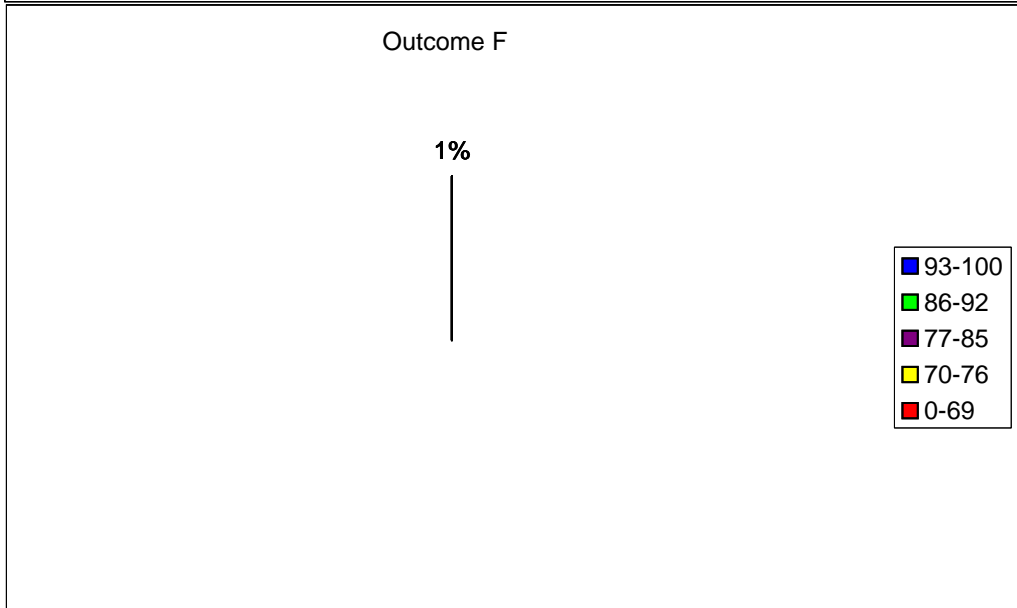
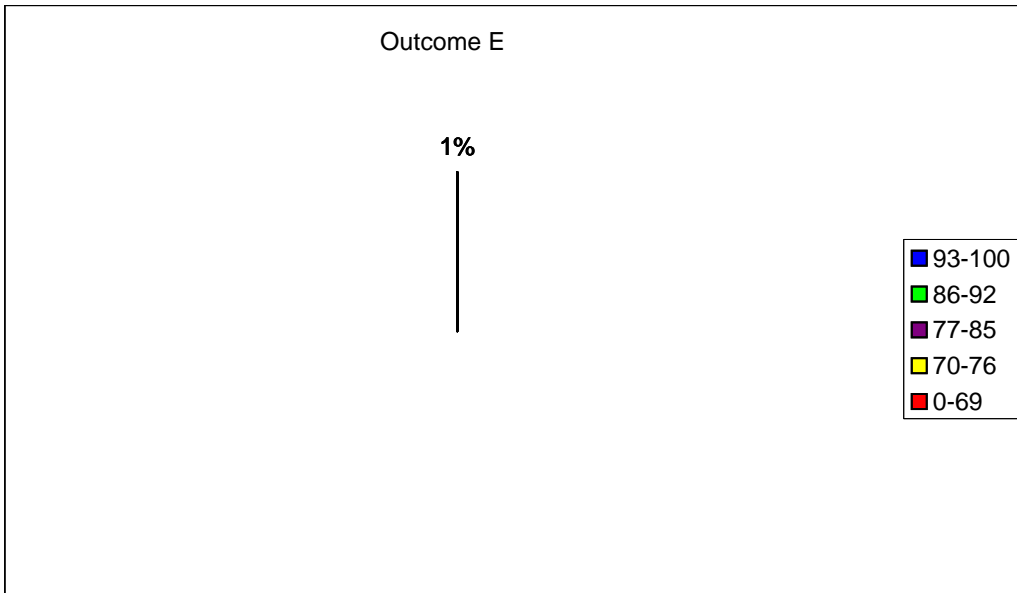
Outcome C



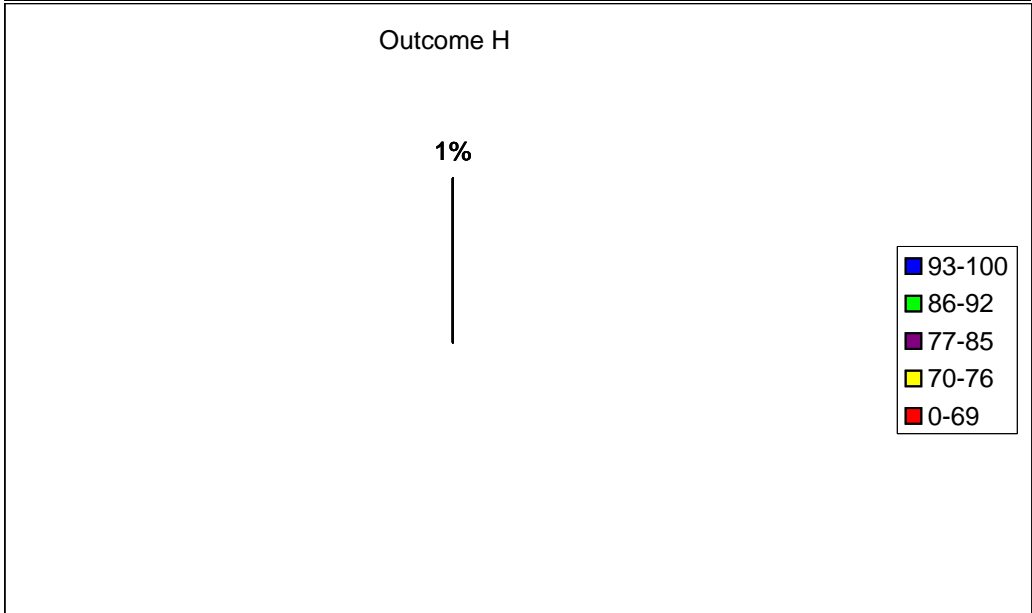
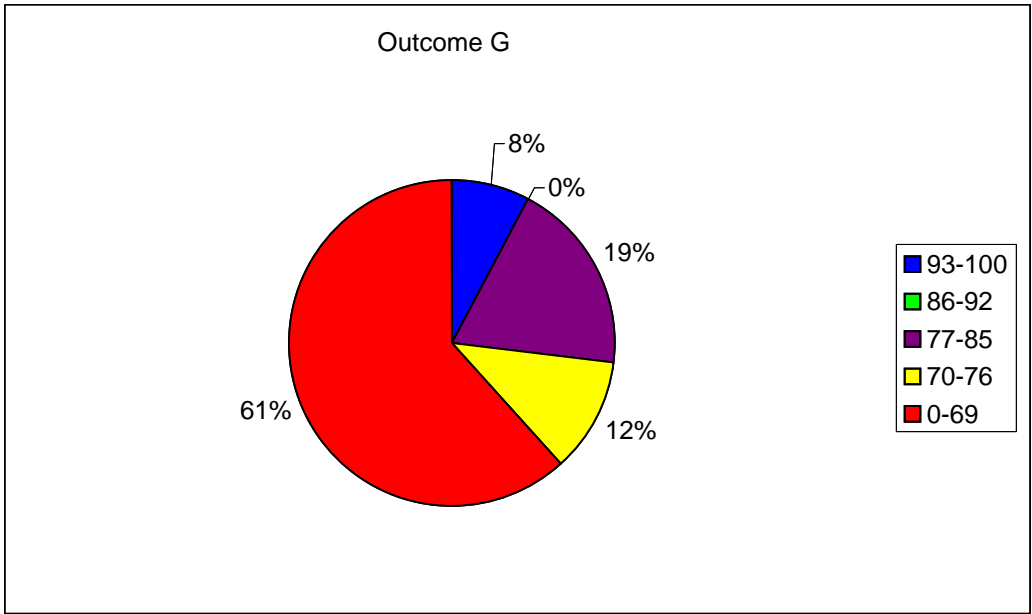
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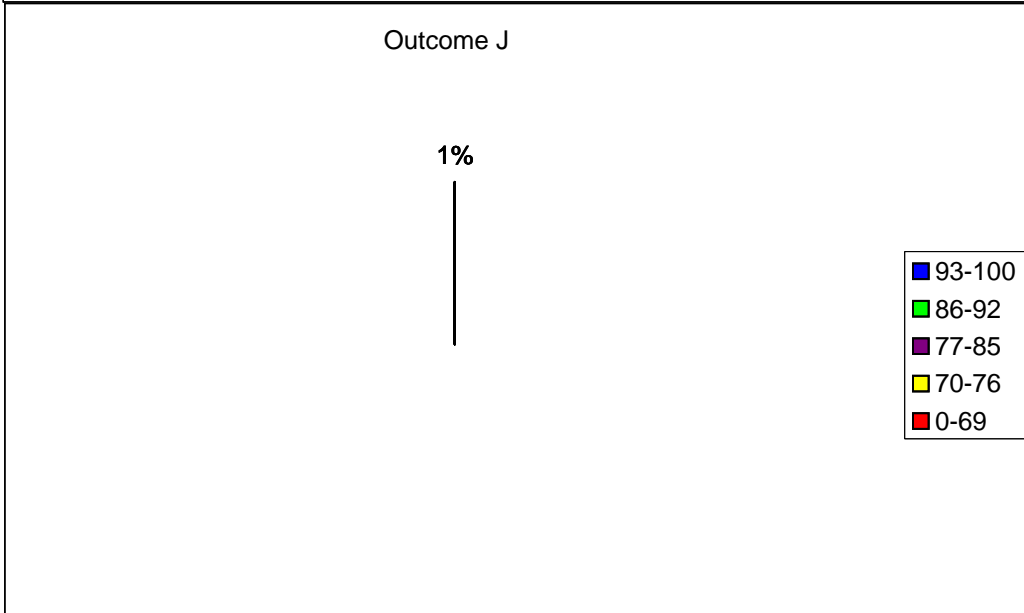
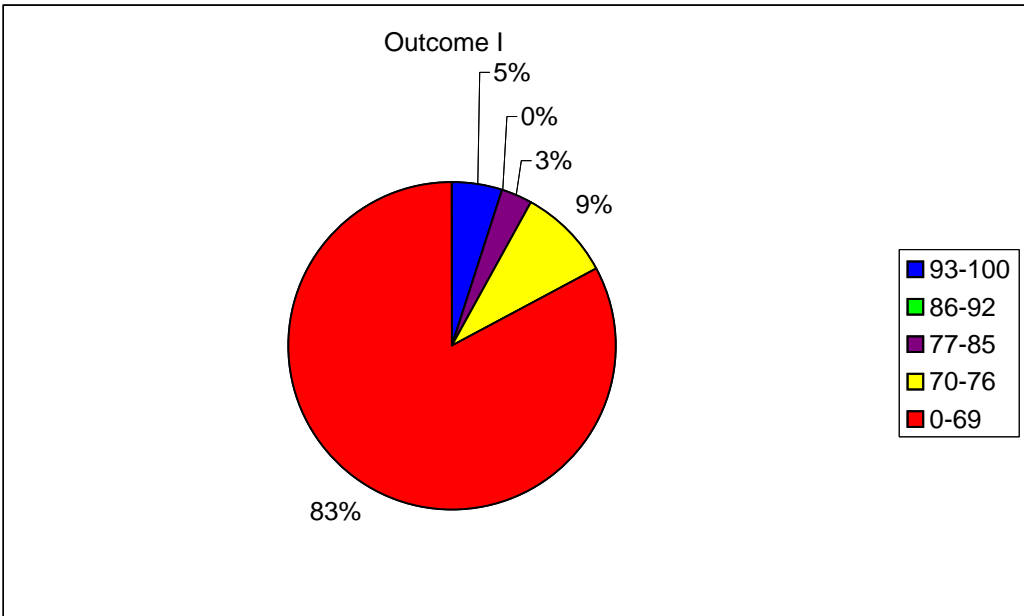
ABET Program Outcomes



ABET Program Outcomes



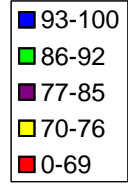
ABET Program Outcomes



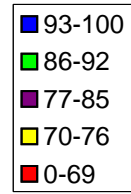
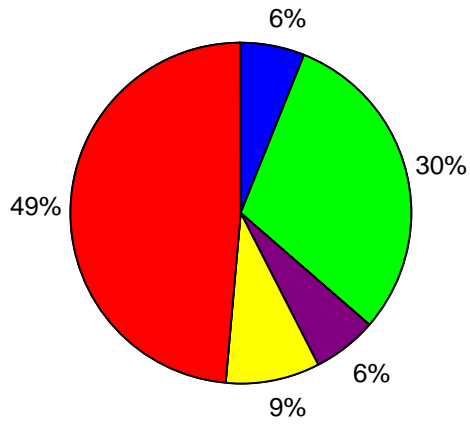
ABET Program Outcomes

Outcome K

1%



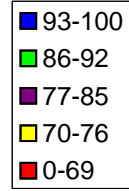
Outcome L



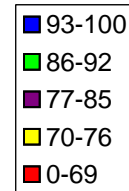
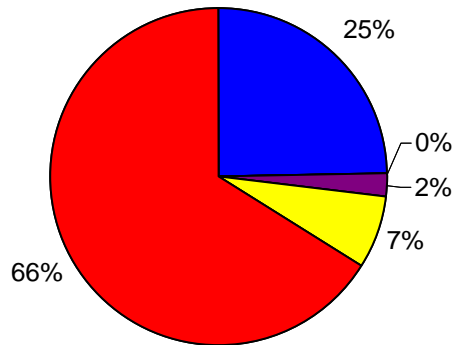
ABET Program Outcomes

Outcome M

1%



Outcome N



APPENDIX E
POWERPOINT SLIDES
ABET OFFSITE