OREGON INSTITUTE OF TECHNOLOGY
Mechanical Engineering Program

Mechanical Engineering Assessment Report 2012-13

June 14, 2013

INTRODUCTION

This report documents the assessment done within the Mechanical Engineering (ME) program at Oregon Institute of Technology during the 2012-13 school year.

The ME program is using a three year assessment cycle. In this, each outcome is assessed at least once every three years. The document "Mechanical Engineering Program Assessment Plan" documents this plan over the three year cycle. The outcomes being assessed within the 2012-13 school year are summarized here, both the assessment being done and results of these assessments. For the overall three year cycle the reader is referred to the program's assessment plan.

PROGRAM MISSION STATEMENT AND EDUCATIONAL OBJECTIVES

The mission statement of the ME Program is in line with and built upon the mission statements of the Institution and the Department. The ME program's Mission Statement and Program Educational Objectives are stated as:

Mechanical Engineering Program Mission Statement

The Mechanical Engineering Program at Oregon Institute of Technology is an applied engineering program. Its mission is to provide graduates the skills and knowledge for successful careers in mechanical engineering.

Mechanical Engineering Program Educational Objectives

The program expects graduates to achieve, within several years of graduation, the following objectives. Mechanical Engineering graduates will have

- *demonstrated the ability to analyze, design and improve practical thermal and/or mechanical systems.*
- *shown the ability to communicate effectively and work well on team-based engineering projects.*
- *succeeded in entry-level mechanical engineering positions regionally and nationally.*
- *pursued continued professional development, including professional registration if desired.*
- *successfully pursued engineering graduate studies and research, if desired.*

EDUCATIONAL OUTCOMES

The ME program's Student Learning Outcomes are aligned with ABET EAC outcomes. These are stated as:

(a) an ability to analyze and model physical systems or components using (apply knowledge of) mathematics (including multi-variable calculus and differential equations), basic science and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design and realize a physical system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
(m1) Graduates will be able to work professionally in the area of thermal systems
(m2) Graduates will be able to work professionally in the area of mechanical systems.

These outcomes mirror those of the EAC of ABET. Outcomes (a) and (c) have been slightly modified to better represent ABET's Mechanical Engineering program specific criteria. Also, outcomes (m1) and (m2) have been added also to address ABET's Mechanical Engineering program specific criteria.

ASSESSMENT CYCLE

Assessment within the MMET Department is done on a three-year cycle. Each outcome is assessed at least once every three years. The schedule for assessment activities for the ME Program is shown in Table 1.

Table 1: Assessment Cycle

Educational Outcome	*2012-13*	*2013-14*	*2014-15*	*TAC*
Review Program Mission and Educational Objectives			x	
Assess Program Educational Objectives	x			
a) Graduates will have the ability to analyze and model physical systems or components using (apply knowledge of) mathematics (including multi-variable calculus and differential equations), basic science and engineering.			x	b
b) Graduates will have the ability to design and conduct experiments, as well as to analyze and interpret data.		x		c
c) Graduates will be able to design and realize a physical system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.			x	d
d) Graduates will be able to function on multi-disciplinary teams.	x			e
e) Graduates will be able to identify, formulate, and solve engineering problems. Graduates will be able to analyze and model physical systems or components using principles of engineering, basic science and mathematics (including multivariate calculus and differential equations) to model, analyze, design, and realize physical systems or components.			x	f
f) Graduates will have an understanding of professional and ethical responsibility.	x			i
g) Graduates will have the ability to communicate effectively.		x		g
h) Graduates will have the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.	x			j
i) Graduates will recognize the need for, and have the ability to engage in life-long learning.		x		h
j) Graduates will have a knowledge of contemporary issues.		x		j
k) Graduates will be able to use the techniques, skills, and modern engineering tools necessary for engineering practice.		x		a
m1) Graduates will be able to work professionally in the area of thermal systems.			x	
m2) Graduates will be able to work professionally in the area of mechanical systems.			x	

Note that ME Program Mission and Program Educational Objectives are to be assessed along with program Student Learning Outcomes.

The MMET Department consists of both engineering and engineering technology programs. The ABET outcomes for engineering and engineering technology are quite similar. The engineering technology outcomes (a-k) are listed in Table I for reference.

MISSION STATEMENT AND PROGRAM EDUCATIONAL OBJECTIVES REVIEW

The ME Program Mission Statement and Program Educational Objectives are reviewed and updated through the assessment process. At the beginning of each assessment cycle the faculty and select constituents will review and, as necessary, revise them. If revised, the revisions will be reviewed by a broader constituency.

EMPLOYER AND ALUMNI SURVEYS

In 2013 a survey was distributed to alumni and their employers to evaluate Program Educational Objectives (PEO).

Employer:
Of 13 employer responses all were meets or exceeds expectations in all 11 categories (some N/A). The PEO objectives varied from thermal to mechanical systems and included communications and teamwork. Thermal systems were rated weakest with no "exceeds" recorded (half meets, half N/A). However, employers also rated thermal systems as the least important to their work. Most comments lauded out the students' technical abilities. Six other questions about whether our students could pursue FE registration or advanced research were rated as 1/3 agree and 2/3 strongly agree.

Alumni:
154 Alumni responded; 23 from BME, 85 from BMET, 46 from BManuf and 9 from MS Manuf (18 other). They were asked where more emphasis should be placed in the PEO plan. On a scale from 1(more emphasis) to 3 (less emphasis) they rated the following:
Thermal systems: 1.88
Mechanical systems: 1.70
Communication: 1.66 (oral sub score 1.57)
Teamwork:1.68

Overall, students want to see more emphasis on everything, but mostly communication and oral presentation. Most comments were praising "hands-on" nature of OIT. Other than one comment about wanting more analytical training the only negative comments were about wishing they paid attention more in the communication classes. Some comments asked for more specifics in various CAD skills and even some spreadsheet analysis (~10 to 20 of 118). No consistent desire from the alumni stood out.

Other status of alumni:
15/119 are professionally registered
95/133 are pursuing professional development
43/131 have pursued graduate studies
50/118 have done research
Have family or friends who would pursue BME at Wilsonville (45/64)

SUMMARY OF 2012-13 ASSESSMENT ACTIVITIES

As seen in the above assessment cycle, outcomes d, f and h were assessed during the 2012-13 school year. Each Student Learning Outcome is broken down into several Performance Criteria to be assessed individually.

Following are the assessment results for the SLOs addressed during 2012-13.

OUTCOME (d) Multi-disciplinary Teams

Graduates will be able to function on multi-disciplinary teams.

The Performance Criteria to consider in assessing this outcome are:

- Identify and achieve goal/purpose.
- Assume roles and responsibilities as appropriate.
- Communicate effectively.
- Recognize and help reconcile disagreements among team/group members.
- Share appropriately in work of team/group.
- Develop strategies for effective action.
- Recognize and adapt to cultural differences.

Teamwork is developed throughout the ME Program's educational experience. However, there are several places formal teams pursue solutions to engineering problems. The introductory Orientation courses (MET 111/112), Fluid Mechanics I (MECH 318), and Senior Projects are the predominant examples.

1. Assessment method: Faculty review of student team experiences

Following the Institution's plan for assessment of this outcome, MMET faculty involved in a group project assessed the group experience. Each faculty advisor assessed group function and dynamics using an analytical rubric. That rubric is shown in Appendix II. This assessment is done within senior projects. The senior project teams are a mix of the department's three programs, Mechanical Engineering, Mechanical Engineering Technology, and Manufacturing Engineering Technology and in some cases students from outside the department. This gives a good mix of students and an interdisciplinary element to the projects. It also makes assessing Mechanical Engineering students separately difficult.

Table 2 shows the aggregate faculty scores. Here the assessment method was a rubric completed by the faculty judging each group with a measurement scale of 1 to 4. Three faculty members were involved in assessing twenty-eight students across seven projects.

Table 2. Faculty Assessment Results for SLO d, Teamwork

Performance Criteria	Minimum Acceptable Performance	Results
Achieves Goals/Purpose	80% score 3 or 4	100% 7/7
Assumes Roles and Responsibilities	80% score 3 or 4	86% 6/7
Communicates Effectively	80% score 3 or 4	86% 6/7
Reconciles Disagreements	80% score 3 or 4	86% 6/7
Shares Work Appropriately	80% score 3 or 4	29% 2/7
Develops Strategies/Actions	80% score 3 or 4	29% 2/7
Cultural Adaptation	80% score 3 or 4	86% 6/7

Note: scores are allocated per team. The senior project allows students to experience the intensive pressures of design and building which also leads to disagreements and brings forth teamwork difficulties. Here they may be identified and reconciled. As such, the senior project is imperative to their overall education, especially in teamwork development. The low scores in sharing work and developing strategies/actions reflect the need for this type of education.

Strengths: Focusing on the task and completing the mission

Weaknesses: Ownership of ideas and recognition, some inappropriate interchanges between genders/cultures

2. Assessment method: Student review of student team experiences

The same rubric as used by faculty above was used by the students to evaluate teamwork. Again this assessment was done within senior projects involving the same teams as the above faculty assessment. Responses were obtained from 28 ME, 4 MET, and 5 MFG students. Students were asked to rate their team's performance. Table 3 shows the aggregate student scores.

Table 3. Assessment Results for SLO d, Teamwork

Performance Criteria	Minimum Acceptable Performance	ME	MET	MFG	Overall
Achieves Goals/Purpose	80% score 3 or 4	96% 26/27	4/4	5/5	97% 35/36
Assumes Roles and Responsibilities	80% score 3 or 4	81% 22/27	3/4	5/5	83% 30/36
Communicates Effectively	80% score 3 or 4	93% 25/27	2/4	4/5	86% 31/36
Reconciles Disagreements	80% score 3 or 4	75% 21/28	2/4	5/5	76% 28/37
Shares Work Appropriately	80% score 3 or 4	71% 20/28	3/4	4/5	73% 27/37
Develops Strategies/Actions	80% score 3 or 4	82% 23/28	2/4	5/5	81% 30/37
Cultural Adaptation	80% score 3 or 4	93% 26/28	3/4	5/5	92% 34/37

Results: In the academic environment, students want their grade. This leads to desired ownership and a desire to see the best in a project. As a result the students tend to more readily see the advantages their own ideas and want credit for that. It is difficult to have students set aside personal advancement and see what is the best for the project. Some gender and cultural difficulties were observed. Project management was weak (last minute scrambling).

Outcome: Instructors are briefed on judging student contributions such that students are clear on objectives and that they will get due credit for their work and contributions more so than whether their idea is actually implemented or not.

Since student self-evaluation reflects the <u>end</u> result of what the students feel they learned, and faculty gave judgments on what they observed <u>during</u> the process, the students may have achieved the desired outcome of better teamwork skills as a result of the poor behavior and its resolution.

Table 4. Discipline Mix on Senior Project Teams

Project	ME	MET	MFG
Knee	4		
Grappler	3		1
BHS	4		3
Eco-Marathon	10	1	
SAE Formula	7	3	1

Assessment Method: MMET Undergraduate Exit Survey

During the spring term each graduating senior completes an exit survey. The survey includes questions on how well the program prepared the student on each SLO. This survey data is reviewed by faculty to determine any strengths or weaknesses as perceived by students on this SLO.

In spring of 2013, 17 students in senior projects completed an exit survey. Students were asked to *"Please rate how well the Mechanical Engineering Program prepared you in the following areas: To function on multi-disciplinary teams."* Table 5 shows the results of this inquiry.

Table 5 : Senior Project Exit Survey, Teamwork

	Highly Prepared	**Prepared**	**Inadequately Prepared**
To function on multi-disciplinary teams	9	8	0

The students feel they are prepared or highly prepared for teamwork. Despite some disagreements during senior projects, all felt they were prepared to work in a team environment. Perhaps living through the difficulty helped to prepare them.

OUTCOME (f) Professional and Ethical Responsibility

Graduates will have an understanding of professional and ethical responsibility.

The Performance Criteria to consider in assessing this outcome are:

- Evaluate the ethical issues related to a problem in the discipline.
- Demonstrate knowledge of the professional code of ethics in their discipline.
- Demonstrate professional behavior in the academic environment.

Ethics:

Ethics are learned throughout a student's education at Oregon Tech. From the introduction of professional canons in Orientation courses (MECH 111/112) through Senior Projects, ethical conduct is highlighted and expected. One formal course, Ethics in the Professions (PHIL 331), is required in the curriculum. Assessment of this outcome is accomplished near the end of the student's education.

Assessment method: Direct assessment of student work.

Paralleling the institution's assessment of this outcome, the ME program uses an institutional rubric created at Oregon Tech. This rubric is shown in Appendix II. The faculty assessed an upper-division assignment addressing the ASME code of ethics and an ethical scenario. A short paper assigned in senior projects is used. The results of this assessment are shown in Table 6.

Table 6. Assessment Results for SLO f, fall term 2012, Senior Projects, 10 seniors

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Knowledge of code of ethics	Rubric-graded assignment	1-4 proficiency scale	80% score 3 or 4	100% 10/10
Describes ethical issue(s)	Rubric-graded assignment	1-4 proficiency scale	80% score 3 or 4	100% 10/10
Describes parties involved and discusses their points of view	Rubric-graded assignment	1-4 proficiency scale	80% score 3 or 4	100% 10/10
Describes and analyzes possible/ alternative approaches	Rubric-graded assignment	1-4 proficiency scale	80% score 3 or 4	100% 10/10
Chooses an approach and explains the benefits and risks	Rubric-graded assignment	1-4 proficiency scale	80% score 3 or 4	90% 9/10

The ethics assignment asked students questions about the ASME Canons and then gave an ethics scenario to be evaluated. Students were asked to describe the parties involved, describe alternatives, and choose a particular approach related to the ethics scenario presented. Each of these were assessed using the institutional ethics rubric.

For this performance assessment the department set a goal to have over 80% of students performing at a rubric level of 3 or 4, proficient or highly proficient. As seen in Table 6 students performed above this level related to all institutional performance criteria.

Students reviewed by this assessment are performing above expectations. They have a good academic knowledge related to ethical issues. These institutional performance criteria relate to the ME Program's first two performance criteria listed above and show students within the program are meeting this portion of the SLO.

Professionalism:

Professionalism is taught throughout the ME curriculum. No courses specifically address this specific educational outcome but it is stressed in many ways. Classroom conduct, teamwork, laboratories and other class related activities provide the opportunity for students to learn proper conduct. Also, activities outside formal courses add to this education, such as professional societies on campus, tours of engineering facilities and guest speakers.

Assessment Method: Faculty Assessment of Student Actions

To assess professionalism the Program Directors of the ME, MET and MFG programs came together to assess each graduating senior's conduct. Twelve areas were evaluated on a scale of 0 to 2. The desire was for at least 80% of the students to attain an evaluation of one or two. Table 7 shows the result of this activity for the sixteen ME students expected to graduate in spring term 2013.

The assessment shows the faculty feel the ME students exhibit professionalism in the areas considered.

Table 7. Faculty Professionalism Assessment

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Timeliness of work	Faculty Rating	0-2 scale	80% at 1 or 2	16/16
Quality of work (course expectations)	Faculty Rating	0-2 scale	80% at 1 or 2	16/16
Quality of work (work product)	Faculty Rating	0-2 scale	80% at 1 or 2	16/16
Attitude toward feedback	Faculty Rating	0-2 scale	80% at 1 or 2	16/16
Attitude toward assigned tasks	Faculty Rating	0-2 scale	80% at 1 or 2	16/16
Punctuality	Faculty Rating	0-2 scale	80% at 1 or 2	16/16
Attendance	Faculty Rating	0-2 scale	80% at 1 or 2	15/16
Academic Integrity	Faculty Rating	0-2 scale	80% at 1 or 2	16/16
Interpersonal skills	Faculty Rating	0-2 scale	80% at 1 or 2	15/16
Knowledge of classroom policies and procedures	Faculty Rating	0-2 scale	80% at 1 or 2	16/16
Work ethic	Faculty Rating	0-2 scale	80% at 1 or 2	16/16
Appearance	Faculty Rating	0-2 scale	80% at 1 or 2	16/16

Result: Only 4 of the 16 students received less than a majority of perfect "2" scores. The year, 2012-2013 seemed to have a professional group. (Except for some teamwork issues addressed above).

Assessment Method: MMET Undergraduate Exit Survey

During the spring term each graduating senior completes an exit survey. The survey includes questions on how well the program prepared the student on each SLO. This survey data is reviewed by faculty to determine any strengths or weaknesses as perceived by students on this SLO.

In spring of 2013, 17 students in senior projects completed an exit survey. Students were asked to *"Please rate how well the Mechanical Engineering Program prepared you in the following areas: To have an understanding of professional and ethical responsibility"*. Table 8 shows the results of this inquiry.

Table 8 : Senior Project Exit Survey, Professional Responsibilities & Ethics

	Highly Prepared	**Prepared**	**Inadequately Prepared**
To have an understanding of professional and ethical responsibility	5	12	0

The students feel they are prepared or highly prepared for teamwork. Students remain apprehensive about the details of various employment possibilities they may encounter.

OUTCOME (h) Impact of Engineering

Graduates will have the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and social context.

The Performance Criteria to consider in assessing this outcome are:

- Understand global impact of engineering decisions
- Understand maco-economic impact of engineering solutions
- Understand environmental and social impact of engineering decisions

Much of this SLO is learned in the general education requirements of the institution. The Humanities and Social Science electives stress these topics, particularly in a technical directed institution such as ours. Writing courses also develop an understanding of these performance criteria. ME students are required to take Introduction to Technology, Society, and Values (HUM 125) and Ethics in the Professions (PHIL 331) which more directly address this SLO. Besides these formal courses understanding of this SLO is obtained throughout the technical courses within the curriculum.

Although much of the formal training related to this SLO is gained through general education requirements it will be assessed through departmental course work.

Assessment method: Direct assessment of student work.

Towards the end of the student's experience, within Senior Projects, an assignment is given to allow assessment of this SLO. A short paper is required giving the student an opportunity to analyze a topic or situation involving these performance criteria. A rubric developed by the departmental faculty was used to assess this assignment. This rubric is shown in Appendix II.

An assignment was given in senior projects winter term 2013. This asked the students to assess the reality and effects of portable energy. The rubric presented in Appendix II was applied by the faculty members involved in this course sequence. Table 9 presents the results of this assessment for mechanical engineering students.

Table 9. Assessment Results for SLO h, winter term 2013, Senior Projects, 13 seniors

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Understand global impact of engineering decisions	Rubric-graded assignment	1-4 proficiency scale	80% score 3 or 4	100% 13/13
Understand macro-economic impact of engineering solutions	Rubric-graded assignment	1-4 proficiency scale	80% score 3 or 4	100% 13/13
Understand environmental and social impact of engineering decisions	Rubric-graded assignment	1-4 proficiency scale	80% score 3 or 4	100% 13/13

The assessment shows good performance in all categories.

Assessment Method: MMET Undergraduate Exit Survey

During the spring term each graduating senior completes an exit survey. The survey includes questions on how well the program prepared the student on each SLO. This survey data is reviewed by faculty to determine any strengths or weaknesses as perceived by students on this SLO.

In spring of 2013, 17 students in senior projects completed an exit survey. Students were asked to *"Please rate how well the Mechanical Engineering Program prepared you in the following areas: To have the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and social context."* Table 10 shows the results of this inquiry.

Table 10 : Senior Project Exit Survey, Broad Education

	Highly Prepared	**Prepared**	**Inadequately Prepared**
To have the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and social context	5	12	0

In general the students feel they are prepared or highly prepared for engineering impacts and globalization. Potential reluctance may still exist because they know they will be working in a world market, but there are so many, and they don't know details about them all.

SUMMARY OF STUDENT LEARNING OUTCOMES & ACTIONS TAKEN

The results from the assessments above will be discussed during the faculty convocation held in September 2013. During that meeting actions will be decided upon to address any weaknesses or, as appropriate, to improve areas showing good, but not excellent, performance. Specifically Changes to ENGR 485 will be assessed. Enrollment in ENGR 445 (project management) will be tracked and the nature of the new projects will be assessed.

RELATED CHANGES DUE TO PRIOR ASSESSMENTS

CURRENT ACTION ITEMS –

1) **"How Faculty manage teamwork", will be discussed during convocation Sept.2013**
2) **"Use of oral presentations", will be discussed during convocation Sept.2013**
3) **Implementation of past items, will be assessed during convocation Sept.2013**
    a. **ENGR 485 FE Exam**
    b. **ENGR 445 Project management**
    c. **Assignment revisions**
    d. **Increasing projects**

FUTURE ACTION ITEMS – to be completed before next assessment cycle, fall 2015

1) **To be determined during Convocation 2013**
    a. **How to track increasing oral presentations and see if conditions improve**
    b. **What projects will be added and how to determine the effects**
    c. **How should assessment assignments be revised**
    d. **Should we use the FE to track technical adequacy to each course**

Convocation 2013 results will be appended to this report as Appendix III

APPENDIX I
Student Learning Outcomes - Curriculum Maps

The curriculum maps below show the courses in which each SLO is introduced, emphasized or reinforced. This is a continuum as most SLOs are considered in all courses. However, the maps presented indicate the courses most instrumental in obtaining each SLO.

OUTCOME (d): Multi-disciplinary Teams

	Freshman		*Sophomore*		*Junior*		*Senior*	
Fall	CHE 221		MATH 252		MATH 253N		MECH 323	
	MET 111	I	MET 242		MFG 314		MECH 351	
	WRI 121		PHY 221	I	MECH 318	R	MECH 490	E
	Hum/Soc Sci		WRI 227		MECH 363	R	WRI 321	E
			Econ Elec		MET 375		MECH Elec	
							Hum/Soc Sci	
Winter	CHE 222		ENGR 211		ENGR 212		MECH 417	E
	MET 112	I	MATH 254N		ENGR 355		MECH 436	
	MFG 103		MATH 361		MECH 315		MECH 437	E
	WRI 122		PHY 222	R	MECH 360		MECH 491	E
					MET 326		WRI 322	E
					SPE 321	E	PHIL 331	
							WRI 322	
Spring	MATH 251		ENGR 266		HUM 125		IMGT 345	
	MFG 120		ENGR 213		MATH 451		ENGR 485	
	MET 160	I	ENGR 236		MECH 312		MECH 480	
	MET 241		MATH 321		MECH 313		MECH 492	E
	SPE 111		PHY 223	R	MECH 316	R	WRI 323	E
							MECH Elec	
							Hum/Soc Sci	

I = Introduced
R = Reinforced
E = Emphasized

OUTCOME (f): Professional and Ethical Responsibility

	Freshman		*Sophomore*		*Junior*		*Senior*	
Fall	CHE 221		MATH 252		MATH 253N		MECH 323	
	MET 111	I	MET 242		MFG 314		MECH 351	
	WRI 121		PHY 221		MECH 318		MECH 490	E
	Hum/Soc Sci	R	WRI 227		MECH 363		WRI 321	E
			Econ Elec	R	MET 375		MECH Elec	
							Hum/Soc Sci	R
Winter	CHE 222		ENGR 211		ENGR 212		MECH 417	
	MET 112	I	MATH 254N		ENGR 355		MECH 436	
	MFG 103		MATH 361		MECH 315		MECH 437	
	WRI 122		PHY 222		MECH 360		MECH 491	E
					MET 326		WRI 322	E
					SPE 321		PHIL 331	E
							WRI 322	
Spring	MATH 251		ENGR 266		HUM 125	E	IMGT 345	
	MFG 120		ENGR 213		MATH 451		ENGR 485	
	MET 160		ENGR 236		MECH 312		MECH 480	
	MET 241		MATH 321		MECH 313	R	MECH 492	E
	SPE 111		PHY 223		MECH 316		WRI 323	E
							MECH Elec	
							Hum/Soc Sci	R

I = Introduced
R = Reinforced
E = Emphasized

OUTCOME (h): Impact of Engineering Solutions

	Freshman		*Sophomore*		*Junior*		*Senior*	
Fall	CHE 221		MATH 252		MATH 253N		MECH 323	
	MET 111	I	MET 242		MFG 314		MECH 351	
	WRI 121		PHY 221		MECH 318		MECH 490	E
	Hum/Soc Sci	R	WRI 227	R	MECH 363		WRI 321	E
			Econ Elec	R	MET 375		MECH Elec	
							Hum/Soc Sci	R
Winter	CHE 222		ENGR 211		ENGR 212		MECH 417	
	MET 112	I	MATH 254N		ENGR 355		MECH 436	
	MFG 103		MATH 361		MECH 315	R	MECH 437	
	WRI 122	I	PHY 222		MECH 360		MECH 491	E
					MET 326		WRI 322	E
					SPE 321	R	PHIL 331	E
							WRI 322	
Spring	MATH 251		ENGR 266		HUM 125	E	IMGT 345	
	MFG 120		ENGR 213		MATH 451		ENGR 485	
	MET 160		ENGR 236		MECH 312		MECH 480	
	MET 241		MATH 321		MECH 313	R	MECH 492	E
	SPE 111	R	PHY 223		MECH 316	R	WRI 323	E
							MECH Elec	
							Hum/Soc Sci	R

I = Introduced
R = Reinforced
E = Emphasized

APPENDIX II
Rubrics

Rubric for Teamwork

EAC SLO d: Graduates will be able to function on multi-disciplinary teams.

Performance Criteria	No/Limited Proficiency (1)	Some Proficiency (2)	Proficiency (3)	High Proficiency (4)	Score:
1. Identify and achieve goal/purpose	Clear goals are not formulated or documented; thus all members don't accept or understand the purpose/task of the group. Group does not achieve goal.	Individuals share some goals but a common purpose may be lacking. Priorities may be unrealistic and documentation may be incomplete. Group may not achieve goal.	Group shares common goals and purpose. Some priorities may be unrealistic or undocumented. Group achieves goal.	When appropriate, realistic, prioritized and measurable goals are agreed upon and documented and all team members share the common objectives/purpose. Team achieves goal.	
2. Assume Roles and Responsibilities	Members do not fulfill roles and responsibilities. Leadership roles are not defined and/or shared. Members are not self-motivated and assignments are not completed on time. Many members miss meetings.	Some members may not fulfill roles and responsibilities. Leadership roles are not clearly defined and/or effectively shared. Some members are not motivated and some assignments are not completed in a timely manner. Meetings rarely include most members.	Members often fulfill roles and responsibilities. Leadership roles are generally defined and/or shared. Generally, members are motivated and complete assignments in a timely manner. Many members attend most meetings.	Members consistently and effectively fulfill roles and responsibilities. Leadership roles are clearly defined and/or shared. Members move team toward the goal by giving and seeking information or opinions, and assessing ideas and arguments critically. Members are all self-motivated and complete assignments on time. Most members attend all meetings.	
3. Communicate Effectively	Members do not communicate openly and respectfully. Members do not listen to each other. Communication patterns undermine teamwork	Members may not consistently communicate openly and respectfully. Members may not listen to each other.	Members usually communicate openly and respectfully. Members often listen to most ideas. Members usually support and encourage each other.	Members always communicate openly and respectfully. Members listen to each other's ideas. Members support and encourage each other. Communication patterns foster a positive climate that motivates the team and builds cohesion and trust.	

Performance Criteria	No/Limited Proficiency (1)	Some Proficiency (2)	Proficiency (3)	High Proficiency (4)	Score:
4. Reconcile Disagreement	Members do not welcome disagreement. Difference often results in voting. Subgroups are present.	Few members welcome disagreement. Difference often results in voting. Some members respect and accept disagreement and work to account for differences. Subgroups may be present.	Many members welcome disagreement and use difference to improve decisions. Most members respect and accept disagreement and work to account for differences. Subgroups rarely present.	All members welcome disagreement and use difference to improve decisions. All members respect and accept disagreement and employ effective conflict resolution skills. Subgroups absent.	
5. Share Appropriately	Contributions are unequal. Certain members dominate discussions, decision making, and work. Some members may not contribute at all. Individuals work on separate sections of the work product, but have no coordinating effort to tie parts together.	Contributions are unequal although all members contribute something to discussions, decision making and work. Coordination is sporadic so that the final work product is of uneven quality.	Many members contribute to discussions, decision-making and work. Individuals focus on separate sections of the work product, but have a coordinator who ties the disparate parts together (they rely on the sum of each individual's work)	All members contribute significantly to discussions, decision making and work. The work product is a collective effort; team members have both individual and mutual accountability for the successful completion of the work product.	
6. Develop Strategies for Effective Action	Members seldom use decision making processes to decide on action. Individuals often make decisions for the group. The group does not share common norms and expectations for outcomes. Group fails to reach consensus on most decisions. Group does not produce plans for action.	Members sometimes use decision making processes to decide on action. Some of the members of the group do not share norms and expectations for outcomes. Group sometimes fails to reach consensus. Plans for action are informal and often arbitrarily assigned.	Members usually use effective decision making processes to decide on action. Most of the group shares norms and expectations for outcomes. Group reaches consensus on most decisions and produces plans for action.	Members use effective decision making processes to decide on action. Group shares a clear set of norms and expectations for outcomes. Group reaches consensus on decisions and produces detailed plans for action.	
7. Cultural Adaptation	Members do not recognize differences in background or communication style.	Members may recognize, but do not adapt to differences in background and communication style	Members usually recognize and adapt to differences in background and communication style.	Members always recognize and adapt to differences in background and communication style.	

Rubric for Ethics

TAC SLO
EAC SLO f: Graduates will have an understanding of professional and ethical responsibility.

Performance Criteria	Limited or No Proficiency (1)	Some Proficiency (2)	Proficiency (3)	High Proficiency (4)
Demonstrates knowledge of the professional code of ethics	Identifies provisions in the professional code of ethics, but is unable to demonstrate importance or relevance to the profession.	Describes the importance of provisions, but some examples do not apply or fail to illustrate importance of the specified provision.	Describes the importance of provisions in the professional code of ethics. Examples are applicable to the specified provisions and illustrate importance.	Describes in detail the importance of provisions in the professional code of ethics and relevance to the profession. Examples are applicable to the specified provisions and illustrate importance.
Using code of ethics, describes ethical issue(s)	Has a vague idea of what the issue is and is uncertain how the code of ethics applies.	Describes the issue(s) using concepts from code of ethics, but important elements may be missing or misunderstood.	Describes the issue(s) using basic concepts from code of ethics.	Describes the issue(s) in detail, demonstrating full understanding of relevant code of ethics provisions and how they relate to the issue(s).
Describes parties involved and discusses their points of view	Is unsure who should be involved in the issue and/or does not reflect on their viewpoints.	Describes some of the parties and their viewpoints, but important elements are missing or misunderstood.	Describes who should be involved in the issue(s) and discusses the viewpoints of the parties at a basic level.	Describes who should be involved in the issue(s) and thoroughly discusses their viewpoints.
Describes and analyzes possible/ alternative approaches	Is unable to describe or analyze alternatives or consider the effect on parties involved.	Describes and analyzes only one alternative and its effect on parties involved, but important elements are missing or misunderstood.	Describes and analyzes at least two alternatives and their effects on parties involved.	Describes and analyzes a number of alternative approaches and thoroughly considers the interests and concerns of all parties involved.
Chooses an approach and explains the benefits and risks	Has difficulty choosing an approach or stating benefits and risks.	Chooses an approach and explains benefits and risks, but important elements are missing or misunderstood.	Chooses an approach and explains basic benefits and risks.	Chooses an approach and thoughtfully and thoroughly explains benefits and risks.

Rubric for Impact of Engineering Solutions

EAC SLO h: Graduates will have the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and social context.

Performance Criteria	Limited or No Proficiency (1)	Some Proficiency (2)	Proficiency (3)	High Proficiency (4)	Score
Understand global impact of engineering decisions	Does not understand that engineering solutions have a global impact.	Realizes that engineering solutions have a global impact but has difficulty giving examples.	Understands engineering decisions have a global impact and can explain several examples.	Understands engineering decisions have a global impact, can analyze examples, and can reflect on impact of proposed engineering solutions.	
Understand macro-economic impact of engineering solutions	Has little or no understanding of macro-economics.	Has little understanding of macro-economics and the effects of engineering solutions. Cannot give examples of such impacts.	Has some understanding of macro-economics and the impacts on it from engineering solutions. Can give examples.	Has an understanding of macro-economics and the impact of engineering solution on it. Can explain examples and reflect on the impact new solutions may have.	
Understand environmental and social impact of engineering decisions	Does not believe that engineering decisions have a social or environmental impact.	Believes engineering solutions have a social and/or environmental impact but can't relate this to a particular situation.	Understands engineering decisions have social and/or environmental impacts. Can describe examples.	Understands engineering decisions have social and/or environmental impacts. Can relate this knowledge to a current situation.	