OREGON INSTITUTE OF TECHNOLOGY
Mechanical Engineering Program
Assessment 2007-08

October 16, 2008

INTRODUCTION

The Mechanical Engineering Program within the Mechanical and Manufacturing Engineering and Technology Department participates in a comprehensive academic assessment activity. Included is a systematic plan that fits the curricula, student body, and faculty needs. Assessment is woven by threads of the department's structure and academic programs, general education, and the criteria given for accreditation of engineering and engineering technology programs by the Accreditation Board for Engineering and Technology (ABET).

The current document summarizes the results of the 2007-08 assessment activities.

PROGRAM MISSION STATEMENT

The Mechanical Engineering Bachelor of Science 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.

PROGRAM EDUCATIONAL OBJECTIVES

The ME Program's mission leads to three Educational Objectives.

- *Provide graduates the skills and knowledge necessary for immediate employment while also assuring abilities required for continued academic work.*
- *Enable students to be effective communicators, life-long learners, and ethical engineering professionals.*
- *Develop and maintain partnerships with public and private institutions to ensure a relevant, high quality program.*

ASSESSMENT ACTIVITIES

The Mechanical Engineering Program Outcomes have been mapped to the a-k ABET Outcomes. This mapping can be reviewed in the ME Program Assessment Plan. Within this report Outcomes will be referenced by the ABET a-k nomenclature. These are listed below for reference.

a) Graduates will have the ability to apply mathematics, science and engineering
b) Graduates will be able to design and conduct experiments, as well as to analyze and interpret data
c) Graduates will be able 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) Graduates will be able to function on multi-disciplinary teams
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.
f) Graduates will have an understanding of professional and ethical responsibility

g) Graduates will have the ability to communicate effectively
h) Graduates will have the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and social context
i) Graduates will recognize the need for, and have the ability to engage in life-long learning
j) Graduates will have a knowledge of contemporary issues
k) Graduates will be able to use the techniques, skills, and modern engineering tools necessary for engineering practice

In addition to the eleven a-k Outcomes there are four Outcomes identified through the ABET Mechanical Engineering specific criteria. These have been defined as below.

me1) Graduates will be able to analyze and model physical systems or components using principles of engineering, basic science and mathematics.
me2) Graduates will be able to design and realize physical systems or components using principles of engineering, basic science and mathematics.
me3) Graduates will be able to work professionally in the area of thermal systems.
me4) Graduates will be able to work professionally in the area of mechanical systems.

The program faculty determined that Outcomes me1 and me2 are covered through Outcome e. Thus, Outcomes a-k plus me3 and me4 have been assessed. The results of assessing each of these Outcomes is the purpose of this report.

OUTCOME A

Graduates will have the ability to apply mathematics, science and engineering

Graduates must have a fundamental knowledge of engineering and the underlying mathematics and science. They must also be able to apply this knowledge to real world problems.

These skills are taught in required mathematics, science and core engineering courses.

Two assessment methods have been used to evaluate student learning in these areas. First, pre-exams are given in select courses. These courses are generally the first professional courses encountered that have the math, science and core engineering courses as prerequisites. The pre-exams are given at the beginning of the professional course, the first week or two of the term, and are designed to test the prerequisite material needed for that course. The specific courses selected include:

MECH 312 Advanced Dynamics
MECH 313 Thermodynamics II
MECH 315 Machine Design I
MECH 318 Fluid Mechanics I
MECH 360 Materials II
MECH 363 Instrumentation
MET 326 Electrical Power Systems

Pre-exams are evaluated by a committee of faculty members using rubrics. For Outcome a two rubrics were used in evaluation. The first assessed mathematical ability and the second science and core engineering. Graded pre-exams were collected from each of the above courses. Then participating faculty members evaluated each exam on a scale between 1 and 5, five indicating excellent abilities and one being lacking. The percentage of students scoring three or above were then tabulated. The desired result was for over 80% of our students to be performing at three or above.

The second assessment method was review of Fundamentals of Engineering Exam results. All graduates from the ME Program are required to sit for this exam in Oregon. Besides being the best time for a graduate to take this professional exam, it provides the faculty with an indispensable assessment tool. For mathematics and core engineering topics the morning FE Exam is most valuable.

Pre-exams from Machine Design I, Fluid Mechanics I, Materials II, Instrumentation, and Electrical Power Systems, Advanced Dynamics and Thermodynamics II have been assessed.

The pre-exam assessment showed students performing above the base 80% in all courses except for the Thermodynamics II and Machine Design pre-exams. Thermo II tested prerequisite material from Thermodynamics I and that for Machine Design tested prerequisite knowledge in Statics and Strength of Materials. The low results may result from the particular exams given. However, the low scores here are of concern.

Review of the Fundamentals of Engineering Exam showed all graduates performing above national averages in mathematics and core engineering. The program has had only three graduates so any conclusions are tenuous at best. However the preliminary results are encouraging.

The results on the pre-exams testing thermodynamics, statics and strength of materials is being shared with the instructors of those courses. It has been confirmed that the material tested is included in these courses. Assessment will be ongoing to determine why students performed so poorly in these three areas. Use of an analytic rubric may be warranted.

The wide variation in student performance is also a concern. It has been recommended that fewer pre-exams be given and the effort saved go into making these exams more consistent in format and administration. This should give some indication whether the variation is due to differences in student learning or in the exams themselves.

OUTCOME B

Graduates will be able to design and conduct experiments, as well as to analyze and interpret data

Being able to carry out experiments and interpret the resulting data is critical to an applied engineering education. Graduates will be able to plan an experiment or test to determine or measure a given result, select and set up appropriate equipment, conduct an experiment or test, interpret the resulting data and then use the results to improve processes.

Students are exposed to experiments and tests through extensive laboratories. In these they set up experiments as well as collect and interpret data. In addition to laboratory courses senior projects include testing of some kind.

Laboratory reports were collected from three selected courses, MECH 363 Instrumentation, MECH 437 Heat Transfer Lab, and MECH 480 Vibrations and assessed. For each lab report two rubrics are applied, one for experimental methods, getting data, and a second for analyzing and using experimental data. A faculty committee reviewed the lab reports and scored each according to the rubrics. Data reduction of the rubric scores followed the process described in Outcome A above.

Review of senior projects is very similar. The same rubrics are used for review of students final senior project reports.

Assessment of all three laboratory courses showed good performance by the students in setting up experiments and obtaining data. This was less clear in Instrumentation. It was not clear that students were setting up equipment nor how they were collecting data. However, all assessments were easily above our desired level.

The results in interpreting and analyzing data was somewhat below the desired 80%. Instrumentation was 74%, Heat Transfer Lab 88%, and Vibrations 75%. This is of concern but the faculty found no clear indication where to improve. It was decided to wait for assessment of senior project final reports, due the end of spring term, before making recommendations. However, it was suggested that if the senior project reports don't clarify the situations, that the faculty involved in laboratory courses meet and review expectations, handout materials and reporting.

The reviewing faculty thought it important that students become familiar with setting up experiments in the Instrumentation course. It was recommended that the MECH 363 laboratory experiments and procedures be reviewed for this experience. A new instructor will be taking over the MECH 363 Instrumentation course in fall of 2008. The faculty will work with him to clarify the intent of the laboratories in that course.

OUTCOME C

Graduates will be able 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

In the applied mechanical engineering program at OIT Outcome C is interpreted as the ability to plan and carry out an engineering project. The performance criteria of an engineering project include:

- Generate an appropriate set of Criteria, targets to be met
- Generate one or several Proposed Solutions to meet the Criteria
- Generate a Work Breakdown/Task Statements needed for project completion
- Generate a Time Line for work defined and given resources
- Apply engineering analysis and tools to accomplish the work defined
- Track or manage a project

Parts of this are taught throughout the curriculum. However the main emphasis is from project classes, Orientation MET 111/112 and Senior Projects MECH 490/491/492.

The primary assessment method is to review Senior Project work. A faculty committee reviews senior project reports and presentations. Senior Projects is a capstone sequence which allows students to apply their education to real world problems. The committee is to evaluate the students preparedness to plan, propose, and manage an engineering project.

The committee reviews four student assignments, written and oral proposals fall term, and written and oral final reports spring term. A rubric to assess planning and managing projects was used for both written reports and oral presentations. As above a base score of three was determined to be adequate with the desire that above 80% of our students attain this level.

Evaluation of fall term proposals showed 89% of our students were performing at or above a score of three on the rubric. However during discussions it was felt that students lacked the skill to plan an engineering project.

Final senior project presentations have been given and assessed. This occurred at the end of spring term. These presentations supported the assessment of the proposal reports and presentations, that the student teams lacked the ability to plan and manage engineering projects. The final reports, which are due the end of spring term,

have not yet been assessed. The faculty feels assessment of these reports will only substantiate the conclusion that the students need better training in project planning and management.

It was thus recommended that several small design projects be placed throughout the curriculum to better prepare students for senior projects and eventual project planning and management in industry. It was decided to require students to plan and manage very small design projects in Fluid Mechanics I and Machine Design II. This was initiated spring term in Machine Design and will be implemented in Fluid Mechanics in fall of 2008.

OUTCOME D

Graduates will be able to function on multi-disciplinary teams

Mechanical Engineers will be working on interdisciplinary teams throughout their careers. It is important that they have the skills to succeed in a team environment and have the chance to apply these skills during their education.

The major experience students have with teams is in senior projects. Here Mechanical Engineering students work on teams with at least a mix of Mechanical Engineering Technology and Manufacturing Engineering Technology students. The desire is to involve team members from electronics, computer systems, and other majors as the projects allow. This is not always possible but these projects bring a real world element to teamwork and are encouraged.

Teamwork is assessed mainly through senior projects. Each senior projects team, as a group, completes a rubric assessing several elements of teamwork. Those elements include:

- Attendance at Group Meetings
- Establishing and Documenting Goals
- Accountability for Results (Work Products)
- Team cohesion
- Communication
- Team decision making
- Adjusting plans as needs arise
- Assessment of team function
- Timely submission of work Assignments and Reports
- Leadership
- Managing conflict

The assessment showed that accountability, assessment, and managing conflicts were the areas identified as being the biggest problem areas. It has been suggested that senior project faculty point out these elements of teamwork and identify these three potential problem areas to their students.

The results from assessing Outcome C showed improvement could be made in project planning and management. It is thought that improvement in this area will likewise promote better teamwork.

A survey of employers of our graduates was planned. The return on these surveys has been very poor in the past and with only three graduates it was decided not to pursue this effort this year. There was also some discussion that this assesses our Objectives rather than outcomes.

OUTCOME 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.

The core of OIT's upper division mechanical engineering program concentrates on identification, formulation and solution of engineering problems. Graduates will have the ability to apply the analysis techniques taught in upper division MECH courses. The upper division MECH courses include the following.

MECH 312	Advanced Dynamics	(3-0-3)
MECH 313	Thermodynamics II	(3-0-3)
MECH 315	Machine Design I	(3-0-3)
MECH 316	Machine Design II	(3-0-3)
MECH 318	Fluid Mechanics I	(3-3-4)
MECH 323	Heat Transfer	(3-0-3)
MECH 351	Finite Element Analysis	(2-3-3)
MECH 360	Materials II	(3-0-3)
MECH 363	Instrumentation	(2-3-3)
MECH 417	Fluid Mechanics II	(3-0-3)
MECH 436	Control Systems	(2-3-3)
MECH 437	Heat Transfer Lab	(1-3-2)
MECH 480	Vibrations	(2-3-3)

More open ended problem solving, an extension in depth and breadth of this Outcome, is found in senior projects.

Three assessment methods have been applied to evaluate this outcome. First, the Fundamentals of Engineering Exam, which all graduates are required to sit for, is reviewed. The afternoon session aimed at upper division mechanical engineering work will be most informative.

Secondly, courses are selected from the above list in which graded assignments are collected and assessed by a faculty committee. Each assignment will be assessed by each committee member using a rubric.

The third method of assessment is evaluation of written senior project proposals and final reports. The same rubric will be used by a faculty committee as is done for collected assignments above.

The first three students graduated from the Mechanical Engineering program in 2007. All took and passed the Fundamentals of Engineering exam. All were above the national average in all discipline areas but for mechanical design and economics. The number of graduates is too small to draw actionable results from. However a review of the machine design courses was completed related to this assessment. See Outcome ME4 for details.

Course assignments were collected and assessed in MECH 315 Machine Design I, MECH 323 Heat Transfer, MECH 363 Instrumentation, MECH 437 Heat Transfer Lab and MECH 480 Vibrations. MECH 313 Thermodynamics II assignments have been collected but as yet not assessed. In all, faculty have assessed nine assignments. For each a rubric was applied by each faculty member. It was determined that performance expectation on this rubric's scale of 1 to 5 was a level of 3. The percentage of students performing at or above three was determined for each assignment. All assignments showed a performance over the desired base of 80% but for the lab reports in MECH 363 and MECH 480 which were assessed at 78% and 79%. It was noted that the MECH 363 assignment contained little data to evaluate and the scores varied widely between the reviewers, from 44% to 100%.

Written proposals from senior projects were also reviewed by a faculty committee. The same rubric was used along with the same reduction of rubric data. Evaluation was done department wide as senior projects is a mix of engineering and engineering technology students, as well as students from other departments. The assessment of project proposals from the Klamath Falls campus, which encompasses all ME students, was well above the base 80% figure. It was noted by the faculty that evaluation of technical abilities was difficult at the proposal stage.

Senior project final reports should be a good place to assess this outcome. These will be collected and graded the end of spring term and are thus not yet available. However, the faculty feels that the technical abilities shown by the senior project students will be masked by the poor project planning and management shown.

Review of courses showed good assessment results for this outcome. It was also felt that poor project planning and management would mask the technical work preformed in senior projects. Although senior project reports are not yet available it was felt that no additional information will be forthcoming from these.

If the senior project report assessment is not further conclusive, the faculty felt that no specific action, beyond normal course improvement, was required.

OUTCOME F

Graduates will have an understanding of professional and ethical responsibility

Graduates will gain an understanding of professional and ethical responsibilities through their education at OIT. Further they are expected to act with high professional and ethical standards.

One class formally gives students formal exposure to the subject, PHIL 331 Ethics: Moral Issues in the Professions. Besides this minimal formal training, the culture of the department and the program promotes professional and ethical behavior.

The assessment done in 2007-08 was to dedicate a faculty meeting to discuss ethics as related to this outcome. The meeting was to specifically discuss ethics and determine where we stand and how to better promote ethical understanding and actions. The meeting brought out several elements for consideration.

It was the general feeling of the group that, while conceptual training in ethics is necessary, relating professional ethics to the students day to day lives would promote the best learning. A wide range of areas were defined ranging from being a contributing team member, appropriately referencing sources to cheating. Some discussion focused on developing a departmental policy regarding egregious actions, such as cheating. There was some concern that a writing policy could restrict individual responses. It was also noted that any policy would need to correspond with the schools policy where they overlap.

Three recommendations resulted from this meeting and included:

- Consider adding review of the OIT Student Handbook's code of conduct and possibly additional case studies to the MET 111/112 Orientation courses.
- The appointment of an individual or committee to review school policies related to ethical behavior and consider if a departmental policy would enhance this policy.
- A review of ethical responsibilities be added to senior projects. This should center on student responsibilities related to projects and teamwork.

OUTCOME G

Graduates will have the ability to communicate effectively

Effective communication is critical to a successful career in mechanical engineering. Students must be able to communicate in writing, speech, and graphically. OIT's Mechanical Engineering program has a particular strength in this area. The specific skills addressed include:

- Ability to communicate clearly and concisely in written reports
- Ability to communicate verbally, both prepared presentations and impromptu discussions
- Ability to communicate through drawings, both formal drawings and sketches

ME students learn through formal writing and speech classes, extensive laboratory report writing, and through senior project reports and presentations. Drawing and CAD skills area also gained through several directed courses, orientation courses and senior projects.

Three assessment methods are used to evaluate this outcome. Senior project reports and presentations are evaluated. Here both written reports and oral presentations are evaluated for communication skills with results and recommendations provided to the department. Fall project proposal presentations and oral presentations have been reviewed and assessed. Final reports and presentations are due during spring term and will be evaluated when available.

Graded laboratory assignments from MECH 363 Instrumentation and MECH 437 Heat Transfer Lab have been collected and assessed.

Senior project written proposals and oral presentations were evaluated by a faculty committee. Each member of the committee evaluated each assignment using a rubric aimed at communication. Again an acceptable score on this 1 to 5 Rubric gradation was judged to be three. The percentage of students performing at or above three was determined. In evaluation of written proposals at the Klamath Falls campus, which includes all ME students, all reports were judged acceptable, over a score of three. Likewise all oral presentations were judged acceptable. Senior Project final presentations have been give and assessed. These also showed a good level of performance by the students. Senior Project final reports are now being collected.

Graded lab assignments from Instrumentation and Heat Transfer Lab were assessed using the same rubric and process. 63% of the Instrumentation reports were judged to be at or above a score of three. This is below the desired 80% level. From the content and grading of lab reports in MECH 363, it appears the elements looked for by several faculty members weren't stressed. The report sections generally used in laboratory reports were present but the separation of material into these sections was poor in many cases. Heat Transfer Lab reports were assessed at 91% performance at or above an acceptable level. Discussions with the faculty committee determined the writing of both reports, sentence structure, grammar, etc., was well done and easily within acceptable norms.

Review of an assignment from MET 242 CAD for Mechanical Design II was also assessed using the same rubric and process. It was assessed that 69% of students were performing at or above a level of three. Again the desired level is at 80%. There are several opportunities for students to use and improve their drawing skills between MET 242 and graduation. However, a cursory look at the available senior project reports showed a lack of drawing sets.

The faculty recommended that laboratory writing guides and content be reviewed so that faculty teaching lab courses are giving the students a consistent format and expectations. This is planned to be implemented during the departmental retreat during fall of 2008.

The faculty also thought the pairing of senior projects with the one credit writing courses has improved student abilities in report writing. It was recommended this pairing continue and, although having no effect on the ME program, be extended to satellite campuses.

It was further recommended that the term projects in Fluids and Machine Design include the creation of drawings sets.

OUTCOME H

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

To be productive citizens graduates need a broad understanding of world affairs and the impact of these affairs on the engineering profession.

Students take a broad range of social science and humanities electives. These give students a broad perspective of world affairs even though they are electives and each student will have a different mix of subjects. How these world affairs affect the engineering profession is discussed in the engineering courses, particularly upper division courses.

This outcome is being assessed through several targeted assignments. These assignments are assessed by a faculty committee using a rubric. Each faculty member assesses the assignments collected using this rubric. The Rubric, as those above, uses a range from 1 to 5 for scoring. A score at or above 3 has been determined as adequate performance. Once the Rubrics are completed the percentage of students evaluated at 3 or above, adequate performance, is tabulated. The desired percentage is determined to be 80%.

During 2007-08 three assignments were given and assessed. In Fluid Mechanics I (MECH 318) assignments related to nuclear power and global warming were given. The third was made part of Senior Projects and given during winter term (MECH 491) involving evaluation of "Peak Oil."

In all three cases over 80% of the students performed well. The two assignments in MECH 318 evaluated at 100% performance. The "Peak Oil" assignment in senior projects evaluated to 83%. The committee found it interesting that the MECH 318 assignments were evaluated higher than the senior project assignment. It was found that the MECH 318 assignments were very targeted in evaluating one contemporary article while the senior projects assignment was much more loosely defined. The committee thought this may be the reason for the variations between courses.

Overall students showed appropriate skills in evaluating contemporary issues in the context of their profession. No recommendations were forthcoming from assessment of this outcome.

OUTCOME I

Graduates will recognize the need for, and have the ability to engage in life-long learning

In a rapidly changing world, particularly technological change, a commitment to life long learning is essential for a long successful career.

This outcome is assessed through a graduate exit survey. This exit survey is required of all graduating seniors and, among other things, will assess the students understanding and ability to engage in lifelong learning. The exit survey will strive to determine where in the curriculum these skills are learned and methods to promote

them. The Faculty will review the surveys and report findings and recommendations in a written report.

These surveys are now being collected from graduating students. Once available the results will be reviewed by a faculty committee for assessment and recommendations.

OUTCOME J

Graduates will have a knowledge of contemporary issues

To be productive citizens graduates need an understanding the the world and of current issues.

ME graduates are required to take four Humanities/Social Science electives as well as PHIL 331 Ethics: Moral Issues in the Professions. These give students an exposure to current issues.

This outcome is assessed through targeted assignments. These are the same assignments used to assess outcome h and carefully selected to address both outcomes. Three assignments were collected and assessed. They are described in Outcome h above.

A faculty committee used a rubric to assess the three assignments collected. Each was scored between 1 and 5 with three showing an acceptable understanding. The percentage of students performing at or above a score of three were calculated for each faculty member's assessment. These were then combined into an overall percentage.

In all three assignments over 80% of the students performed at or above an acceptable level, in most cases considerable above. The faculty committee thus found students capable of understanding and assessing current topics. No recommendations were given.

OUTCOME K

Graduates will be able to use the techniques, skills, and modern engineering tools necessary for engineering practice

Modern engineering tools include computers, test equipment, and controls. In the applied engineering program at OIT these tools include CAD systems both two dimensional and solid modelers, various test equipment used in laboratories and projects, and an introduction to industrial controllers. Graduates will be able to operate the tools encountered and extend the knowledge gained to new unfamiliar programs and equipment.

Students are exposed to computers in nearly all of our engineering courses. Computer aided design is specifically taught in MET 241 and 242 CAD for Mechanical Design, MET 275 Solid Modeling and MECH 351 Finite Element Analysis. Students are exposed to laboratory equipment in each of the ME programs upper division lab courses. These include MECH 318 Fluid Mechanics I, MECH 363 Instrumentation, MECH 436 Control Systems, MECH 437 Heat Transfer Lab, and MECH 480 Vibrations. Industrial controls are specifically taught in MECH 436 Control Systems.

Assessment of the skills taught are done through selected assignments. These include a homework assignment from MET 242 CAD for Mechanical Design II, and laboratory reports from MECH 363 Instrumentation and MECH 480 Vibrations.

Assignments from MET 242, MECH 363 and MECH 480 have been collected and assessed. For each assignment a faculty committee assesses each assignment using a rubric targeting modern engineering tools. The rubric has a scale from 1 to 5 with three being judged acceptable. After each faculty member has assessed

all assignments they are evaluated to determine the percentage of students performing at or above a level of three. For each a target of 80% is sought.

Assessment of CAD drawings from MECH 242 showed that on average 96% of the students performed at an acceptable level. The impression, from senior project reports, is that students are also gaining the knowledge to use CAD solid modeling software.

The laboratory assignment from MECH 363 may not be appropriate to evaluate this outcome. From the reports it appeared students did not set up the laboratory equipment but simply recorded data. This was judged the reason for the wide range in assessments from various faculty members. One faculty member determined there was insufficient information to evaluate.

Review of a Vibrations laboratory report showed 86% of the students, on average, performed at an acceptable level.

Assessments of all assessments showed acceptable levels of performance. No recommendations for improvement beyond ongoing course improvements was given.

OUTCOMES ME1 & ME2

Graduates will be able to analyze and model physical systems or components using principles of engineering, basic science and mathematics

Graduates will be able to design and realize physical systems or components using principles of engineering, basic science and mathematics.

These two outcomes were derived from the mechanical engineering specific ABET criteria. They are similar to general ABET criteria e. Therefore, the intent of these outcomes has been incorporated into Outcome E.

OUTCOME ME3

Graduates will be able to work professionally in the area of thermal systems.

The discipline of mechanical engineering is very broad. The course of study at OIT includes study of mechanical, thermal, fluid, and electrical systems as well as materials science and instrumentation. Technical courses in computer aided design, machining and welding are also included. This outcome is directed at the thermal science related courses.

The courses directly contributing to thermal systems include:

ENGR 355	Thermodynamics	(3-0-3)
MECH 313	Thermodynamics II	(3-0-3)
MECH 318	Fluid Mechanics I	(3-3-4)
MECH 323	Heat Transfer	(1-3-2)
MECH 363	Instrumentation	(2-3-3)
MECH 417	Fluid Mechanics II	(3-0-3)
MECH 437	Heat Transfer Lab	(1-3-2)

Two assessment methods were implemented to assess this outcome. First graded assignments were collected from thermal systems courses and assessed. Secondly, results from the Fundamentals of Engineering Exam were reviewed in terms of thermal systems topics.

Assignments were selected from MECH 313 Thermodynamics II, MECH 323 Heat Transfer, MECH 363 Instrumentation and MECH 437 Heat Transfer Lab for collection and assessment. This has been completed for all but MECH 313 which is taught spring term. Here the final exam is to be evaluated but has not yet been collected. For each collection members of a faculty committee apply a rubric to the assignment. The scores on the rubrics range from 1 to 5 with three being judged acceptable performance. Once the rubric scoring is completed the data will be tabulated to determine the percentage of students, for each assignment, are performing at or above an acceptable level. The desire is for 80% or more of the students will fall into the acceptable category. This follows the same scheme and same rubric used in Outcome e but with consideration given only to the thermal courses.

Two rubrics were used in evaluation of this outcome, one for "Identifying, Formulating and Solving Engineering" Problems and another for the "Ability to use Techniques, Skills and Engineering Tools"

Over 80% of the students assessed performed at an adequate level regarding solution of thermal systems. The only exception was Instrumentation where the percentage was 78%. The committee thought this Instrumentation Lab was a poor assignment for this assessment. Please see the discussion for Outcome e and the detailed outcome reports. The only thermal oriented course assessed regarding engineering tools was MECH 363. The percentage here was 88% but the same concerns were noted in this assessment as above.

The program's first three graduates did exceptionally well on the Fundamentals of Engineering exam. They all passed and were above the national average in all discipline areas but for mechanical design and economics. Their scores on the national exam were above average in the area of thermal sciences. However the sample is very small and these three graduates were exceptional students.

No recommendations were given by the faculty committee.

OUTCOME ME4

Graduates will be able to work professionally in the area of mechanical systems.

The discipline of mechanical engineering is very broad. The course of study at OIT includes study of mechanical, thermal, fluid, and electrical systems as well as materials science and instrumentation. Technical courses in computer aided design, machining and welding are also included. This outcome is directed at the mechanical system related courses.

The courses directly contributing to thermal systems include:

ENGR 211	Statics	(4-0-4)
ENGR 212	Dynamics	(3-0-3)
ENGR 213	Strength of Materials	(3-3-4)
MECH 312	Advanced Dynamics	(3-0-3)
MECH 315	Machine Design I	(3-0-3)
MECH 316	Machine Design II	(3-0-3)
MECH 351	Finite Element Analysis	(2-3-3)
MECH 436	Control Systems	(2-3-3)
MECH 480	Vibrations	(2-3-3)

Some senior projects concentrate on mechanical systems. However, not all projects involve this so the senior projects sequence isn't included here.

Two assessment methods were implemented to assess this outcome. First graded assignments were collected from mechanical systems courses and assessed. Secondly, results from the Fundamentals of Engineering Exam were reviewed in terms of mechanical systems topics.

Assignments from MECH 316 Machine Design I and MECH 480 Vibrations have been collected and assessed. For each collection members of a faculty committee apply a rubric to the assignment. The scores on the rubrics range from 1 to 5 with three being judged acceptable performance. Once each faculty's rubrics are completed they will be tabulated to determine the percentage of students, for each assignment, performing at or above an acceptable level. The desire is for 80% or more of the students will fall into the acceptable category. This follows the same scheme and same Rubric used in Outcome e but with consideration given only to the mechanical system courses.

Two rubrics are used in evaluation of this outcome, one for “Identifying, Formulating and Solving Engineering Problems” and another for the “Ability to use Techniques, Skills and Engineering Tools”

Two assignments from Machine Design I were assessed regarding “Identifying, Formulating and Solving Engineering Problems”, one homework assignment and the final exam. Both assessments showed 83% of the students performed at or above a Rubric score of 3. This is slightly above the desired 80%.

One laboratory report was assessed in MECH 480 Vibrations related to use of engineering tools. The assessment of this assignment shows 86% of students performing at an acceptable level or above.

The program's first three graduates did exceptionally well on the Fundamentals of Engineering exam. They all passed and were above the national average in all discipline areas but for mechanical design and economics. In these two disciplines they were slightly below the national average. The sample is however very small so hard conclusions are hard to make.

The committee recommended that it be verified the machine design sequence covers the material found on the Fundamentals of Engineering Exam. This has been done. The content of this course sequence was compared to the equations booklet used in the FE Exam. It was found that all material necessary is covered in either MECH 315 or MECH 316, Machine Design I and II.