

**ELECTRICAL AND COMPUTER ENGINEERING
ACADEMIC OUTCOMES ASSESSMENT PROGRAM
OPERATING MANUAL**

- 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 a multi-disciplinary team
- 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.

This section of the Outcomes Assessment Program document sets out the procedures and timelines for the operation of our program.

A Assessment Measures

- i) *Assessment using the Senior Design Sequence*

A major portion of the Electrical Engineering Program assessment will be done by assessing the results of EE 5900 sequence - Senior Design. assessment data will be collected using four forms. Two forms will be completed by the advisors to senior design teams, the General Evaluation which covers the whole senior design course, and the Written Report Assessment which covers the written report. Sponsors of senior design projects will be asked to fill out a separate evaluation form. During Senior Design Presentations, all members of the audience will be asked to fill out the Senior Design Oral Evaluation form.

The General Evaluation and the Written report Assessment will be distributed to the faculty teaching senior design before the beginning of the 14th week of the semester. They are to be returned to the chair of the Assessment Committee by the end of Finals week.

The coordinator of senior design will see that the Senior Design Evaluation Forms are distributed the audience members on the day of the presentation, collected, sorted, and passed to the faculty advisors to the senior design projects. The faculty advisors will pass them on to the chair of the Assessment Committee before the end of the week after Finals week.

The coordinator of senior design will see that the Senior Design Project Sponsor survey is passed along to the project sponsor with the project report along with a request to return the survey. Copies of the all returned surveys will be passed on to the chair of the Assessment Committee as the come in.

The following 7 pages are copies of the: Faculty Advisor Survey- General Evaluation; Written Report Assessment;

**Michigan Tech Department of Electrical & Computer Engineering
Senior Design Faculty Advisor Survey - General Evaluation**

Faculty Name: _____ Team # _____

Circle the answer that best fits your experiences with your senior design team. Please fill out one form for each team.

During the design project this past year, please rate your impressions of how well the team did the following : (compare to your expectations of an almost finished engineer)					
	Exceeds expectations	Meets expectations	Below expectations	Not Acceptable	Not able to evaluate
a. demonstrated an ability to apply knowledge of mathematics, science & engineering					
b. Demonstrated an ability to design & conduct experiments, as well as analysis & interpret data					
c. demonstrated an ability to design a project to meet desired needs.					
d. demonstrated an ability to work together as a team					
e. demonstrated an ability to identify, formulate & solve engineering problems					
f. demonstrated an understanding of professional & ethical responsibility					
g. demonstrated an ability to communicate effectively					
h. demonstrated having a broad education necessary to understand the impact of engineering solutions in a global & societal context					
i. demonstrated a recognition of the need for, & an ability to engage in life-long learning					
j. demonstrated an appreciation & knowledge of contemporary issues					

k. demonstrated an ability to use the techniques, skills and modern engineering tools necessary for engineering practice	Exceeds expectations	Meets expectations	Below expectations	Not Acceptable	Not able to evaluate
l. Demonstrated an ability to use probability and statistics, including applications	Exceeds expectations	Meets expectations	Below expectations	Not Acceptable	Not able to evaluate
m. Demonstrated an ability to use math, sciences and engineering to analyze/design devices and systems containing hardware & software	Exceeds expectations	Meets expectations	Below expectations	Not Acceptable	Not able to evaluate
n. Demonstrated an ability to use advanced mathematics (diffy q's, linear algebra, complex variables & discrete mathematics)	Exceeds expectations	Meets expectations	Below expectations	Not Acceptable	Not able to evaluate

Additional Comments/Thoughts

Suggestions for improvement of senior design class

Michigan Technological University
Electrical & Computer Engineering Department
Written Report Assessment

Faculty Name _____ Team # _____

Circle the answer that best describes this design report. Please fill out one per team report.

Attribute	4 – Exceeds expectations	3 – Meets expectations	2 - Below expectations	1 - Not acceptable
Report Mechanics				
Organization	Unique organization enhances readability and/or understandability of report	Content appropriate to all section of report	Some content in inappropriate section of report	Inappropriate content of most sections of report
Aesthetics/Format	Text, tables, figures so clear and understandable as to enhance report impact unique format aspects that enhance report impact	Text, tables, figures readable and understandable. Format followed	Some portions are sloppy and difficult to read with format errors	Unacceptable – tables and figures cannot be read/understood, fonts difficult to read, so many format errors as to make report useless
Grammar, Punctuation and Spelling	No spelling, grammar or punctuation errors	Only a very few grammar or spelling & punctuation errors	Spelling, grammar and punctuation errors	Too many spelling, grammar and punctuation errors
Length		Appropriate length	Too long or too short	Far too long or too short
Content				
Abstract/Executive Summary – problem stated, conclusion summarized	So clear and complete as to enhance impact of report	Problem clearly stated, key results clearly stated	Problem stated somewhat, significant results not included	Problem not stated, conclusion not summarized, only stated what did
Introduction – problem stated, constraints explained	So clear and complete as to enhance impact of report	Problem clearly stated, constraints clearly discussed	Problem stated, perhaps poorly, no or limited discussion of constraints	Problem not stated, constraints not explained, contains results/conclusions
Discussion – Quantitative Analysis, Back up Statements with Justifications	So clear and complete as to enhance impact of report	Clear, for design report, justifications presented and explained	Unclear explanations, for design report, few justifications	No quantitative support or explanations provided
Conclusions/ Recommendations – present, significance explained, no new ideas	So clear and complete as to enhance impact of report	Clear, clearly follow report discussion, meaningful recommendations	Weak, includes ideas not already discussed in report, wishes rather than recommendations	Not stated, includes ideas not already discussed in report
References – provided as appropriate		Correct format, all cited in report		Incorrect format, not cited in report
Students' use of technical reference materials	Students able to pull relative materials from advanced references and used a variety of sources	Looked into further references such as technical journals and trade magazines	Used web materials, given documentation and some books	Only used web materials and given documentation
Appendix	So clear and complete as to enhance impact of report	Appropriate locations, appendix indexed, clear and easy to follow	Appropriate locations, appendix not clear and easy to follow	Appendix contains material that should be in text, contains material that should be in appendix

(over for questions)

General Comments about report

Suggestions for improving written assignments for senior design

Michigan Technological University
Electrical & Computer Engineering Department
Senior Design Oral Evaluation - 2001
 Team # _____

Please circle the answer that best summarizes your impressions of the presentation.

	4 - Exceeds Expectations	3 - Meets Expectations	2- Below Expectations	1- Not Acceptable
Introduction: Problem Stated & Constraints Explained	Problems & constraints clearly stated & explained	Problem clearly stated & constraints stated	Problem poorly stated & constraints not stated	Problem not stated; no constraints given
Design Process Explained	Outstanding outline of steps taken to tackle problem	Very good summary of design process & steps	Inadequate coverage of steps & process	Little to no explanation of design process
Demonstrated How Solution Solved Problems	Solution superior with quantitative justification of results	Very good solution with justification of results	Solved problem poorly and did not justify results	Problem not solved
Conclusions/ Recommendations Significance Explained	Present logical & superior explanation	Present logical & significance explained	Present but not logical & significance not explained	No conclusions or recommendations
Presentation Provided Adequate Summary of Project & Kept Audience Interested	Outstanding story told, audience very interested	Complete story told, kept interest	Story incomplete, kept interest some of the time	Story missing or not told, hard to keep interest
How would you rate the quality of visual aids?	Very clear and readable, excellent layout & readability	Clear & readable, good layout & organization	Difficulty reading, some with too much or too little	Not clear or readable. Not well laid out or organized
How would you rate the overall presentation dynamics?	Projected well & clearly	Voice clear & understandable, no distracting mannerism, good eye contact	Difficult at times to hear or understand. Some distracting mannerisms. Poor eye contact	Could not hear or understand. Many disturbing mannerisms. No eye contact
Presenters Responded Well to Questions	Very clear & complete	Clear & direct	Evasive did not answer question	Non-responsive
Taking all things into consideration I would rate this presentation	Outstanding, exceeded expectations	Very good, meets expectations	Okay, below expectations	Poor, not acceptable

1. List two strengths of this group's presentation.

2. List two things that could have been improved for this presentation.

_____ Senior Design Student

_____ Industrial Visitor

_____ Other

Name for Senior Design Students: _____

Michigan Tech Department of Electrical & Computer Engineering Senior Design Project Sponsor Survey

Sponsor: _____ Team #: _____

Circle the answer that best describes your experience with senior design. Please fill out one for each team you sponsored.

General Senior Design Impressions					
How satisfied were you with your involvement in the senior design project?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very dissatisfied
Communication between me and the students was	Way too much	Slightly too much	Just right	Slightly too little	Way too little
Communication between me and the advisor was	Way too much	Slightly too much	Just right	Slightly too little	Way too little
Overall, how did the student perform compared to entry-level engineers in your organization?	Better than entry level engineers		Same as entry level engineers		Worse than entry level engineers
Would you participate again?	Definitely	Probably Yes	Probably no	Definitely no	
During the design project this past year, please rate your impressions of how well the team did the following : (compare to your expectations of a group of senior engineering students)					
demonstrated an ability to design a project to meet desired needs.	Exceeds expectations	Meets expectations	Below expectations	Not Acceptable	Not able to evaluate
demonstrated an ability to apply knowledge of mathematics, science & engineering	Exceeds expectations	Meets expectations	Below expectations	Not Acceptable	Not able to evaluate
demonstrated an ability to identify, formulate & solve engineering problems	Exceeds expectations	Meets expectations	Below expectations	Not Acceptable	Not able to evaluate
demonstrated an ability to work together as a team	Exceeds expectations	Meets expectations	Below expectations	Not Acceptable	Not able to evaluate
demonstrated an ability to communicate effectively	Exceeds expectations	Meets expectations	Below expectations	Not Acceptable	Not able to evaluate
demonstrated an ability to use the techniques, skills and modern engineering tools necessary for engineering practice	Exceeds expectations	Meets expectations	Below expectations	Not Acceptable	Not able to evaluate

Please answer two questions on the back

1. How did your company benefit from participation?

2. How could the education/corporate collaboration be improved?

Thank you for your participation. If you have any questions or comments, please contact David Stone at 906-487-3116 or dstone@mtu.edu

ii) *Sampled Retention of Expected Prerequisite Knowledge:*

The instructor in each EE course section will evaluate the student's performance on the prerequisite knowledge required for the course **during the first two weeks** of the semester. A report on the assessment of prerequisite knowledge will be **due by the end of the fourth week** of the semester. The topics to be covered are listed on the Course Information Sheet under "Prerequisites by Topics".

The form, format, and style of this evaluation is left to the discretion of the instructor. For example it may be an in-class or take-home exam, open book or closed book, a homework assignment, a quiz, a lab practical exam, or any other form that can be graded. In order for the students to take the evaluation seriously, it must be graded and it must count as part of the course grade.

To minimize penalizing students who took the prerequisite courses in which the expected prerequisite topics were inadequately covered, it is recommended that instructors:

- Limit the evaluation to topics in the "Prerequisites by Topics" section in the course Information Sheets.
- Provide a study guide to the students covering the major topics to be covered on the prerequisite evaluation.
- Consider grading options for the evaluation that allow students a second chance to improve their grade on the evaluation (a retest, pass/fail option, etc.) (The ORIGINAL grade should be reported to the assessment committee.)

Instructors will use the *Report on Evaluation of Prerequisite Knowledge* form, which follows this section. If students attempt the evaluation more than once, the **first** score will be reported to the assessment committee. It is not expected that all instructors will use all the lines on the form. If you do not break the reporting down into specific prerequisites, specify "general" as the prereq topic.

The "Instructors Comments" field on the *Report on Evaluation of Prerequisite Knowledge* form is the very important. The comments can be used to indicate any strengths or weaknesses that the instructor has uncovered, recommendations for changes in prerequisite course, or general recommendations for improving the programs.

Two key principles are addressed by this approach. First, testing for prerequisite knowledge (i.e., in a course subsequent to that in which the material is presented) introduces an element of time that allows a more accurate estimation of students' long-term retention of the prerequisite material. Second, repeated emphasis to the students of the need for long-term retention may help to overcome the difficult task of increasing student cognition of the continuity, need, and importance of lifelong learning.

Initially, our basic success metric is to determine whether 70% of assessed students for a given outcome receive 60% credit.

The report forms will be collected by the staff in the ECE office and the Assessment Committee will collect, consolidate, and convey the recommendations to the appropriate

faculty via the Undergraduate Program Committee or other designated responsible faculty, who will return a brief written description of the actions taken to address the recommendations. The Assessment Committee will catalog the actions taken so that their effectiveness may be evaluated in future assessment cycles. Further, the Assessment Committee will use the reports to collect appropriate data for aggregation and reporting, and will supply a summary report to all faculty during the subsequent semester.

Report on Evaluation of Prerequisite Knowledge

Electrical and Computer Engineering Department

Due: end of 4th week of semester

Course No: _____ Sem/yr: _____ Instructor: _____

Specific Topics Tested	Mean Score (%)	% with score > 60%
Prereq topic (specify)		
Prereq topic (specify)		
Prereq topic (specify)		
Written Expression (grammar, spelling, clarity of explanation, etc)		
Other (specify)		

Comments of Administration of your Evaluation of Prerequisite Knowledge: Describe how your evaluation was organized and administered (In-class exam vs. homework assignment) and comment on how well this approach worked.

Instructors Comments: Your observations, comments, and recommendations are often much more valuable than numerical scores. Please attach extra sheets if necessary.

iv) Fundamentals of Engineering Exam:

The results of the Fundamentals of Engineering Examination given nationally by the National Council of Examiners for Engineering and Surveying (NCEES) will be used to assess how well students in Michigan Tech's Electrical Engineering Programs compare with students both in the State of Michigan and in the nation. The assessment will use the NCEES Report #5 which gives average student scores for selected subjects (based on several questions for that subject) for MTU students, students in Michigan, and all students taking the exam nationally. The selected subjects and corresponding ABET criteria assessed are given in Table V.

Subjects	ABET Criteria
Chemistry	a, k
Computers	a, e, k
Electrical Circuits	a, e, k
Engineering Economics	a, e, k
Ethics	f
Mathematics	a, k, l, n
Analog Electronic Circuits	a, e, k
Communications Theory	a, e, k
Computer and Numerical Methods	a, k, n
Computer Hardware Engineering	a, e, k, m
Computer Software Engineering	a, e, k, m
Control systems Theory and Analysis*	a, e, k
Digital Systems	a, e, k, m
Electromagnetic theory and Applications	a, e, k, n
Instrumentation	a, b, e, k
Network Analysis	a, e, k
Signal Processing	a, e, k, n
Solid State Electronics and Devices	a, e, k
Power Systems	a, e, k

The MTU Electrical Engineering program will be deemed successful in this element if more than 70% of MTU students taking the exam pass. Further, the program will be deemed successful if the MTU pass rate for each subject listed is above the pass rate for

State and National students. The results of the tests given in a given academic year will be incorporated into the that academic year's annual assessment report.

v) Assessment by Other Units of the University

The Assessment Council:

The University has established the Assessment Council to promote assessment within the university and to share assessment results between different units of the University. The Assessment Council is composed of a representative from each academic department. The assessment reports from each unit are collected by the council in October of each year and redistributed to its members. The Electrical and Computer Engineering Department's representative takes the appropriate reports and distributes them to the Electrical and Computer Engineering Department's Assessment Committee for review. After reviewing the reports our assessment committee will contact the other departments if we have any concerns.

General Education Assessment:

This procedure is being reworked with our new Gen Ed program

College of Engineering Alumni Survey:

The College of Engineering surveys the alumni who have been out x and y years. The surveys are generally sent out in the spring of each year. The results are distributed to the Department Chair who will forward them to the chair of the Assessment Committee.

Engineering Fundamentals Assessment:

This assessment and reporting procedure is underdevelopment by the staff of the Engineering Fundamentals Dept.

vi) Ad Hoc Assessments:

The faculty recognizes that as any assessment program evolves additional innovations for assessment must be encouraged. While it is impractical to incorporate every new assessment tool or idea into our mainstream assessment program, it is imperative that we give fair examination to viable alternatives. Thus, as part of its annual assessment cycle, the Assessment Committee will evaluate new assessment innovations undertaken by individual faculty. The evaluation will consider the efficacy of the assessment tool, the resources required for its implementation, and the appropriateness of incorporating the ad hoc assessment data into the current assessment metrics.

Examples of current ad hoc assessment opportunities that have been suggested by individual faculty include:

Student presentations in the manner of a five-minute project meeting, to be undertaken in the senior design project courses and/or in upper division courses involving student projects.

Student poster sessions in late sophomore- and/or early junior-level laboratory courses.

Use of existing written feedback from on-campus interviewers and co-op sponsors.

Faculty using these assessment measures should write a short memo to the assessment committee soon after the evaluation is complete. The memo should include a description of what was done, what the results were, and recommendations based on the results. This assessment will be incorporated into the annual assessment report which will include an evaluation of incorporating that particular assessment measure in the departmental assessment plan.

vii) *Semester End Instructor Assessment*

At the end of each semester the instructor of all EE lecture courses will evaluate the course which they have just taught. This evaluation will include, but not be limited to, whether the syllabus was covered, what was omitted, and why; what areas of the course were problem areas for the students, what are suggestions for changes in the syllabus. The evaluations will be collected and archived by the assessment committee. They will be incorporated into the annual assessment report and they will be archived on the internal course web site. The report from is shown on the next page:

Semester End Course Report
Electrical and Computer Engineering Department
Due: 1 week after grades are due

Course No: _____ Sem/yr: _____ Instructor: _____

Comment on what you covered in your class as compared with the approved syllabus: Are there any major differences? Why? Do you recommend any changes to the approved syllabus?

Comments on aspects of the course that students had particular difficulties with: Do you have any insights on why they had difficulties? Any recommendations for alleviating these difficulties.

Other Instructors Comments: Your observations, comments, and recommendations are often the most important input for improving the course. Please attach extra sheets if necessary.

viii) *Program Assessment by the Undergraduate Advisor*

Undergraduate Advisor will write a short memo to the assessment committee at least once a semester recommending improvements or changes to the undergraduate program. The Undergraduate Advisor is the primary contact for students with programmatic concerns and is often the first one to become aware of problems with the program.

ix) *Senior Survey*

The survey on the following page will be distributed to all seniors at the same time that the course evaluations for senior design are distributed. These surveys are to be returned to the chair of the Assessment Committee.

Electrical and Computer Engineering Department Survey of Graduating Seniors

Please rate yourself on the following skills, abilities, and attributes of an engineering graduate. How important is each of the following to you as you start your career (4 = very important, 1 = not important). What is your ability in each of these areas (4 = excellent, 1 = poor).

	importance				ability			
	very important	somewhat important	neutral	not important	excellent	good	adequate	poor
An understanding of and an ability to apply:								
calculus, linear algebra, and differential equations	4	3	2	1	4	3	2	1
probability and/or statistics	4	3	2	1	4	3	2	1
physics and chemistry	4	3	2	1	4	3	2	1
electrical engineering	4	3	2	1	4	3	2	1
computer science	4	3	2	1	4	3	2	1
An understanding of and the ability to:								
analyze and interpret data	4	3	2	1	4	3	2	1
design a electrical or electronic processes, or devices to meet a desired need	4	3	2	1	4	3	2	1
design a system which contains hardware and software to meet a desired need	4	3	2	1	4	3	2	1
design and conduct experiments	4	3	2	1	4	3	2	1
function on a multi-disciplinary or cross-functional team	4	3	2	1	4	3	2	1
identify, formulate, and solve engineering problems	4	3	2	1	4	3	2	1
recognize professional and ethical responsibility	4	3	2	1	4	3	2	1
communicate orally: informal and prepared talks	4	3	2	1	4	3	2	1
communicate in writing: letters, technical reports, etc	4	3	2	1	4	3	2	1
know impact of engineering in a global/societal context	4	3	2	1	4	3	2	1
continue to update your engineering skills	4	3	2	1	4	3	2	1
know about contemporary issues	4	3	2	1	4	3	2	1
use techniques, skills and tools in engineering practice	4	3	2	1	4	3	2	1

B Interaction with Constituents

The primary method for reporting to constituents will be the official departmental web page. (www.ee.mtu.edu). This is where we will archive newsletters as well as have information about our program. Collecting feedback from constituents will mostly be on an informal basis. Comments received by the department head and other faculty members will be emailed to the chair of the assessment committee so that they can be incorporated into the annual assessment report.

There will be two formal methods of reporting to and receiving feedback from our constituents:

i) *Report to the department's External Advisory Committee*

The Undergraduate Program Committee is responsible for giving the EAC an update on the undergraduate program at least every 2 years. Their comments will be sent to the Assessment Committee to be incorporated in the annual assessment report.

ii) *Report to ABET*

Every six years the department will prepare Self Studies of the undergraduate Electrical Engineering and Computer Engineering programs.. The Self Studies will be the responsibility of an ad-hoc ABET committee designated by the department chair. Comments from the ABET evaluator will be acted upon by the department chair. After accreditation has been received the main body of the Self Study will be made available on the departmental web page.

C Annual Assessment Report

The Assessment Committee will prepare the annual assessment report at the beginning of each academic year. The report will summarize the assessment activities for the previous academic year. The report will contain tabulations the assessment measures, a summery of the results of the assessment measures, and a summery of the comments received on an ad-hoc basis. Also included will be recommendations on improving the assessment process. The assessment report will be presented to the faculty at a faculty meeting. After discussion and possible amendment the report will be approved by the faculty. Other standing committees such as the Undergraduate Program Committee and the Graduate Committee will develop appropriate recommendations for improving the degree programs of the department.

D Administration and Implementation Schedule

The Assessment Committee oversees the assessment program, and administers it with the help of the Undergraduate Program Committee, the Graduate Committee and the entire faculty. These committees continually review the effectiveness of the assessment program and recommend modifications to the program as necessary. They also analyze the results of the assessment to determine what changes in the curriculum are desirable. The Undergraduate Program Committee and the Graduate Committee will send an email memo to the chair of the

assessment committee on changed made to the educational goals, outcomes, or programs for archival purposes.

The tentative schedule for assessment activities is shown in Table V.

first two weeks of the fall semester	faculty will administer a test of prerequisite knowledge
September 15	Assessment Committee complete report on previous year' s assessment activities.
October	Faculty review and approve report. Report will be sent to other Committees for developing and implementing improvements.
October 15	Alumni survey is mailed
November	Second mailing of alumni survey. Assessment reports from other departments are reviewed.
December/January	Alumni survey data processed and report written
Week before spring semester	Instructor assessment of fall semesters courses is completed
first two weeks of the spring semester	faculty will administer a test of prerequisite knowledge
May	Senior project assessment implemented.
Summer	Assessment Committee and Undergraduate Curriculum Committee begin report on previous year's assessment activities.
Throughout the academic year	Ad-hoc comments on the program are sent to the assessment committee. Documentation of program changes are sent to the assessment committee.