



DEPARTMENT OF OCEAN &
MECHANICAL ENGINEERING

College of Engineering & Computer Science
Florida Atlantic University

Continuous Improvement Plan

Ocean Engineering
Undergraduate Curriculum

Plan for the Assessment and Continuous Improvement of the
Ocean Engineering Undergraduate Curriculum
Department of Ocean and Mechanical Engineering
Florida Atlantic University
January 2, 2018

The Ocean Engineering program is accredited by the Engineering Accreditation Commission (EAC) of ABET, 111 Market Place, Ste. 1050, Baltimore, MD 21202-4012 (www.abet.org). Florida Atlantic University is accredited by the Southern Association of Colleges and Schools (SACS) Commission on Colleges to award associate, bachelor, masters, specialist and doctoral degrees. Contact the Commission on Colleges at 1866 Southern Lane, Decatur, Georgia 30033-4097. Both of these organizations have moved towards the requirement of a Continuous Improvement Program (CIP) for the curriculum and the progress of the students. The department has responded to these requirements in the following manner:

1. The establishment of a mission statement for the Ocean Engineering Program.
2. The establishment of educational objectives for the Ocean Engineering Program.
3. The development of student educational outcomes for student performance.
4. A mapping of the student educational outcomes to the educational objectives.
5. A mapping of the contents of each required course in the curriculum to the student educational outcomes.
6. The responsibility of the OE Undergraduate Committee for reviewing course sequences in the program.
7. The development of assessment tools for each of the intended courses and student educational outcomes.
8. The forwarding of the recommendations of the OE Undergraduate Committee to the faculty at large, for decisions regarding adjustments or changes that are necessary to insure continuous improvement of the Ocean Engineering program.

Each of these steps will be presented or discussed in detail. A flowchart has been developed to show the linking of the different segments of the Continuous Improvement Program, which is presented in Appendix 1. The Educational Objectives established for the Ocean Engineering Program will be reviewed every three years.

1. Mission Statement of the Ocean Engineering Program

The program mission is to provide an outstanding ocean engineering program for learning and research and to prepare individuals to meet national and international engineering challenges in the ocean environment.

2. Educational Objectives for the Ocean Engineering Program

Graduates of the ocean engineering baccalaureate program at the Florida Atlantic University, within a few years after graduation, will:

1. Demonstrate an ability to carry out engineering tasks in the multi- disciplinary field of ocean engineering.
2. Make meaningful contributions in terms of design, development and integration of engineering systems, particularly for applications in the ocean environment.
3. Pursue further study for the graduate degree and / or participate in professional societies.
4. Develop and exhibit leadership qualities in their engineering work.
5. Understand various complexities and issues of the contemporary society and make professional contributions in the larger and long-term interest of the society.

3. Student Educational Outcomes

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

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

- a. An ability to apply knowledge of mathematics, science, and engineering.
- b. An ability to design and conduct experiments, as well as analyze and interpret data.
- c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- d. An ability to function on multidisciplinary teams.
- e. An ability to identify, formulate, and solve engineering problems.
- f. An understanding of professional and ethical responsibility.
- g. An ability to communicate effectively.
- h. The broad education necessary to understand the impact of engineering solutions in a global, economic, 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.
4. The mapping of the Ocean Engineering student educational outcomes to the educational objectives is presented in Appendix 2.
5. The mapping of each required course in the Ocean Engineering program to the student educational outcomes is presented in Appendix 3.
6. The OE Undergraduate Committee develops and maintains the course syllabus for each course. These are posted on the internet on the Ocean Engineering web page at www.ome.fau.edu. It establishes the prerequisites and co-requisites for each course, the topics to be included and the expected course outcomes. The committee is responsible for addressing the feedback received from the surveys and assessment results and forwarding recommendations for change to the courses in their sequence of the curriculum to the faculty.
7. The following indirect and direct assessment tools have been developed and are in use for the Ocean Engineering Program. The corresponding frequency of assessment and criteria are listed in Appendix 4-8 and 4-9.

Indirect Assessment

Indirect assessment represents a qualitative measure of attainment of the student outcomes. The indirect assessment is carried out using the following instruments:

- Survey of alumni (conducted once in 3 years)
- Survey of employers (conducted once in 3 years)
- Survey of graduating seniors (conducted at FAU every year)
- Survey of graduating seniors (conducted by Engineering Benchmark, Inc. (EBI) every year)
- Survey of students on course outcomes (conducted every semester in all OE courses)

The sample forms used to survey alumni and employers for assessment of program outcomes are given in Appendix 4-1 and 4-2. These surveys ask the alumni and employers to assess attainment of program outcomes using a scale ranging from 1 to 10, with 1 meaning unsatisfactory, 5 satisfactory and 10 excellent.

The sample form used to survey graduating seniors for assessment of program outcomes is given in Appendix 4-3. This survey asks the graduating seniors to assess attainment of program outcomes using a scale ranging from 1 to 10, with 1 meaning unsatisfactory, 5 satisfactory and 10 excellent. In addition, the Department Chair conducts an exit interview with graduating seniors in an informal setting. Questions on courses, facility, teaching and the support received from faculty and departmental staff are discussed. Any concerns raised by the students and suggestions for

improvements are shared with the program faculty and steps are taken for program improvement. The exit interview is conducted every year.

Each year, the College of Engineering and Computer Science, through Educational Benchmark, Inc. (EBI), conducts a survey of all graduating seniors on the quality of the education received at Florida Atlantic University. The EBI survey is standardized and results of the individual program as well as its comparison with similar programs (ocean engineering, naval architecture and marine engineering) at other institutions are provided. The survey questionnaire contains close to a hundred questions grouped into 15 factors. As shown in Appendix 4-4, many of the EBI questions are directly related to the ABET student outcomes.

A sample form used to survey students on one of the OE courses EGN 4432 (Dynamic Systems) is given in Appendix 4-5. Similar forms are used to survey students on all other OE courses. This survey asks students to assess their self-reported attainment of specific course outcomes using a scale ranging from 1 (lowest) to 10 (highest). It should be noted that the specific outcomes for each of the OE courses are explicitly mapped to A-K outcomes so that the evaluation of assessment data can be directly compared to other instruments used in this report.

Direct Assessments

Direct Assessment is based on quantitative measure of the program outcomes. The direct assessment is carried out using the following instruments:

- 1) Capstone senior design project performance appraisal by a committee consisting of faculty and external industry representatives (carried out every year)
- 2) Performance in coursework directly related to program outcomes

Students' performance in coursework assignments is an excellent measure of student outcomes. A sample form used for the coursework assessment is provided in Appendix 4-6. It should be noted that the assessment of student outcomes is based not solely on the overall grade, but on individual assignments such as lab reports, project reports, teamwork in conducting experiments, project presentation, specific tests and quizzes.

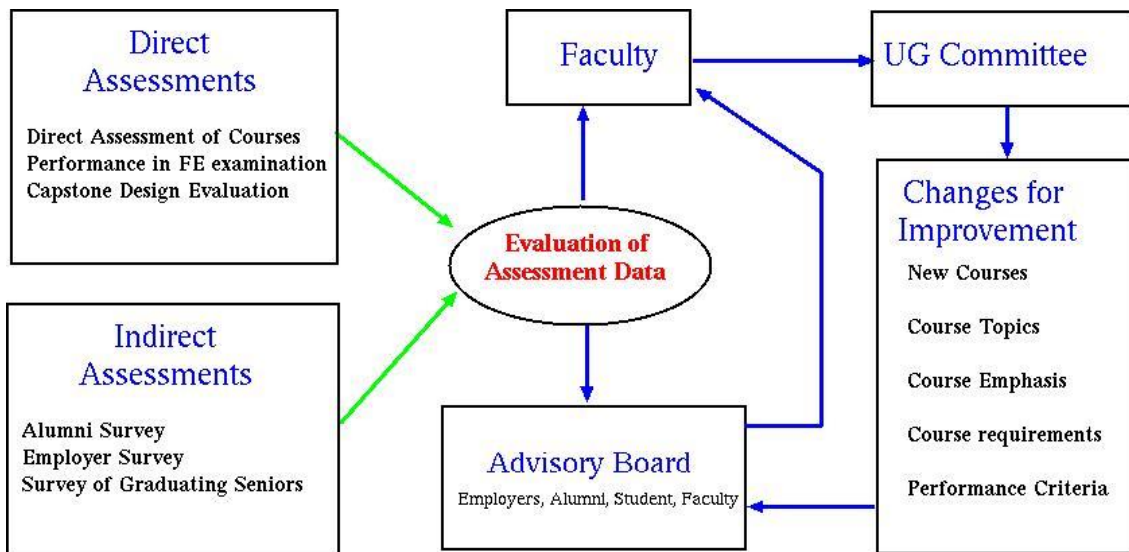
The appraisal of each of the capstone senior design projects is based on oral communication process involving presentation by students in a group followed by a question and answer session conducted by a committee of evaluators consisting of instructor(s), faculty and external members from industry or navy laboratories. A sample form used for the evaluation is given in Appendix 4-7.

8. The OE Undergraduate Committee reviews all of the assessment data. The

recommendations of the OE Undergraduate Committee will be acted upon in a faculty meeting as deemed appropriate. Course or curriculum changes will be forwarded to the OE Undergraduate Committee for implementation.

Appendix 1 – Assessment and Continuous Improvement Plan

The continuous process of assessment, evaluation, and improvement related to attaining outcomes is illustrated in the following flowchart. Direct assessment of outcomes includes appraisal of performance in capstone senior design projects and assessment of students' performance in courses. Indirect assessment includes alumni and employer surveys, survey of graduating seniors, and students' self-assessment on course outcomes. Assessment data were used to determine how well the desired program outcomes were being achieved. Based on the evaluation of the assessment data (gathered from a variety of sources), the program faculty, with the recommendation of the undergraduate committee, approves implementation of changes for improvement. The changes could include introduction of new courses, new facilities and instructional equipment or space, change or emphasis of topics, course requirements etc. The BSOE constituency including the students, alumni, and the Industrial Advisory Board may also offer feedback through the assessment process for improvement.



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

<i>Program Educational Objectives</i>	<i>Outcome a</i>	<i>Outcome b</i>	<i>Outcome c</i>	<i>Outcome d</i>	<i>Outcome e</i>	<i>Outcome f</i>	<i>Outcome g</i>	<i>Outcome h</i>	<i>Outcome i</i>	<i>Outcome j</i>	<i>Outcome k</i>
1. Efficiently carry out engineering tasks in the multi-disciplinary field of ocean engineering.	x	x	x		x						x
2. Make significant contributions in terms of design, development and integration of engineering systems, particularly for applications in the ocean environment			x		x						
3. Pursue further study for the graduate degree or be engaged in life- long learning									x		
4. Exhibit leadership qualities in their engineering work				x			x				
5. Understand various complexities and issues of the contemporary society and make professional contributions in the larger and long- term interest of the society						x		x	x	x	

Appendix 3
Mapping of OE Courses to Educational Outcomes

Courses	Learning Outcomes to be assessed (1: Lowest, 10: Highest)										
	a	b	c	d	e	f	g	h	i	j	k
EOC 4612C Into to Electronics & Programming	x		x		x		x				x
EOC 3130L OE Lab		x		x			x				x
EOC 4631C OE Data Analysis	x	x			x	x					x
EOC 3213 Marine Topics	x		x		x			x			
EOC 3306 Acoustics for Ocean Engineers	x	x			x	x		x			x
EOC 4620 Dynamic Systems	x		x		x						x
EOC 4422 Ocean Wave Mechanics	x	x		x	x						x
EOC 4804 OE Systems Control & Design			x	x		x	x	x	x		
EOC 3410 Structures I	x	x			x		x				x
EOC 4412 Ocean Structures	x				x		x		x	x	x
EOC 3114 Vibrations	x	x			x		x				x
EOC 4193 Ocean Thermal Systems	x		x		x						x
EOC 3123 OE Fluid Mechanics	x	x			x						
EOC 4124 Ship Hydrodynamics	x		x		x				x	x	x
EOG 4201C Marine Materials and Corrosion	x				x				x	x	
EOC 4307 Underwater Acoustics	x				x				x	x	x
EOC 4804L OE Systems Control & Design			x	x		x	x	x	x		
OCE 3008 Oceanography								x		x	

Each of the student outcomes is evaluated based on the following selected courses highlighted in red.

Appendix 4-1 Alumni Survey Form for Outcomes

Using a scale ranging from 1 to 10, with 1 meaning unsatisfactory, 5 satisfactory and 10 excellent, please assess how the BSOE program at FAU fares in achieving the learning outcomes through its curriculum. If unable to rank any of the outcome(s), you leave that blank. Please return the completed form to Dr. An (pan@fau.edu). Thanks.

BSOE Student Outcomes	Assessment
The learning outcomes of the BSOE program at FAU are the following:	15.....10 Unsatisfactory Satisfactory Excellent
(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 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.	

Name: _____ **Year of Graduation with BSOE at FAU:** _____

Present Affiliation and Address:

Appendix 4-2 Employer Survey Form for Outcomes

Based on the performance of FAU-BSOE graduates, please assess how the BSOE program at FAU fares in achieving the learning outcomes through its curriculum (using a scale ranging from 1 to 10, with 1 meaning unsatisfactory, 5 satisfactory and 10 excellent). If unable to evaluate any of the outcome(s), you may leave that blank. Please return the completed form to Dr. An (pan@fau.edu) by **15 September 2013**. Thanks.

PS: You may also send any additional comments about the program on p.2 of this form.

BSOE Student Outcomes	Assessment Scale
The learning outcomes of the BSOE program at FAU are the following:	15.....10 Unsatisfactory Satisfactory Excellent
(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 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.	

Your Name:

Affiliation and Address:

Appendix 4-3 Graduating Seniors Survey Form for Outcomes

Using a scale ranging from 1 to 10, with 1 meaning unsatisfactory, 5 satisfactory and 10 excellent, please assess how the BSOE program at FAU fares in achieving the learning outcomes through its curriculum. If unable to evaluate any of the outcome(s), you may leave that blank. Please return the completed form to Teresa Perez or Dr. An. Thanks.

PS: You may also send any additional comments about the program on p.2 of this form.

BSOE Student Outcomes	Assessment Scale
The learning outcomes of the BSOE program at FAU are the following:	15.....10 Unsatisfactory Satisfactory Excellent
(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 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.	

Name:

Email where you can be reached in the future:

Appendix 4-4 EBI Survey Questions related to Student Outcomes

ABET Outcome	EBI Questions
a Math, Science	Q45, 46, 47. Application of math, science and engineering.
b Experiment	Q48, Q49 and Q50. Design and conduct experiments and analyze data
c Design	Q51. Technical Design. Q78 Manufacturability Q79 Sustainability
	Q72 to Q. 77. Societal Awareness , Economics, Ethics etc in Design
d Teamwork	Q52. Functioning in multidisciplinary teams
e Problem Formulation	Q53, 54, 55. Identification, formulation and solution of problems
f Ethics	Q56. Understanding of ethical responsibilities Q.57 Professional responsibility
g Communication	Q58. Oral communication Q59. Written communication
h Societal Context	Q69. Understanding of engineering solution in global/societal context Q 70. On economical aspect Q 71. On environmental aspect
i Lifelong Learning	Q60. Degree to which the program enhanced student's ability to recognize the need to engage in lifelong learning
j Contemporary Issues	Q61. Understanding of contemporary issues

<p>k Engineering Skills</p>	<p>Q62. Ability to use modern engineering tools</p>
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Appendix 4-5

Student Survey of Course Outcomes

Course Number and Title: EGN 4432 Dynamic Systems

Semester Taught: _____

Instructor: _____

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

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

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

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

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

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

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

Outcome 1: A basic knowledge of the fundamental principles governing the dynamics of simple mechanical, thermal, fluid and electrical systems. (a) _____

Outcome 2: An ability to apply the knowledge of mathematics and engineering to model simple dynamic systems. (a) _____

Outcome 3: An ability to simulate dynamic systems using computer simulation tools. (k) _____

Outcome 4: An ability to characterize the stability properties of a dynamic system. (e) _____

Outcome 5: An ability to design a simple feedback control system that meets desired system output specifications. (c) _____

Appendix 4-6 - Direct Course Assessment Form

EGN 4432 Dynamic Systems

Semester / Year: _____

Direct Course Assessment on Course Outcomes

Outcome	Assignment	Course Assignment Assessment Ave (10pt max)
1		
2		
3		
4		
5		

NOTE: Please do not include students' grades who withdrew your class.

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

Outcome 1: A basic knowledge of the fundamental principles governing the dynamics of simple mechanical, thermal, fluid and electrical systems. (a)

Outcome 2: An ability to apply the knowledge of mathematics and engineering to model simple dynamic systems. (a)

Outcome 3: An ability to simulate dynamic systems using computer simulation tools. (k)

Outcome 4: An ability to characterize the stability properties of a dynamic system. (e)

Outcome 5: An ability to design a simple feedback control system that meets desired system output specifications. (c)

NOTE: If any of the outcomes above is less than 7 out of 10, please provide comments as to how improvements can be made and implemented in the future

Appendix 4-7

EVALUATION OF EOC 4804 OCEAN ENGINEERING SYSTEMS CONTROL & DESIGN

Instructor: _____ Year: _____

Project Title: _____

Evaluator's Name and Affiliation (Please Print): _____

Dear Evaluator: Based on the design accomplishments, team effort and project presentation, please rate the team's overall attainment of the following outcomes. **If any of the outcome(s) cannot be evaluated based on the available information, you may leave those unevaluated.** Any additional comments are welcomed. Please return the completed forms to Dr. An. Thanks!

Item	Evaluation		
	Poor	Satisfactory	Excellent
a. An ability to apply knowledge of mathematics, science, and engineering			
b. An ability to design and construct experiments, as well as to analyze and interpret data			
c. An ability to design a system, component, or process to meet desired needs			
d. An ability to function on multi-disciplinary teams			
e. An ability to identify, formulate, and solve engineering problems			
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			

Additional Comments: (Continue on the other side, if more space is needed.)

Appendix 4-8 (Frequency of Assessment)

Assessment Method	Outcomes Assessed	Frequency	Rationale and Discussion
Indirect Assessments			
Alumni Survey	A-K	Once every 3 years	Once every 3 years the alumni that graduated over the previous five years are surveyed. Thus all graduates are surveyed at least once the achievement of outcomes
Employer Survey	A-K	Once every 3 years	This survey is conducted along with the alumni survey to get the viewpoints of both the graduates and their employers. The frequency is found to be just about right to get a reasonable response and returns.
Senior Exit Interview	Overall Program and Objectives	Each Year	The exit interview covers overall program, its strengths and weaknesses and seeks input and opinion for improvement. Outcomes or senior year courses are done separately.
EBI survey	Overall Program and Objectives	Each Year	Carried out by the College
Student Assessment of Outcomes	A-K	Each semester	This assessment was introduced in Spring 2013. This assesses the self-reported students' attainment on each of the course outcomes covered
Direct Assessments			
Senior Design	A-K	Each year	The assessments of all outcomes which are typically required in capstone design project are assessed by a committee of faculty and industry and Navy representatives.
Direct Assessment of Course Outcomes	A-K	Each year	Specific course assignments (and not the overall course grade) are used for this assessment.

Appendix 4-9 (Satisfactory Attainment Criteria)

Satisfactory Attainment Criteria for the Indirect Assessments

Indirect Assessment	Satisfactory Attainment Criteria set by faculty
Alumni Survey (2012-2013)	At least 67% of the alumni find that all outcomes are achieved at a satisfactory level
Employer Survey (2012-2013)	At least 67% of the employers find that all outcomes are achieved.
Graduating Senior Survey (2013, 2014)	At least 67% of the graduates find that all outcomes are achieved.
EBI Survey (2011-2014)	Average score is 5 or above (out of 7) for all outcomes.
Student Survey on Course Outcomes	Average score is 6 or above (out of 10) for each of the outcomes.

Satisfactory Attainment Criteria for the Direct Assessments

Direct Assessment	Satisfactory Attainment Criteria set by faculty
Senior Design Project Performance appraisal 2011-2012, 2012-2013, 2013-2014	All outcomes are attained at least at the satisfactory level.
Direct Assessment of performance in Coursework (2012-2013, 2013-2014)	The class average score is 7 or above (out of 10) in each of the outcomes assessed.