ABET
Self-Study Report

for the

Department of Ocean and Resources Engineering

University of Hawaii at Manoa
Honolulu, Hawaii

July 1, 2009

CONFIDENTIAL

The information supplied in this Self-Study Report is for the confidential use of ABET and its authorized agents, and will not be disclosed without authorization of the institution concerned, except for summary data not identifiable to a specific institution.
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Self-Study Report
Ocean and Resources Engineering
Master of Science
University of Hawaii at Manoa

BACKGROUND INFORMATION

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B. Program History

1. Name

Master of Science (MS) in Ocean and Resources Engineering (formerly Master of Science in Ocean Engineering).

The Ocean and Resources Engineering Department (ORE) does not offer an undergraduate degree. It is a graduate only, research-oriented department and, hence, is accredited at the Master’s level. Undergraduate ABET requirements are satisfied by students completing an ABET accredited undergraduate engineering degree before beginning the master’s program (verified by the Department) or by incoming students making-up sufficient undergraduate courses (as assigned by the Department) at the University of Hawaii ABET-accredited College of Engineering to fulfill basic ABET undergraduate requirements.

The degree name was changed in Spring of 2000. Students admitted before Spring 2000 received an MS in Ocean Engineering upon graduation. Students graduating after December 2003 received an MS in Ocean and Resources Engineering. Between 2000 and 2003 students could select either name. The University of Hawaii conferred the first MS degree in Ocean and Resources Engineering in December 2000 and conferred the last MS degree in Ocean Engineering in December 2003.
2. General History

The program began in 1966, founded by famed Coastal Engineer, Dr. Charles Bretschneider. The Department was originally part of the College of Engineering. In 1987, the Department elected to join the newly formed School of Ocean and Earth Science and Technology (SOEST). The thought was that the department would form the technology aspect of this school and grow under the increasing resources pumped into the newly formed school. This proved not to work as well as originally hoped and the department languished for some years. In the late 1990’s the department was further stressed by the closing of its major research facility, the J.K.K. Look Laboratory of Ocean Engineering, an aging off-campus facility. Beginning in 2002, under the leadership of Dr. Kwok Fai Cheung and a new vision of the department in the SOEST Dean’s office, a major turnaround has been accomplished. ORE has shown remarkable advancement over the last two ABET cycles. In 1997, the program was reeling under its loss of laboratory space and faculty. By 2003, this had been corrected and the present program was instituted with its current master’s course plan and assessment processes. During the last six years, the earlier gains have been consolidated with new faculty hires, significantly stronger support from the administration, additional space, many new grants, new marine facilities, an increased number of students, and much higher morale. New faculty have been hired (now 8, up from 4), new space has been made available, more student internships are available, the Kilo Nalu Ocean Observatory has taken shape, a new computer cluster is available, a 25-foot boat has been obtained, a new arrangement has been undertaken with the Hawaii Undersea Research Laboratory for support of students, and research and considerably more research funding is available. The department is growing comfortably, is optimistic and morale is high.

Building on the mission of the University of Hawaii and the School of Ocean and Earth Science and Technology (SOEST), the Department of Ocean and Resources Engineering (ORE) has developed a Mission Statement, expanded this into a series of objectives, and honed these objectives into a set of program outcomes anticipated to produce the desired objectives. The program outcomes are measured by 12 rubrics consisting of six direct measures and six indirect measures. The measured rubrics show a very clear picture; ORE has fully achieved its program outcomes and objectives.

C. Options

The program has three option areas: Coastal Engineering, Offshore Engineering and Resources Engineering.

D. Organizational Structure

The Department is one of four academic departments in the School of Ocean and Earth Science and Technology. The other three academic departments are: Oceanography, Meteorology, and Geology and Geophysics. The school also has eight other research units. SOEST is the largest research entity at the University of Hawaii with an annual budget in excess of $100 million and 250 PhD level faculty. Within the department there are now eight faculty members spread approximately equally among the three option areas (coastal, offshore and resources). The department also enjoys a close working relationship with the College of Engineering.
The University of Hawaii has ten campuses of which Manoa is the flagship with 20,000 students. The University of Hawaii at Manoa is the only full graduate studies and research university (Carnegie Class 1) of the 10-campus system. Manoa has 19 schools and colleges of which SOEST and the College of Engineering are two. Each School or College has a Dean and answers to a Vice Chancellor. Manoa is overseen by a Chancellor who answers to the University of Hawaii System President.

E. Program Delivery Modes

Normal-day, on-campus program at the advanced level. Classes are taught in lecture, seminar and research lab mode depending on the course. There are no evening, off-campus or online options for any courses.

F. Deficiencies, Weaknesses or Concerns from Previous Evaluation(s) and the Actions taken to Address them

The program underwent an ABET review in 2003 with interim reports filed in 2005 and 2007. The shortcomings of these reviews focused on program outcomes and assessment methods. The department worked with its advisory committees, faculty and students to address these concerns using more tightly worded outcomes and broader assessment methods. These improvements include:

More Specific Program Outcomes

*Program outcomes have been honed to more clearly address needs. The current program outcomes are listed below:*

The graduate program in Ocean and Resources Engineering channels the students’ previous education and work experience to ocean-related engineering careers. Students, upon graduating from the program, will have:

1. A broad education necessary to understand the impact of engineering solutions in a global and societal context;
2. An ability to apply knowledge of mathematics, science, and basic engineering topics that include statics, dynamics, fluid mechanics, solid mechanics, and probability and statistics;
3. Proficiency in the core program that comprises hydrostatics, oceanography, water waves, fluid-structure interaction, underwater acoustics, laboratory and at-sea experience;
4. Working knowledge of at least one of the three option areas that include coastal, offshore, and ocean resources engineering;
5. An ability to use the techniques, skills, and latest engineering tools necessary for ocean and resources engineering practice;
6. An ability to identify, formulate, and solve ocean and resources engineering problems;
7. An ability to design and optimize engineering systems to meet the needs of the marine community;
8. An ability to work independently and function on multi-disciplinary teams;
9. An appreciation of professional and ethical responsibilities;
10. An ability to communicate effectively to technical and non-technical audiences;
11. An awareness of latest research and contemporary issues in and beyond the marine community; and
12. A recognition of the need for, and an ability to engage in life-long learning and continuing professional development.

Broader rubrics used to measure the effectiveness and achievement of the outcomes

Rubrics have been honed to accurately measure the achievement of both program objectives and outcomes.

Direct Measures:
1. The master’s qualifying exam
2. Committee verification of undergraduate ABET requirements and assignment of remedial action
3. Capstone Design Class
4. Master’s thesis defense and evaluation of thesis for outcome elements
5. Circulation and review of thesis proposals by all the faculty
6. Student employment placing, particularly repeat hires by employers

Indirect measures:
7. Local and International Advisory Panels
8. Employer Surveys
9. Student Exit Interviews
10. ABET course reviews done at the end of each course by both students and faculty
11. Alumni Surveys
12. Student advising meeting to determine fulfillment of undergrad requirements and progress

Interim Reviews
As a result of a General Review in Fall 2003, the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology, Inc. (ABET) conducted two interim reviews in Spring 2005 and 2007.

1. The General Review found a program weakness in the area of program outcomes and assessment. It was noted that the program assessment relied too heavily on the technique of assessing outcomes by survey. It was further noted that the link between assessment and program improvement was not clearly made.

A major series of new assessment measurements have been introduced since the last general review. These include a preliminary conference and group evaluation of qualifying exam results, clearer definition of the course outcomes matrix, broader evaluation of thesis projects, closer association with employers and employer feedback, and broader internship program with feedback. Since the last interim review, courses and thesis projects are reevaluated every year to more closely correspond to the input from these rubrics. Several rubrics have been added or strengthened. The rubrics presently used are listed above.
2. The General Review found a concern in that the program appears to be deficient with respect to enforcing engineering ABET undergraduate on all incoming students.

The department developed a new procedure to identify pre-program deficiencies, approve curriculum, advise students, and certify students for graduation. The progress of each student from the preliminary conference to the exit interview is recorded in a student progress form that is kept in the student’s file. The procedure, which was implemented in Fall 2002 and followed rigorously since, assures that all graduates satisfy the basic and advanced level curricular criteria outlined in this self-study report. Each student is annually reviewed to ensure all deficiencies are being addressed. In addition, since the last interim review, a thorough independent review is conducted by the University Graduate Division before any student is allowed to graduate.
A. Student Admissions

The University of Hawaii Graduate Division screens all applicants for admission to assure validity of their prior degrees and satisfaction of the university admission requirements. The Department Chair, who also serves as the Graduate Chair, evaluates the applicants and determines their admissibility to the Ocean and Resources Engineering program in consultation with the full faculty. The Department Chair also provides consultation to applicants, assists in their fellowship or education-leave applications, and matches applicants of research assistantships with research projects.

Most applicants to the Ocean and Resources Engineering program at the MS level have undergraduate degrees in engineering, and satisfy the pre-program requirements that include:

- a general education component,
- one year of college-level mathematics and science, and
- one and one-half years of engineering topics

as outlined in ABET Criteria. The Department also admits students with undergraduate degrees in mathematics and science. Typically, students in this category would be about 10% of total admissions. These students, who normally have a general education component and a year of college-level mathematics and science, are given conditional acceptance. The Department requires those students to make up the deficiencies in basic engineering courses that at a minimum include:

- computer aided design,
- statics and dynamics,
- solid mechanics and laboratory,
- fluid mechanics and laboratory,
- probability and statistics,

and at least five undergraduate engineering courses complementing the intended specialization in the program. These additional courses amount to approximately one and one-half years of study as required by ABET Criteria. A department committee verifies that these students meet a-k requirements by completing approved course work in the University of Hawaii ABET accredited College of Engineering.

Entering non-native English speaking students are required to have taken a TOEFL examination to evaluate their English language abilities. Depending on their scores, these students are individually evaluated at the University of Hawaii English Language Institute and assigned English-as-second-language (ESL) courses if needed. The English Language Institute offers a number of courses on technical writing and communication for native and non-native English speakers in graduate studies.

Upon admission, the progress of each student from the preliminary conference to the exit interview is recorded in a student progress form, which is kept in the student’s file. The appendix provides a copy of the progress form, which consists of six sections:
• Prior education and work experience,
• Pre-program requirements,
• Program requirements,
• Research work,
• Exit interview, and
• Post-graduation monitoring.

The Department continues to monitor the student for at least three years after graduation to provide data for program assessment. Although this advising procedure was formally implemented in Fall 2002, most of the components had been in place for years and students who graduated many years ago are still in contact with the Department.

At the beginning of each semester, the Department Chair meets with each incoming student at a preliminary conference to discuss the student’s prior education and work experience, determine any pre-program deficiencies, and discuss the coursework and research requirements. The student identifies an area of study from one of the three option areas:

- coastal engineering,
- offshore engineering, and
- ocean resources engineering,

and selects an academic advisor from the departmental faculty, who specializes in that area of study. If the student is supported by a research assistantship, the faculty member providing the support will serve as the academic advisor. The Department Chair serves as the advisor to the students without an undergraduate engineering degree until they satisfy the pre-program requirements and select academic advisors from their areas of study.

The University of Hawaii Graduate Division requires that all transfer credits must not have been used to obtain a prior degree and must be approved during the first semester of enrollment. The Ocean and Resources Engineering program allows up to six transfer credits from ABET accredited engineering programs. These courses must be equivalent to the core and option-area courses of the program and approved by the instructors upon evaluation of the course notes, assignments, and exam questions. The Department Chair will then recommend the Graduate Division to approve the transfer credits.

The Department administers a General Examination to the MS students, except those with pre-program deficiencies, during their first semester of enrollment. Students who passed the Fundamentals of Engineering (FE) examination within the last three years are exempted. The questions in the two-hour examination are similar to those in the FE Examination and measure the students’ ability to apply knowledge of mathematics, science, and mechanics in the solution of basic engineering problems. Passing the examination completes the pre-program requirements and advances the students to master’s candidacy.

B. Evaluating Student Performance

Each year the Chairman receives a progress report from the University of Hawaii Graduate Division. This highlights the courses and progress each student has made with respect to the anticipated time lines for graduating. As the department has only about 35 students (typically
about 20 Master’s students and 15 PhD students), it is not an impossible task to monitor each student’s transcript and progress on an annual basis. When clear deficiencies are noted these are discussed both with the student and the advisor.

C. [No subject listed on ABET template]

D. Advising Students

The academic advisor formulates a program of study for the student based on the student’s background and interest and performs periodic review of the progress to assure satisfaction of the program coursework requirements. The MS degree program requires a minimum of 30 academic credits. At least 24 credits must be earned in advanced-level courses number 600 or above and only two credits of directed reading or research can be counted toward the MS requirements. Each student must also satisfy the coursework requirements, consisting of 15 credits of core courses, 9 credits of option-area courses, and 1 credit of seminar. The core courses cover the basic disciplines that include:

- hydrostatics
- oceanography
- water waves
- fluid-structure interaction
- underwater acoustics
- laboratory and at-sea experience

The option-area courses allow students to specialize in coastal engineering, offshore engineering or ocean resources engineering, culminating with a capstone design that integrates the program coursework in a project team-taught by the faculty and practicing engineers. The 1-credit seminar requirement includes attendance of 15 seminars on relevant subjects selected by the students.

The Department encourages student participation in extracurricular and community activities. They elect a representative, who serves as the liaison with the Ocean and Resources Engineering faculty and the University of Hawaii Graduate Student Organization. Through their representative, the students participate in activities at the department, university, and community levels. Most of the students are members of the Student Chapters of the Marine Technology Society and the Society of Naval Architecture and Marine Engineering. The Ocean and Resources Engineering faculty members have served as officers in professional societies such as:

- American Society of Civil Engineers
- American Society for Engineering Education – Ocean and Marine Division
- American Society of Mechanical Engineers – Ocean, Offshore and Arctic Engineering Division
- Institute of Electrical and Electronic Engineers – Oceanic Engineering Society
- International Society of Offshore and Polar Engineering
- Marine Technology Society
- Society of Naval Architecture and Marine Engineering
They provide liaison between students and professional societies and assist students in organizing technical activities.

During the course of the study, each student selects a research advisor and forms a committee with at least three faculty members and completes the MS degree requirements with a Plan A thesis or Plan B independent project. The Plan A thesis is research oriented and the work must be original and of publication quality. Students receive six academic credits for the thesis. The Plan B independent project focuses on an engineering application, design, or optimization, and carries three academic credits. Both require a proposal outlining the subject area, objectives, proposed methodology, sources of data, and anticipated results that must be presented at a department seminar and approved by the committee.

The research advisor, who serves as the chair of the committee, identifies elective courses to form a coherent research program and guides the student through the research work. The research or independent project normally takes one to three semesters to complete and is an important component of the program that tests the student’s ability to carry out independent research work and introduces the student to the latest technological developments in ocean and resources engineering. The work results in a thesis or a report that demonstrates both mastery of the subject matter and a high level of communication skills. The student must present and defend the work at a final examination, which provides the faculty a final opportunity to test the student’s understanding and ability to integrate his or her work at the MS level.

The minimum residency requirement for an MS degree at the University of Hawaii is two semesters full-time. Table 1-1 outlines the typical timeline to satisfy the program requirements. Since the core and option-area courses are offered in the fall-spring semester sequence, most students begin their enrollment in the fall semester. Students with pre-program deficiencies spend the first year taking undergraduate engineering courses, while students with an undergraduate engineering degree from an ABET accredited program proceed directly to the program coursework and take the General Examination during their first semester. Students normally begin their research work after completing two semesters of the program coursework and take the final examination at the completion of the research or independent work. The University of Hawaii Graduate Division specifies that students failing any one of the general or final examinations twice will be dropped from the program. Students, who do not complete all requirements within seven years after admission, will be automatically dropped from the program. Reinstatement for a limited period of time is possible only upon submission of a petition to the Graduate Division by the Department Chair providing a detailed degree plan and new limited timeline to completion of all degree requirements.

Upon completion of the program, students will have satisfied the ABET Engineering Criteria as well as the General Criteria for Advanced Level Programs outlined in the *Criteria for Accrediting Engineering Programs*. The Department Chair concludes the course of study of each student with an exit interview. The research advisor continues to monitor the progress of the student for at least three years after graduation to provide feedback data for the program. The Department continues to update the alumni with a newsletter generally published twice a year. The next Fall newsletter will come out in November, 2009. The
newsletters are posted on the ORE website, emailed to alumni and sent in print format on request. The newsletter serves as an open forum for the faculty and alumni to exchange ideas and develops a sense of community and belonging of the Ocean and Resources Engineering program.

E. Transfer Students and Transfer Courses

The University of Hawaii Graduate Division requires that all transfer credits must not have been used to obtain a prior degree and must be approved during the first semester of enrollment. The Ocean and Resources Engineering program allows up to six transfer credits from ABET accredited engineering programs. These courses must be equivalent to the core and option-area courses of the program and approved by the instructors upon evaluation of the course notes, assignments, and exam questions. The Department Chair will then recommend the Graduate Division to approve the transfer credits.

F. Graduation Requirements

The graduation requirements are clearly stated and checked by both the Department and university Graduate Division. All graduating students must be cleared by the university computer system as having met all requirements. Independently, the Department Chairman, secretary and student’s advisor check all requirements on the student’s transcripts with the student progress form. Only when all of these checks agree does the Department Chairman sign the release form, which then goes to the University Graduate Division for final verification before a degree is awarded.

G. Enrollment and Graduation Trends

Table 1-1. Timeline for Completion of MS Degree

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Semester</th>
<th>Semester</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fall</td>
<td>Sp</td>
<td>Sum</td>
</tr>
<tr>
<td>Pre-program</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Examination</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coursework</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approval of research</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final Examination</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The University of Hawaii awarded 34 MS degrees in Ocean and Resources Engineering during the academic years 2003 through spring 2009. The student progress form was implemented to categorize the information in their files. The data provides confirmation on how well these graduates satisfy the current pre-program and program requirements and how the present advising procedure has improved the programmatic outcomes.

Table 1-2 provides statistical data of the 2004 – 2009 MS graduates. Approximately 60% of the students were recruited from US mainland, 35% from foreign countries, and 5% from Hawaii (those who went through high school or undergraduate education in Hawaii).
were no transfer students from other graduate programs. A few students have undergraduate degrees in ocean engineering or naval architecture and received exemptions for up to two courses, but did not receive transfer credits. A third of the incoming students have full-time engineering work experience after their undergraduate education. Most students received some form of financial support. Twenty-one students (61%) received research assistantships, four internships (12%) and six received tuition waivers during their study; two were active-duty naval officers studying full time. There were slightly more students who chose to complete their study with a Plan A thesis (55%) rather than an independent project Plan B (45%). Most students took more than the required minimum number of credits. Students with an undergraduate engineering degree typically finish the program in two years, while those without an undergraduate engineering degree spent a median of 3.5 years in the program. Over 60% of the students found work or continued to study in Hawaii immediately after graduation.

<table>
<thead>
<tr>
<th></th>
<th>ABET Undergrad Degree</th>
<th>Foreign Engineering Degree</th>
<th>Science Undergrad Degree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of students</td>
<td>17</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>Number of students from Hawaii</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Full-time eng. experience after BS</td>
<td>8</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Research assistants</td>
<td>8</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Other financial support</td>
<td>2 N, 3 T, 4 I</td>
<td>2 T</td>
<td>1 T</td>
</tr>
<tr>
<td>Plan A Thesis</td>
<td>9</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Plan B Independent project</td>
<td>8</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Average credits for MS degree</td>
<td>33</td>
<td>34</td>
<td>33</td>
</tr>
<tr>
<td>Median years to complete degree</td>
<td>2.0</td>
<td>2.0</td>
<td>3.5</td>
</tr>
<tr>
<td>Work/study in Hawaii after MS</td>
<td>9</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Still in Hawaii in Spring 2009</td>
<td>7</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

The 17 students, who went through ABET accredited programs, already satisfied the requirements of the Professional Component in the ABET Engineering Criterion at the time of admission. Ten of the graduates received their undergraduate degrees from universities in China, India, Canada, Japan and France. Table 1-3 shows the level of training they received in the three elements of the Professional Component. Four of the students went through a focused general education component on subjects directly relevant to engineering practice, while one had a general education component similar to that in the US. All ten students had one year of mathematics and science, but spent more time in the engineering topics in comparison to their US counterparts. Three of the graduates without undergraduate degrees in engineering did not satisfy the requirements of the Professional Component at the time of admission and took undergraduate engineering classes at the University of Hawaii to make
up the deficiencies. The data in Table 1-4 shows all three of them satisfied the Professional Component by the time they graduated from this program.

**Table 1-3. Professional component for students with foreign engineering degree**

<table>
<thead>
<tr>
<th>Professional Component</th>
<th>Student 1</th>
<th>Student 2</th>
<th>Student 3</th>
<th>Student 4</th>
<th>Student 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>General education (yr)</td>
<td>0.5</td>
<td>0.5</td>
<td>1.0</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Math and Science (yr)</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Engineering topics (yr)</td>
<td>2.5</td>
<td>2.5</td>
<td>2.0</td>
<td>2.5</td>
<td>3.0</td>
</tr>
</tbody>
</table>

**Table 1-4. Professional component for students with science undergraduate degree**

<table>
<thead>
<tr>
<th>Professional Component</th>
<th>Student 1</th>
<th>Student 2</th>
<th>Student 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>General education (yr)</td>
<td>2.0</td>
<td>0.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Mathematics and Science (yr)</td>
<td>3.0</td>
<td>0.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Engineering topics (yr)</td>
<td>0.5</td>
<td>1.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

The new systematic advising procedure was implemented in Fall 2002, the individual components were in place for some time and the data in Tables 1-2 to 1-4 shows that the program’s graduates satisfy the ABET requirements. However, the Program Criteria of hydrostatics, oceanography, and underwater acoustics were officially incorporated into the core program in Fall 2002. The faculty noted this situation during the preparation for EC 2000 and took immediate measures to correct this deficiency in Spring 2001.

Table 1-5 provides data for the 15 current MS students (as of June 2009). The proportion of students with ABET accredited undergraduate degrees remains the same as the graduates over the last six years, while the number of students from Hawaii has increased to one third. There are two masters foreign students from China and Mexico and 10 foreign PhD students adding to the cultural diversity of the student body. About 60% of the students have full-time engineering experience prior to admission and 95% receive some form of financial support. The student advising procedure applied rigorously since Fall 2002 also assures that the pre-program requirements are applied uniformly for all the MS students in the program.

**Table 1-5. Profile of MS Students Enrolled in June 2009**

(N = Navy education program, I = Internship, T = Tuition Waiver)

<table>
<thead>
<tr>
<th></th>
<th>ABET Undergrad Degree</th>
<th>Foreign Engineering Degree</th>
<th>Science Undergrad Degree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of students</td>
<td>10</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Number of students from Hawaii</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Full-time eng. experience after BS</td>
<td>8</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Research assistants</td>
<td>6</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Other financial support</td>
<td>3(I)</td>
<td>0</td>
<td>1(I)</td>
</tr>
</tbody>
</table>
### Table 1-6. History of Admissions Standards for Graduate Students for Past Five Years

<table>
<thead>
<tr>
<th>Academic Year</th>
<th>Composite GRE</th>
<th>Composite Undergraduate GPA</th>
<th>Percentile Rank in Undergraduate Program</th>
<th>Number of New Students Enrolled</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MIN</td>
<td>AVG</td>
<td>MIN</td>
<td>AVG</td>
</tr>
<tr>
<td>2004</td>
<td></td>
<td></td>
<td>2.90</td>
<td>3.36</td>
</tr>
<tr>
<td>2005</td>
<td></td>
<td></td>
<td>2.63</td>
<td>3.28</td>
</tr>
<tr>
<td>2006</td>
<td></td>
<td></td>
<td>3.00</td>
<td>3.34</td>
</tr>
<tr>
<td>2007</td>
<td></td>
<td></td>
<td>3.00</td>
<td>3.35</td>
</tr>
<tr>
<td>2008</td>
<td></td>
<td></td>
<td>2.85</td>
<td>3.84</td>
</tr>
</tbody>
</table>

### Table 1-7. Transfer Students for Past Five Academic Years

<table>
<thead>
<tr>
<th>Academic Year</th>
<th>Number of Transfer Students Enrolled</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>0</td>
</tr>
<tr>
<td>2005</td>
<td>0</td>
</tr>
<tr>
<td>2006</td>
<td>0</td>
</tr>
<tr>
<td>2007</td>
<td>0</td>
</tr>
<tr>
<td>2008</td>
<td>0</td>
</tr>
</tbody>
</table>

### Table 1-8. Enrollment Trends for Past Five Academic Years

<table>
<thead>
<tr>
<th></th>
<th>Year 2004</th>
<th>Year 2005</th>
<th>Year 2006</th>
<th>Year 2007</th>
<th>Year 2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full-time Students</td>
<td>15</td>
<td>18</td>
<td>11</td>
<td>21</td>
<td>19</td>
</tr>
<tr>
<td>Part-time Students</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Student FTE¹</td>
<td>17</td>
<td>20</td>
<td>13</td>
<td>23.5</td>
<td>19.5</td>
</tr>
<tr>
<td>Graduates</td>
<td>2</td>
<td>8</td>
<td>5</td>
<td>3</td>
<td>8</td>
</tr>
</tbody>
</table>

¹ FTE = Full-Time Equivalent

### Table 1-9. Program Graduates

<table>
<thead>
<tr>
<th>Name</th>
<th>Year Matriculated</th>
<th>Year Graduated</th>
<th>Prior Degree(s) if Masters Student</th>
<th>Certification/ Licensure</th>
<th>Initial or Current Employment/ Job Title/ Other Placement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Douyere, Yann</td>
<td>1999</td>
<td>MS 2003</td>
<td>BS, EE</td>
<td></td>
<td>Math and Science Department, Kapiolani College, Hawaii</td>
</tr>
<tr>
<td>Hahn, Eric</td>
<td>2002</td>
<td>MS 2003</td>
<td>BS, ME</td>
<td></td>
<td>Naval Facilities Engineering Service Center, Port Huememe, California</td>
</tr>
<tr>
<td>Woo, Kristen</td>
<td>2000</td>
<td>MS 2003</td>
<td>BS, CE</td>
<td></td>
<td>Pearl Harbor Naval Shipyard, Honolulu, Hawaii</td>
</tr>
<tr>
<td>Ramsey, Melanie</td>
<td>2000</td>
<td>MS 2003</td>
<td>BS, ME</td>
<td></td>
<td>Pearl Harbor Naval Shipyard, Honolulu, Hawaii</td>
</tr>
<tr>
<td>Winsley, Jon</td>
<td>2001</td>
<td>MS 2003</td>
<td>BS, ME</td>
<td></td>
<td>Sea Engineering Inc., Waimanalo, Hawaii</td>
</tr>
<tr>
<td>Name</td>
<td>Year Matriculated</td>
<td>Year Graduated</td>
<td>Prior Degree(s) if Masters Student</td>
<td>Certification/Licensure</td>
<td>Initial or Current Employment/Job Title/Other Placement</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------------</td>
<td>----------------</td>
<td>------------------------------------</td>
<td>-------------------------</td>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>Zhou, Hongqiang</td>
<td>2002</td>
<td>MS 2003</td>
<td>BE, Naval Arch &amp; OE</td>
<td>PhD Candidate, University Hawaii (Civil Engineering)</td>
<td></td>
</tr>
<tr>
<td>Yamazaki, Yoshiki</td>
<td>2002</td>
<td>MS 2004</td>
<td>BS, ME</td>
<td>PhD Candidate, University Hawaii (ORE)</td>
<td></td>
</tr>
<tr>
<td>Yang, Jinghai</td>
<td>2001</td>
<td>MS 2004</td>
<td>BE, Naval Engr</td>
<td>GMP Inc, Honolulu, Hawaii</td>
<td></td>
</tr>
<tr>
<td>Kincaid, James I</td>
<td>2001</td>
<td>MS 2005</td>
<td>BS, G&amp;G</td>
<td>Sea Engineering Inc, Waimanalo, Hawaii</td>
<td></td>
</tr>
<tr>
<td>Hansen, Demont</td>
<td>2002</td>
<td>MS 2005</td>
<td>BS, CE</td>
<td>Project Engineer Inc, Honolulu, Hawaii</td>
<td></td>
</tr>
<tr>
<td>Nunes, Vasco</td>
<td>2002</td>
<td>MS 2005</td>
<td>BS, CE</td>
<td>PhD Candidate, EPTISA, Madrid, Spain</td>
<td></td>
</tr>
<tr>
<td>Carter, Richard</td>
<td>2002</td>
<td>MS 2005</td>
<td>BS, Elec Pwr Engr</td>
<td>NOAA coral reef Ecosystem Development Program, Honolulu</td>
<td></td>
</tr>
<tr>
<td>Merritt, Daniel</td>
<td>2002</td>
<td>MS 2005</td>
<td>BS, ME</td>
<td>Coastal Planning and Engineering, Inc, Boca Raton Florida</td>
<td></td>
</tr>
<tr>
<td>Wycklendt, Andrew</td>
<td>2003</td>
<td>MS 2005</td>
<td>BS, OE</td>
<td>GMP Inc., Honolulu, Hawaii</td>
<td></td>
</tr>
<tr>
<td>Chen, Long</td>
<td>2002</td>
<td>MS 2006</td>
<td>BS, Naval Arch</td>
<td>Honolulu Seawater Air Conditioning LLC, Honolulu, Hawaii</td>
<td></td>
</tr>
<tr>
<td>Higa, Scott</td>
<td>2003</td>
<td>MS 2006</td>
<td>BS, Mar Sci &amp; Engr</td>
<td>OCEES Inc Honolulu, Hawaii</td>
<td></td>
</tr>
<tr>
<td>Looney, Christopher</td>
<td>2003</td>
<td>MS 2006</td>
<td>BS, Chem Engr</td>
<td>WJCJ Inc, South Pasadena, California</td>
<td></td>
</tr>
<tr>
<td>Sanchez, Alejandro</td>
<td>2004</td>
<td>MS 2006</td>
<td>BS, Oceanography</td>
<td>Coastal Engineer, US Army Corps of Engineers, Vicksburg, Mississippi</td>
<td></td>
</tr>
<tr>
<td>Goo, Justin A.</td>
<td>2005</td>
<td>MS 2007</td>
<td>BS, CE</td>
<td>Coastal Engineer, US Army Corps of Engineers, Honolulu, HI, PhD candidate</td>
<td></td>
</tr>
<tr>
<td>Munger, Sophie</td>
<td>2005</td>
<td>MS 2007</td>
<td>BS, Geology</td>
<td>Coastal Engineer, US Army Corps of Engineers, Vicksburg, Mississippi</td>
<td></td>
</tr>
<tr>
<td>Stopa, Justin</td>
<td>2005</td>
<td>MS 2007</td>
<td>BA, Math</td>
<td>PhD student, University of Hawaii (ORE)</td>
<td></td>
</tr>
<tr>
<td>Craw, Megan L.</td>
<td>2005</td>
<td>MS 2008</td>
<td>BS, Geology</td>
<td>Research Associate, University of Hawaii, Honolulu, Hawaii</td>
<td></td>
</tr>
<tr>
<td>Sites, Eric</td>
<td>2005</td>
<td>MS 2008</td>
<td>BS, CE</td>
<td>Pearl Harbor Engineering, Honolulu, Hawaii</td>
<td></td>
</tr>
<tr>
<td>Dempsey, Ty</td>
<td>2002</td>
<td>MS 2008</td>
<td>BS, CE</td>
<td>Lyon Associates Engineering, Honolulu, Hawaii</td>
<td></td>
</tr>
<tr>
<td>Mohamed, Abdulla</td>
<td>2005</td>
<td>MS 2008</td>
<td>BS, OE</td>
<td>PhD student, University of Hawaii (Civil Engineering)</td>
<td></td>
</tr>
<tr>
<td>Kubic, Charles</td>
<td>2007</td>
<td>MS 2008</td>
<td>BS, CE</td>
<td>Naval Facilities Engineering Service Center, Little Creek, Virginia</td>
<td></td>
</tr>
<tr>
<td>Namekar, Shailesh</td>
<td>2004</td>
<td>MS 2008</td>
<td>BS, CE</td>
<td>PhD student, Clemson University, Clemson, South Carolina</td>
<td></td>
</tr>
<tr>
<td>Wong, Gregory E.</td>
<td>1998</td>
<td>MS 2008</td>
<td>BA, Mar Sci</td>
<td>Project Engineer, Navatek Limited, Honolulu, Hawaii</td>
<td></td>
</tr>
<tr>
<td>Yan, Lei</td>
<td>2006</td>
<td>MS 2008</td>
<td>BS, Coastal Engr</td>
<td>Returned to China</td>
<td></td>
</tr>
<tr>
<td>Babiinskas, Krystin</td>
<td>2007</td>
<td>MS 2009</td>
<td>BS, Aerospace Engr</td>
<td>Mechanical Design Engineer, C and D Zodiac Aerospace, California</td>
<td></td>
</tr>
</tbody>
</table>
CRITERION 2. PROGRAM EDUCATIONAL OBJECTIVES

A. Mission Statement

The published mission of the Department of Ocean and Resources Engineering (ORE) is to provide high quality education, research and service to its constituents.

The specific mission statement goals of the Department are to:

1. Educate top quality ocean and resource engineers to meet the needs of Hawaii, the nation and the engineering profession.
2. Conduct and disseminate research in the field of Ocean and Resources Engineering.
3. Provide service to the State of Hawaii, Pacific Basin and engineering profession through such opportunities as seminars, conferences, consulting, work with government agencies and professional societies.

The Department mission statement reproduced above is found on the Department’s website. This mission relates directly to the more general mission of the University of Hawaii.

The common purpose of the University of Hawaii (UH) system of institutions is to serve the public by creating, preserving, and transmitting knowledge in a multi-cultural environment. The University is positioned to take advantage of Hawaii’s unique location, physical and biological environment, and rich cultural setting. At all levels in the academy, students and teachers engage in the mastery and discovery of knowledge to advance the values and goals of a democratic society and ensure the survival of present and future generations with improvement in the quality of life. The published mission of the University of Hawaii is to:

- Provide all qualified people in Hawaii with equal opportunity for high quality college and university education and training.
- Provide a variety of entry points into a comprehensive set of post-secondary educational offerings, allowing flexibility for students to move within the system to meet individual educational and professional needs.
- Advance missions that promote distinctive pathways to excellence, differentially emphasizing instruction, research, and service while fostering a cohesive response to state needs and participation in the global community.

As the only public higher education institute in Hawaii, the UH system bears a special responsibility to prepare a highly educated citizenry. In addition, the system supports the creation of quality jobs and the preparation of an educated workforce to fill them. Building on a strong liberal arts foundation, the UH system prepares the full array of workers from technicians, physicians, and scientists to artists, teachers, and marketing specialists – who are needed in a technologically advanced and culturally diverse island state (Excerpt from the University of Hawaii System Strategic Plan – The System Mission, June 2002).

The Department of Ocean and Resources Engineering is part of the School of Ocean and Earth Science and Technology (SOEST) at the University of Hawaii Manoa campus. UH Manoa is the flagship campus of the University of Hawaii system and is a research university with “core commitments on Research, Educational Effectiveness, Social Justice, Place, Economic Development, Culture, Society & The Arts, and Technology” (University of
B. **Program Educational Objectives**

The Ocean and Resources Engineering program has three option areas: coastal, offshore engineering, and ocean resources engineering. The ORE program and its educational objectives were developed over a number of years working in close association with our advisory panels and professional engineering societies. These Educational Objectives are published on the Department website (www.soest.hawaii.edu/ORE). The Educational Objectives of the MS program are to produce graduates who, during the first few years following graduation:

1. are effective and creative engineers applying knowledge of mathematics and science to the solution of practical engineering problems;
2. have general understanding of and ability to work in the ocean and resources engineering disciplines;
3. are proficient in one or more of the ocean and resources engineering disciplines;
4. are aware of professional, ethical, managerial, and other non-technical issues commonly encountered in engineering practice;
5. can communicate and work effectively with peers, clients, and the general public in promoting new ideas, products, or designs; and
6. can adapt to the changing needs and technology of the ocean and resources industry.

Since the Department of Ocean and Resources Engineering only offers graduate programs, a concomitant goal is to conduct research in support of the education program. The strong PhD program and the culturally diversified PhD student body expose the MS students to the latest research and development in an international setting.

C. **Consistency of the Program Educational Objectives with the Mission of the Institution**

The ORE department has, in close consultation with its constituents, developed a set of objectives consistent with its mission statement. The objectives are more specific than the department mission, elucidating the expected results of study of our program. In the same way, the ORE mission takes our parent School of Ocean and Earth Science and Technology’s mission to study earth systems and focuses it onto the area of ocean engineering education and research. Similarly, the School of Ocean and Earth Science and Technology (SOEST) mission is a refinement of the UH mission to provide top quality higher education and focus area research for the people of Hawaii and the Pacific Basin.

The mission of the University of Hawaii is to provide higher education and relevant research to the people of Hawaii to train them for 21st century jobs and living. The university emphasizes its Asia-Pacific heritage and marine setting. As part of this mix SOEST has a four-part goal of describing the marine and earth environment. ORE goals fit in with those of SOEST in the area of graduate education and research. ORE is in some respects the
The ORE mission dovetails perfectly with that of SOEST, which is in turn an integral part of that of UH.

For the State of Hawaii, ORE provides several key functions. The ORE coastal program provides wave modeling and tsunami inundation maps critical for public safety. The program is intimately tied in with the State Department of Civil Defense. The ocean alternative energy program links closely to the State goal of providing 30% of its energy from renewables by 2020. The ocean observation program ties directly to the State’s response to Global Climate Change. ORE is critically tied to high priority State areas.

Our Educational Objectives are also specifically consistent with the missions of the University of Hawaii by taking advantage of Hawaii’s mid-ocean location, providing a quality education program vital to Hawaii, disseminating new ideas and techniques to the community through training, and most importantly, supplying qualified ocean engineers to sustain the changing needs of Hawaii and the nation. Although only 5% of the 2004-2009 graduates originated from Hawaii, 60% of them stayed in Hawaii after graduation. The graduates constitute the majority of the practicing ocean engineers in Hawaii and have contributed significantly to the infrastructure development all over the Pacific Basin. Many of the early graduates have founded companies or been serving as senior officers in the local marine industry. Their activities generate ocean-related engineering jobs in Hawaii and provide employment opportunities for recent graduates. This continuing process has made the program an integral part of the local and Pacific basin-wide marine industry.

The Ocean and Resources Engineering program is also an active participant in the global community. Many of the graduates moved to various parts of the US mainland or returned to their home countries that include Canada, China, India, Japan, France, South Africa, Thailand, Ecuador, Germany, Brazil, Spain, Korea, Belgium, Taiwan, the Netherlands, the Philippines, and the United Kingdom. Many of them now hold senior positions in major corporations, universities, or government agencies. The strong ties maintained by the graduates with the Department indicates satisfaction with the education they received and fulfills an important mission of the University of Hawaii in reaching out to the global community.

The Ocean and Resources Engineering program is structured to provide a curriculum and the associated assessment processes that cater to the Educational Objectives as outlined in Table 2-1. The pre-program, which includes a general education component, one year of college-level mathematics and science, and one and one-half years of basic engineering topics, provides students a broad educational background and covers technical and non-technical issues commonly encountered by engineers in professional practice. In addition, MS students are required to take the General Examination to test their knowledge in mathematics, science, and basic engineering, and their preparation for the advanced-level program.
Table 2-1. Relationship between Curricular Elements and ORE Educational Objectives (listed in section B)

<table>
<thead>
<tr>
<th>Curricular Elements</th>
<th>Educational Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Pre-program &amp; Gen. Exam</td>
<td>***</td>
</tr>
<tr>
<td>Program core courses</td>
<td>**</td>
</tr>
<tr>
<td>Option-area courses</td>
<td>*</td>
</tr>
<tr>
<td>Laboratory course</td>
<td>*</td>
</tr>
<tr>
<td>Capstone design project</td>
<td>*</td>
</tr>
<tr>
<td>Seminars</td>
<td></td>
</tr>
<tr>
<td>Thesis/independent project</td>
<td>*</td>
</tr>
<tr>
<td>Defense/final exam</td>
<td>*</td>
</tr>
</tbody>
</table>

*slightly, **moderately, ***highly relevant

The academic program consists of the core courses, the option-area courses, a capstone design course, seminars, and a thesis or an independent project. The core courses provide the students a basic understanding of the ocean and resources engineering disciplines that include hydrostatics, oceanography, water waves, fluid-structure interaction, underwater acoustics, laboratory experiments, and at-sea experience. The option-area courses prepare students for specialization in coastal, offshore, and ocean resources engineering. Elective courses are also available, such as our new acoustics course ORE 654, to provide more in depth coverage in specific areas. The coursework not only covers the subject matter, but also provides surveys of state-of-the-art technology in ocean and resources engineering.

The laboratory course connects materials covered in the classroom with observations and measurements made in the ocean. It is offered in the fall, in order to have sufficient boat-time to conduct measurements in the ocean. The experience offered the students includes coastal navigation, instrument usage, including deployment and retrieval, current measurements, sediment sampling and analysis, bathymetry survey, and wave measurements and analysis. The course also covers hydraulic scale-model experiments and ROV and submersible operations. Each student is required to submit a final report and give a presentation of the findings.

The capstone design project is team-taught by faculty members and practicing professional engineers. Its objective is to familiarize the students with the planning and design of a real-life engineering project in a consulting firm setting. Emphasis is placed on teamwork, risk management, decision making with insufficient information, consultant-client relation, ethics, and environmental and economic aspects of engineering design. The course is conducted as a series of meetings and informal presentations and culminates in a major presentation analogous to a public hearing at a department seminar attended by the faculty, students, and visitors from the local engineering community. In addition, students are required to read a number of engineering case studies and write a paper on issues related to ethics and professional practice.
All students in the program are required to attend 15 approved seminars. The seminars expose the students to the latest development and research related to ocean and resources engineering and instill an understanding in the students for the need to adapt to continuously changing technology. The students get an in-depth understanding in a subject area through the Plan A thesis or Plan B independent project. Both require a proposal outlining the subject, objectives, proposed methodology, sources of information, and anticipated results that must be approved by a committee composed of three faculty members, who supervise and evaluate the work. The research project provides students an opportunity to explore and contribute to the development of the latest technology in an ocean and resources engineering discipline. The work results in a thesis or a report that demonstrates both mastery of the subject matter and a high level of communication skills. The student must present the results at a final examination, which provides the faculty a final opportunity to test the student’s understanding and ability to integrate their work at the MS level.

D. Program Constituencies

The program has a series of constituents:

- The most basic constituents of the program are the students who rely on the program for training and inspiration toward becoming productive engineers.
- The second level of constituents are the employers who will later employ our students and expect well-trained professionals.
- The next level of constituents are the faculty who have invested their careers in the Department to train the next generation of Ocean Engineers and for the opportunity of research advancement.
- The final level of constituents are the alumni and donors who expect the Department to instill knowledge and professional practice skills into a new generation of engineers to foster the engineering profession and its associated professional societies.

The needs of these constituencies are assessed by our advisory committees and by our faculty’s discussions with professional societies with whom they work closely. Surveys are also sent out to graduates, alumni and employers every 2 years.

E. Process for Establishing Program Educational Objectives

The faculty conducted a series of workshops to review the criteria for establishing educational objectives and to realign the Ocean and Resources Engineering program. We developed new assessment processes in compliance with the requirements. The Department completed the first draft of this self-study report that maps out the educational objectives, program outcomes, curricular elements, and assessment process of a tentative program. The draft report also described the faculty and facilities that deliver the program.

In April 2009, the Department met with Dr. Bill Garrard, an ABET consultant, to refine our processes. We organized the program constituencies, which include the students, the local marine industry, and the ocean engineering community, into the following three advisory panels. The student advisory panel included MS and PhD students of the Department. The Local Professional Advisory Panel is mostly composed of senior executives of organizations that employ the graduates of this program in Hawaii. Their background is quite diversified.
and includes academia, management, operations, engineering consulting and government. The International Professional Advisory Panel members, on the other hand, all specialize in various aspects of ocean and resources engineering and come from a cross spectrum of academia and industry in Canada, Taiwan, the Netherlands, and the United States. Some of the panel members, indicated by an asterisk(*), are graduates of the Department.

Student Advisory Panel
1. Masoud Hayatdavoodi (Chair), PhD Candidate of Ocean and Resources Engineering
2. In Chieh Chen, MS Candidate of Ocean and Resources Engineering
3. Blue Eisen, MS Candidate of Ocean and Resources Engineering
4. Volker Roebber, PhD Candidate of Ocean and Resources Engineering
5. Jacob Tyler, MS, Candidate of Ocean and Resources Engineering
6. Yefei Bai, PhD Candidate of Ocean and Resources Engineering
7. Dave Wilkinson, MS Candidate of Ocean and Resources Engineering
8. James Anderson, MS Candidate of Ocean and Resources Engineering
9. Alan Carmichael, MS Candidate of Ocean and Resources Engineering
10. Miguel Quintero, MS, Candidate of Ocean and Resources Engineering

Local Professional Advisory Panel
1. Joe Van Ryzin, PhD, PE (Chair), President, Makai Ocean Engineering Inc., Waimanalo, Hawaii.
2. Jose Andres*, PhD, PE, Vice President, Makai Ocean Engineering Inc., Waimanalo, Hawaii.
3. Roger Babcock, PhD, PE, Associate Professor, Department of Civil and Environmental Engineering, University of Hawaii, Honolulu, Hawaii.
7. Liz Corbin, Branch Chief, Hawaii Department of Business and Economic Development and Tourism.
8. Hans Krock, PhD, PE, Past President and Chairman, OCEES, Honolulu, Hawaii.
9. Steve Oney PhD, Vice President, OCEES, Honolulu, Hawaii

International Professional Advisory Panel
3. Roger Basu, PhD, Manager, Advanced Analysis Department, ABS Americas, Houston, Texas.
4. Sander Calisal, PhD, PEng, Professor, Department of Mechanical Engineering, University of British Columbia, Vancouver, B.C., Canada.
6. Zeki Demirbilek, PhD, PE, Research Hydraulic Engineer, Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory, Harbors and Structures Branch, Vicksburg, Mississippi; Editor, ASCE Journal of Waterway, Port, Coastal, and Ocean Engineering.


8. Paul Palo, PhD, PE, Mechanical Engineer, Ocean Facilities Department, Naval Facilities Engineering Service Center, Port Hueneme, California.

9. Tar-Zen Su*, PhD, Associate Professor, Marine Engineering Department, National Taiwan Ocean University, Taiwan, China.


The three panels were provided with the draft self-study report and were tasked to refine the educational objectives and to evaluate the program attributes in delivering these objectives. The Department appointed three faculty members to serve as the respective coordinators for the student, local professional, and international professional panels. These faculty members primarily served as the liaisons between the panels and the Department and did not participate in panel discussions. The student and local professional panels held several meetings, both most recently in June, 2009. The international professional panel members conducted their discussion and deliberation through electronic media. Both the local and international professional panels researched ABET and peer programs in the US to qualify their recommendations.

In addition to the panel reviews, the Department also commissioned EBI, a nationally recommended survey company, to conduct questionnaire surveys of the 1990-2008 graduates as well as their current employers in Fall 2008. Although the Educational Objectives, by ABET’s definition, are applicable to graduates during the first several years of employment, the survey covered the graduates over a longer period to provide more comprehensive data. The survey questions are structured to gather quantitative data to assess the effectiveness of the academic program in meeting the educational objectives of these two major constituencies. Although this report addresses specifically the MS program, the survey also covered PhD graduates, who went through the same coursework and requirements as the MS graduates, but with a more intensive research project culminating with a dissertation.

With the advisory panel input and survey results, the Ocean and Resources Engineering faculty finalized the educational objectives, assessment process, and curriculum. The University of Hawaii Graduate Division approved the revisions to the curriculum in several steps. The Department implemented the new curriculum and assessment process as described in this self-study report. Table 2-2 shows the assessment process and review cycle. The exit interview and survey are continuing processes. The faculty review the results and made minor adjustments to the program on an ongoing basis. The panels are consulted and all alumni and their employers are surveyed every three years before major revisions to the Educational Objectives and the curricular elements are made. According to this schedule, the next major revision to the Ocean and Resources Engineering program will be made in 2009-2010.
F. Achievement of Program Educational Objectives

Overall, the Department found its six objectives to have been well received by the department’s constituents. The University administration and the administration of the School found the objectives to be highly consistent with those of the University as a whole and School of Ocean and Earth Sciences and Technology, in particular. In order to document the effectiveness of the objectives and their degree of successful completion, the three independent panels of evaluators discussed the ORE program and filed reports. These reports were from: 1) a panel of 10 current students, 2) a panel of local employers of ORE graduates, and 3) an international panel of highly distinguished engineers. The result was general agreement that the objectives had been accomplished.

Table 2-2. Assessment Process and Review Cycle for Educational Objectives

<table>
<thead>
<tr>
<th>Assessment Process</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S</td>
<td>F</td>
<td>S</td>
<td>F</td>
</tr>
<tr>
<td>Exit interview</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Exit survey</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Minor adjustment</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Alumni survey</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Employer survey</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Panels</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>ABET review</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Major revision</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

The Department organized the panel reviews and alumni and employer surveys. The survey questionnaires are in the Appendix. Two of the panel reports are rather lengthy and the survey results are quite comprehensive. This section provides summaries of the results and Criterion 4 describes the revisions to the program. Although both the panel reviews and questionnaire surveys directly address the Educational Objectives and curricular elements, the interpretations of the two sets of results are different. The panel reports reflect the views of the constituencies on the Educational Objectives and curricular elements as outlined in this self-study report, while the survey results represent an evaluation of the program over the past 10 years.
**Student Advisory Panel Report Highlights**

The 10-member student panel conducted a detailed and comprehensive evaluation of the Department based on Strengths, Weaknesses, Opportunities and Threats (SWOT). The report is reproduced as Appendix G. The students concurred that the Educational Objectives reflect the level of education presented by the Department and its faculty. The students were generally satisfied with a few suggestions on improving specific courses and enhancing the renewable energy area. The students want a program that prepares them for the engineering profession and commented positively on class design projects and reports as well as the capstone design. They suggested the Department incorporate more engineering tools used in the industry into the curriculum, increase the number of funded research projects, and hold regular meetings between faculty and students to increase department-wide interaction.

**Local Professional Advisory Panel Report Highlights**

The Local Professional Advisory Panel found that the program adequately fulfills the requirements and objectives suggested by the ABET criteria, and its new outcome-based self-evaluation and management program are well founded and complete. Their report is reproduced as Appendix H. The panel in its 2004-5 report expressed some concern in certain areas such as facilities and institutional support. In its 2009 report, most of these issues had been addressed and the panel focused on increasing the quality of the incoming students. Table 2-3 provides a listing of the pertinent points.

**Table 2-3. Summary of Last Two Local Professional Advisory Panel Reports**

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Comments</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>Low availability of assistantships giving rise to low initial enrollment</td>
<td>Emphasize quality</td>
</tr>
<tr>
<td></td>
<td>Robust and comprehensive advising processes</td>
<td>Increase the pool of ORE applicants</td>
</tr>
<tr>
<td></td>
<td>Major contributions to Hawaii’s state economy</td>
<td>Promote the school</td>
</tr>
<tr>
<td>Educational Objectives</td>
<td>Excellent and consistent with UH missions and ABET criteria</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Good assessment process to meet the constituencies’ needs</td>
<td>Begin exit interview immediately to mature the assessment process.</td>
</tr>
<tr>
<td>Program Outcomes</td>
<td>Well-rounded and comprehensive program outcomes</td>
<td>Institute a systematic feedback mechanism</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Explicitly state laboratory and at-sea experience</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Leverage SOEST resources and industry for hands-on experience</td>
</tr>
</tbody>
</table>
Table 2-3. Summary of Local Professional Advisory Panel Report (continued)

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Comments</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional</td>
<td>Curriculum in general ample to achieve stated objectives</td>
<td>Survey constituencies on relative value of the three option areas</td>
</tr>
<tr>
<td>components</td>
<td>Capstone design instrumental in meeting course objectives</td>
<td>Encourage internships</td>
</tr>
<tr>
<td></td>
<td>Uneven student distribution in the three option areas</td>
<td>Encourage interdisciplinary work with other College of Engineering &amp; SOEST units</td>
</tr>
<tr>
<td></td>
<td>Basic level adequately satisfied by students’ background or the pre-</td>
<td>Encourage co-op and involvement with professional societies</td>
</tr>
<tr>
<td></td>
<td>program</td>
<td>Emphasize design, project planning, and management</td>
</tr>
<tr>
<td>Faculty</td>
<td>Talented faculty meeting ABET requirements, but low number</td>
<td>Increase faculty number</td>
</tr>
<tr>
<td></td>
<td>Excellent and well-balanced cooperating and affiliate faculty</td>
<td>Leverage cooperating and affiliate faculty resources</td>
</tr>
<tr>
<td>Facilities</td>
<td>New on-campus lab facilities instrumental to program</td>
<td>None</td>
</tr>
<tr>
<td>Institutional</td>
<td>Not evaluated</td>
<td>None</td>
</tr>
<tr>
<td>support</td>
<td>Program Criteria</td>
<td>Proposed curriculum meeting or exceeding all ABET criteria</td>
</tr>
<tr>
<td></td>
<td></td>
<td>None</td>
</tr>
</tbody>
</table>

International Professional Advisory Panel Report Highlights

The International Professional Advisory Panel provides an assessment of the program from a different perspective. They cited the intrinsic and unique character of any ocean engineering program as being comprised of:

- The necessity for sufficient technical breadth,
- Relatively small student intake, and
- Relatively small faculty;

and concluded that “the Department has made a compelling case for a viable program that meets the needs of the industry”. The panel report has a format similar to this self-study report and re-cites numerous current practices of the Department to show concurrence. Table 2-4 summarizes the pertinent points.
Table 2-4. Summary of International Professional Advisory Panel Report

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Comments</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>Advising procedure is commendable</td>
<td>Admit students based on market needs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provide intern or co-op opportunities</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Encourage early involvement in professional societies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Require publication of thesis work at conferences or journals</td>
</tr>
<tr>
<td>Educational Objectives</td>
<td>Educational Objectives are comprehensive and commendable</td>
<td>Minor wording changes to clarify the educational objectives</td>
</tr>
<tr>
<td></td>
<td>Should continue to emphasize teamwork, communication skills, and professional issues.</td>
<td>Publish survey results and solicit feedback</td>
</tr>
<tr>
<td>Program Outcomes</td>
<td>None</td>
<td>Minor wording changes to clarify the program outcomes</td>
</tr>
<tr>
<td>Academic Program</td>
<td>Represent an excellent mix consistent with the program outcomes</td>
<td>Incorporate non-technical practice issues in more courses</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hire local professional engineers to teach practical design courses</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Expand the core courses to cover basic naval architecture topics</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Offer new courses on stochastic processes and aquaculture</td>
</tr>
<tr>
<td>Faculty</td>
<td>The collective expertise as a whole is commendably diverse</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Properly augmented by the cooperating and affiliated faculty</td>
<td></td>
</tr>
<tr>
<td>Facilities</td>
<td>Facilities are adequate for the program outcomes</td>
<td>Need experimental capabilities in structural engineering</td>
</tr>
</tbody>
</table>

Alumni Survey

The Department sent out surveys to all the 1990–2007 graduates and received 19 responses with 11 MS and 8 PhD respondents. This response rate is not high, but is reasonable for this type of survey. Alumni were asked to rate 22 curricular elements with a scale from 1 to 5 on the importance they perceive and the preparation they received from the program (5 representing highest importance and preparation). The 22 curricular elements are grouped according to the Educational Objectives and the results are summarized in Table 2-5. The
difference between the two ratings provides a quantitative measure of the program effectiveness in achieving the Educational Objectives. The alumni consider the development of communication and interpersonal skills to be the most important Educational Objective, followed by a general understanding of the program disciplines. The remaining Educational Objectives get about the same “moderately important” rating. The program receives high ratings on the items viewed as important by the alumni and achieves its Educational Objectives on the technical aspects, but falls short of meeting the expectation of the alumni on the non-technical issues.

Table 2-5. Alumni Survey of the Educational Objectives

<table>
<thead>
<tr>
<th>Educational Objectives</th>
<th>Importance</th>
<th>Preparation</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Applying knowledge of mathematics and science to the solution of practical engineering problems</td>
<td>3.7</td>
<td>3.9</td>
<td>0.2</td>
</tr>
<tr>
<td>2. General understanding of and ability to work in the ocean and resources engineering disciplines</td>
<td>4.0</td>
<td>4.0</td>
<td>0.0</td>
</tr>
<tr>
<td>3. Proficient in one or more of the ocean and resources engineering disciplines</td>
<td>3.7</td>
<td>3.7</td>
<td>0.0</td>
</tr>
<tr>
<td>4. Aware of professional, managerial, legal, ethical, and other non-technical issues</td>
<td>3.6</td>
<td>3.1</td>
<td>-0.5</td>
</tr>
<tr>
<td>5. Ability to communicate and work effectively with peers, clients, and the general public</td>
<td>4.3</td>
<td>3.8</td>
<td>-0.5</td>
</tr>
<tr>
<td>6. Adaptation to the changing needs and technology of the ocean and resources industry</td>
<td>3.5</td>
<td>3.3</td>
<td>-0.2</td>
</tr>
</tbody>
</table>

Employer Survey

The Department sent out 38 surveys to the employers of the 1990-2007 graduates and received 13 responses. The employers were asked to rate 20 curricular elements with a scale from 1 to 5 on the importance they perceive and the preparation our graduates received from the program (5 representing highest importance and preparation). The 20 curricular elements are grouped according to the Educational Objectives and the results are summarized in Table 2-6. The employers rate the general understanding of the program discipline as the most important Educational Objective, followed by communication and interpersonal skills. Educational Objectives 4 and 6, as rated by employers, are least important. The program receives relatively high ratings on the Educational Objectives viewed as important by the employers. The results indicate that the expectation of the employers on the Educational Objectives is different from that of the alumni and is slightly higher than what the program achieved.
Table 2-6. Employer Survey Results of the Educational Objectives

<table>
<thead>
<tr>
<th>Educational Objectives</th>
<th>Importance</th>
<th>Preparation</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Applying knowledge of mathematics and science to the solution of practical engineering problems</td>
<td>3.8</td>
<td>3.5</td>
<td>-0.3</td>
</tr>
<tr>
<td>2. General understanding of and ability to work in the ocean and resources engineering disciplines</td>
<td>4.3</td>
<td>3.8</td>
<td>-0.5</td>
</tr>
<tr>
<td>3. Proficient in one or more of the ocean and resources engineering disciplines</td>
<td>4.0</td>
<td>3.5</td>
<td>-0.5</td>
</tr>
<tr>
<td>4. Aware of professional, ethical, managerial, and other non-technical issues</td>
<td>3.3</td>
<td>3.0</td>
<td>-0.3</td>
</tr>
<tr>
<td>5. Ability to communicate and work effectively with peers, clients, and the general public</td>
<td>4.1</td>
<td>3.6</td>
<td>-0.5</td>
</tr>
<tr>
<td>6. Adaptation to the changing needs and technology of the ocean and resources industry</td>
<td>3.2</td>
<td>3.2</td>
<td>0.0</td>
</tr>
</tbody>
</table>
CRITERION 3. PROGRAM OUTCOMES

A. Process for Establishing and Revising Program Outcomes

The Ocean and Resources Engineering Program Outcomes are formulated on the Educational Objectives (Table 3-1) described in the previous section under Criterion 2, as well as detailed incorporation of the standard ABET outcome requirements of ABET a through k as shown in Table 3-2. Table 3-1 maps the Program Outcomes to the Educational Objectives and shows how the Ocean and Resources Engineering program achieves the Educational Objectives established by our constituencies and advisory panels. In particular, Program Outcomes 2 through 7 contribute to the technical Educational Objectives 1 through 3. Program Outcome 1 stresses the importance of a broad educational background for the understanding of non-technical issues in engineering, while Program Outcomes 8 through 12 complement the non-technical Educational Objectives 4 through 6. The Program Outcomes have been endorsed by our advisory panels, as well as the ORE faculty through lengthy discussion.

Table 3-1. Relationships between Program Outcomes and Educational Objectives

<table>
<thead>
<tr>
<th>Program Outcomes</th>
<th>Educational Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1. Broad education</td>
<td>**</td>
</tr>
<tr>
<td>2. Basic science, math, &amp; engineering</td>
<td>***</td>
</tr>
<tr>
<td>3. Ocean engineering core</td>
<td>*</td>
</tr>
<tr>
<td>4. Ocean engineering specialization</td>
<td>*</td>
</tr>
<tr>
<td>5. Use of latest tools in ocean eng</td>
<td>*</td>
</tr>
<tr>
<td>6. Problem formulation &amp; solution</td>
<td>*</td>
</tr>
<tr>
<td>7. Design &amp; optimization in ocean eng</td>
<td>*</td>
</tr>
<tr>
<td>8. Independent &amp; team work</td>
<td>*</td>
</tr>
<tr>
<td>9. Professional issues</td>
<td>***</td>
</tr>
<tr>
<td>10. Communication skills</td>
<td>***</td>
</tr>
<tr>
<td>11. Research &amp; contemporary issues</td>
<td>***</td>
</tr>
<tr>
<td>12. Need for life-long learning</td>
<td>***</td>
</tr>
</tbody>
</table>

*slightly, **moderately, ***highly relevant

B. Program Outcomes

The graduate program in Ocean and Resources Engineering channels the students’ previous education and work experience to ocean-related engineering careers. Students upon graduating from the program will have:

1. A broad education necessary to understand the impact of engineering solutions in a global and societal context;

2. An ability to apply knowledge of mathematics, science, and basic engineering topics that include statics, dynamics, fluid mechanics, solid mechanics, and probability and statistics;
3. Proficiency in the core program that comprises hydrostatics, oceanography, water waves, fluid-structure interaction, underwater acoustics, laboratory and at-sea experience;
4. Working knowledge of at least one of the three option areas that include coastal, offshore, and ocean resources engineering;
5. An ability to use the techniques, skills, and latest engineering tools necessary for ocean and resources engineering practice;
6. An ability to identify, formulate, and solve ocean and resources engineering problems;
7. An ability to design and optimize engineering systems to meet the needs of the marine community;
8. An ability to work independently and function on multi-disciplinary teams;
9. An appreciation of professional and ethical responsibilities;
10. An ability to communicate effectively to technical and non-technical audiences;
11. An awareness of the latest research and contemporary issues in and beyond the marine community, and;
12. Recognition of the need for, and an ability to engage in life-long learning and continuing professional development.

At the graduate level, the program depends on the students’ prior education and remedial undergraduate courses outside the department to fulfill Program Outcomes 1 and 2. The coursework, capstone design, and independent research together deliver Program Outcomes 2 through 10, while attendance of seminars and participation in student and professional activities addresses Program Outcomes 11 and 12.

Students satisfying the pre-program requirements should possess most of the attributes listed in the outcome requirements a through k of the standard ABET engineering education criteria. The department adopted all of the a through k requirements with additional emphasis on the unique characteristics of an ocean engineering program. These include references to the specific subjects required of an ocean engineering program. Although at-sea experience is not part of the ABET requirements, it is an important Program Outcome as viewed by the Local Professional Advisory Panel.

C. Relationship of Program Outcomes to Program Educational Objectives

Table 3-2 shows the relationship between the ORE Program Outcomes and the ABET outcome requirements a through k. The analysis indicates that each of the ABET requirements is related to at least two of the Program Outcomes.
Table 3-2. Relationship between Program Outcomes and ABET Engineering criteria

<table>
<thead>
<tr>
<th>Program Outcomes</th>
<th>ABET Engineering Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
</tr>
<tr>
<td>1. Broad education</td>
<td></td>
</tr>
<tr>
<td>2. Basic science, math, engineering</td>
<td></td>
</tr>
<tr>
<td>3. Ocean engineering core</td>
<td>✓</td>
</tr>
<tr>
<td>4. Ocean engineering specialization</td>
<td></td>
</tr>
<tr>
<td>5. Use of latest tools in ocean eng</td>
<td>✓</td>
</tr>
<tr>
<td>6. Problem formulation &amp; solution</td>
<td>✓</td>
</tr>
<tr>
<td>7. Design &amp; optimization</td>
<td>✓</td>
</tr>
<tr>
<td>8. Independent &amp; team work</td>
<td></td>
</tr>
<tr>
<td>9. Professional issues</td>
<td>✓</td>
</tr>
<tr>
<td>10. Communication skills</td>
<td></td>
</tr>
<tr>
<td>11. Research &amp; contemporary issues</td>
<td></td>
</tr>
<tr>
<td>12. Need for life-long learning</td>
<td></td>
</tr>
</tbody>
</table>

D. Relationship of Courses in the Curriculum to the Program Outcomes

Each of the courses taught in the core program and three optional areas fulfills one or more of the outcome requirements. Together a complete package is achieved with all of the Program Outcomes well-fulfilled. Full course syllabi are provided in the Appendix. The outcome fulfilled by each course is listed on that course syllabus.

Table 3-3 shows the course outcome matrix developed by the faculty. The table shows the emphasis of each course in terms of the Program Outcomes. The core and option-area coursework was intended to deliver Program Outcomes 2 through 10. The ORE program relies partly on students’ previous general education to achieve Program Outcome 1 and their participation in the professional activities and ORE seminars to achieve Program Outcomes 11 and 12.
Table 3-3. Course Outcome Matrix

<table>
<thead>
<tr>
<th>Program Outcome</th>
<th>Program Coursework</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td>1 co</td>
<td>1</td>
</tr>
<tr>
<td>2 co</td>
<td>3</td>
</tr>
<tr>
<td>3 co</td>
<td>el</td>
</tr>
<tr>
<td>4 co</td>
<td>6</td>
</tr>
<tr>
<td>5 oe</td>
<td>6</td>
</tr>
<tr>
<td>6 oe</td>
<td>6</td>
</tr>
<tr>
<td>7 oe</td>
<td>6</td>
</tr>
<tr>
<td>8 oe</td>
<td>6</td>
</tr>
<tr>
<td>9 oe</td>
<td>6</td>
</tr>
<tr>
<td>10 oe</td>
<td>6</td>
</tr>
<tr>
<td>11 oe</td>
<td>6</td>
</tr>
<tr>
<td>12 oe</td>
<td>6</td>
</tr>
</tbody>
</table>

`co` – core, `oe` – offshore eng, `ce` – coastal eng, `or` – ocean resources, `el` – electives

Four graduates were asked to rate 22 curricular elements on a scale from 1 to 5 based on the importance they perceive and the preparation they received from the program. The 22 curricular elements are grouped according to the Program Outcomes and the results corrected to a 0-4 scale are summarized in Table 3-4. The graduates rated all Program Outcomes as having above-average importance and indicated above-average preparation in 10 out of the 12 outcomes. The difference between the “importance” and “preparation” ratings indicates that the program fell slightly below their expectation. Similar results were found with the alumni survey.

Table 3-4. Exit Survey Results on the Program Outcomes in 2002/03 Academic Year

<table>
<thead>
<tr>
<th>Program Outcome</th>
<th>Importance</th>
<th>Preparation</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. General education</td>
<td>2.7</td>
<td>1.7</td>
<td>-1.0</td>
</tr>
<tr>
<td>2. Basic science, math, &amp; engineering</td>
<td>2.5</td>
<td>2.8</td>
<td>0.3</td>
</tr>
<tr>
<td>3. Ocean engineering core</td>
<td>3.0</td>
<td>2.3</td>
<td>-0.7</td>
</tr>
<tr>
<td>4. Ocean engineering specialization</td>
<td>3.5</td>
<td>2.8</td>
<td>-0.7</td>
</tr>
<tr>
<td>5. Use of latest tools</td>
<td>3.4</td>
<td>2.6</td>
<td>-0.8</td>
</tr>
<tr>
<td>6. Problem formulation &amp; solution</td>
<td>3.0</td>
<td>3.0</td>
<td>0.0</td>
</tr>
<tr>
<td>7. Design &amp; optimization</td>
<td>3.5</td>
<td>2.8</td>
<td>-0.7</td>
</tr>
<tr>
<td>8. Independent &amp; team work</td>
<td>2.6</td>
<td>2.4</td>
<td>-0.2</td>
</tr>
</tbody>
</table>
Effective Fall 2003, students are required to fill out a Course Outcome Questionnaire for all Ocean and Resources Engineering courses at the end of each semester. The questionnaire asks the students to rate the level of achievement of the Program Outcomes in each course with a scale of 0 to 4. Table 3-5 summarizes the average ratings of each Program Outcome for the courses. The results, in general, confirm the course outcome matrix in Table 3-3. Contrary to the earlier interpretation, the program coursework does have significant contributions toward Program Outcomes 1, 11, and 12.

<table>
<thead>
<tr>
<th>Program Outcome</th>
<th>Importance</th>
<th>Preparation</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. Professional issues</td>
<td>3.5</td>
<td>3.0</td>
<td>-0.5</td>
</tr>
<tr>
<td>10. Communication skills</td>
<td>3.4</td>
<td>2.6</td>
<td>-0.6</td>
</tr>
<tr>
<td>11. Research &amp; contemporary issues</td>
<td>2.5</td>
<td>1.5</td>
<td>-1.0</td>
</tr>
<tr>
<td>12. Life-long learning</td>
<td>2.1</td>
<td>2.4</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Table 3-5. Summary of Course Outcome Survey 2003-4

<table>
<thead>
<tr>
<th>Program Outcome</th>
<th>Program Coursework</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.6 2.2 3.3 3.0 3.0 2.8 4.0 3.0 - 3.1 3.3 2.1 3.3 3.3 3.1 -</td>
</tr>
<tr>
<td>2</td>
<td>3.2 2.5 3.5 3.6 3.5 3.7 4.0 4.0 - 2.1 3.4 3.0 2.2 1.3 3.5 -</td>
</tr>
<tr>
<td>3</td>
<td>2.9 2.9 3.3 3.7 3.5 3.6 4.0 4.0 - 3.4 3.4 3.0 2.5 3.0 3.4 -</td>
</tr>
<tr>
<td>4</td>
<td>2.8 2.8 3.2 3.5 4.0 3.6 4.0 4.0 - 3.5 3.7 3.4 3.5 3.7 3.6 -</td>
</tr>
<tr>
<td>5</td>
<td>2.3 2.8 2.9 3.2 4.0 3.1 4.0 4.0 - 2.3 3.4 2.7 2.2 1.7 3.6 -</td>
</tr>
<tr>
<td>6</td>
<td>2.7 2.5 3.4 3.5 4.0 3.1 4.0 4.0 - 2.4 3.3 1.7 2.8 2.7 3.4 -</td>
</tr>
<tr>
<td>7</td>
<td>2.4 1.8 2.0 3.4 3.0 1.4 4.0 4.0 - 1.8 3.6 1.1 2.0 1.7 3.4 -</td>
</tr>
<tr>
<td>8</td>
<td>2.8 2.8 3.1 2.9 3.0 1.9 3.0 3.0 - 2.5 2.9 2.3 2.0 1.7 3.3 -</td>
</tr>
<tr>
<td>9</td>
<td>2.7 1.9 2.0 2.5 0.5 1.1 4.0 2.0 - 3.5 2.4 1.1 3.0 3.0 3.4 -</td>
</tr>
<tr>
<td>10</td>
<td>2.5 2.2 2.9 2.1 2.5 1.2 4.0 2.0 - 2.8 2.7 2.6 1.7 4.0 3.0 -</td>
</tr>
<tr>
<td>11</td>
<td>2.1 1.8 3.3 2.7 4.0 1.9 4.0 2.0 - 3.6 2.8 2.7 3.8 4.0 3.4 -</td>
</tr>
<tr>
<td>12</td>
<td>2.5 1.9 3.2 2.7 3.5 2.4 4.0 2.0 - 3.9 3.3 2.1 3.7 4.0 3.6 -</td>
</tr>
<tr>
<td>Sum</td>
<td>31.5 28.3 36.1 36.8 38.5 29.8 47.0 38.0 - 34.8 38.3 28.0 32.7 34.0 40.6 -</td>
</tr>
</tbody>
</table>

The survey results in Table 3-5 are different from those of a course evaluation. Low ratings in some Program Outcomes do not reflect negatively on a course, but instead indicate a larger portion of the course is dedicated to the other Program Outcomes. As a result, it is necessary to measure the relative contributions to the Program Outcomes from each course. Table 3-6 summarizes the survey results, which have been normalized by the rating sum in the bottom row and multiplied by the number of credits for each course. One can interpret a numeric value in Table 3-6 as the portion of a credit in a course that contributes to a Program Outcome. The sum of each column is thus equal to the credit hours of the course. This
approach of data presentation is preferable as it captures the trend of the ratings instead of the ratings themselves, which are more subjective. The normalized results can more accurately measure the impact of focused courses that only cover a few of the Program Outcomes. The standard deviation indicates the focus of each course in terms of the Program Outcomes. For example, ORE 783 Capstone Design Project has the lowest standard deviation, as the course is designed to integrate the program materials in a real-world setting and addresses all Program Outcomes and their inter-relationships. The survey results show the levels of achievement of the Program Outcomes course by course and provide a reference for course update.

Table 3-6. Normalized Ratings of Course Outcome Survey 2003-4

<table>
<thead>
<tr>
<th>Program Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>11</td>
</tr>
<tr>
<td>12</td>
</tr>
<tr>
<td>Sum</td>
</tr>
<tr>
<td>Std Dev</td>
</tr>
</tbody>
</table>

Summation of the contributions from the core and option-area courses provides the level of achievement of the Program Outcomes by sub-disciplines. Summation across each row gives the total credit hours that contribute to the corresponding Program Outcome. Table 3-7 provides a summary of the credit hour totals, as well as the normalized totals, which are determined by dividing the entries by the column sums and multiplied by 12. The normalized totals that have an average value of one, are more convenient for comparison. In fact, most of the values are close to one, indicating adequate levels of achievement of the Program Outcomes. An initial standard was selected to define underrepresented Program Outcomes as those with normalized totals less than 0.9. The faculty will make the standard more stringent as the program moves through the continuous improvement cycle. Based on this standard, Program Outcomes 7 (Design and optimization), 8 (Professional and non-technical issues), and 10 (Communication skills) were not adequately covered by the coursework offered by the program in the 2003/04 academic year. These are, in general, consistent with alumni, employer, and exit survey results.
Table 3-7. Achievement of Program Outcomes

Normalized totals less than 0.9 are highlighted

<table>
<thead>
<tr>
<th>Program Outcomes</th>
<th>Total Credit Hours</th>
<th>Normalized Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CE</td>
<td>OE</td>
</tr>
<tr>
<td>1. General education</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>2. Basic science, math &amp; eng</td>
<td>2.4</td>
<td>2.4</td>
</tr>
<tr>
<td>3. Ocean engineering core</td>
<td>2.4</td>
<td>2.3</td>
</tr>
<tr>
<td>4. Ocean engineering specialization</td>
<td>2.4</td>
<td>2.3</td>
</tr>
<tr>
<td>5. Use of latest tools</td>
<td>2.2</td>
<td>2.2</td>
</tr>
<tr>
<td>6. Problem formulation and solution</td>
<td>2.1</td>
<td>2.2</td>
</tr>
<tr>
<td>7. Design and Optimization</td>
<td>1.7</td>
<td>1.8</td>
</tr>
<tr>
<td>8. Independent and team work</td>
<td>2.0</td>
<td>1.9</td>
</tr>
<tr>
<td>9. Professional and non-tech issues</td>
<td>1.5</td>
<td>1.6</td>
</tr>
<tr>
<td>10. Communication skills</td>
<td>1.7</td>
<td>1.6</td>
</tr>
<tr>
<td>11. Research and contemporary issues</td>
<td>1.8</td>
<td>1.7</td>
</tr>
<tr>
<td>12. Need for life long learning</td>
<td>1.9</td>
<td>1.9</td>
</tr>
<tr>
<td>Sum</td>
<td>24.0</td>
<td>24.0</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>0.29</td>
<td>0.28</td>
</tr>
</tbody>
</table>

The faculty met to discuss the assessment results in Summer 2004 and identified the following improvements to the curriculum.

- Introduce design elements to ORE 664 and ORE 678, which are engineering science classes, to strengthen Program Outcome 7 in the Coastal and Ocean Resources Engineering option areas.
- Increase emphasis on professional and non-technical issues in the core courses ORE 411, 607, and 609 to strengthen Program Outcome 9.
- Invite practicing professional engineers to discuss professional and non-technical issues at the department seminar series ORE 792 to strengthen Program Outcome 9.
- Require students to give progress reports of their research at the department seminar series ORE 792 to strengthen Program Outcome 10.
- Revised the course outcome matrix as shown in Table 3-8 with a 0-4 scale to reflect secondary and new emphasis of courses.

The MS thesis and independent project require the preparation of a comprehensive report and an oral defense and play a significant role in Program Outcome 10 that is not reflected in the results in Table 3-7. These curricular elements along with the coursework are assessed by the Exit Survey.
Table 3-8. Course Outcome Matrix in 2003/4 Academic Year

Highlighted entries represent new emphasis in the program

<table>
<thead>
<tr>
<th>Program Outcome</th>
<th>Program Coursework</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td>co</td>
<td>1 1 1 0 0 0 0 0 0</td>
</tr>
<tr>
<td>co</td>
<td>1 2 3 7 8 9 6 0 1</td>
</tr>
<tr>
<td>co</td>
<td>2 0 0 1 0 0 1 1 1</td>
</tr>
<tr>
<td>co</td>
<td>3 4 4 6 0 0 7 0 8</td>
</tr>
<tr>
<td>co</td>
<td>4 4 4 4 3 4 6 4 4</td>
</tr>
<tr>
<td>co</td>
<td>5 4 4 4 3 3 4 4 4</td>
</tr>
<tr>
<td>co</td>
<td>6 4 4 4 3 3 4 4 4</td>
</tr>
<tr>
<td>co</td>
<td>7 3 3 3 3 3 3 3 3</td>
</tr>
<tr>
<td>oe</td>
<td>8 2 4 4 2 2 2 2 2</td>
</tr>
<tr>
<td>oe</td>
<td>9 4 4 1 4 1 4 3 2</td>
</tr>
<tr>
<td>oe</td>
<td>10 2 3 3 2 2 2 2 2</td>
</tr>
<tr>
<td>oe</td>
<td>11 2 3 3 3 3 3 3 3</td>
</tr>
<tr>
<td>oe</td>
<td>12 2 2 2 2 2 2 3 3</td>
</tr>
<tr>
<td>co</td>
<td>4 4 4 4 4 4 4 4 4</td>
</tr>
<tr>
<td>oe</td>
<td>5 5 5 5 5 5 5 5 5</td>
</tr>
<tr>
<td>oe</td>
<td>6 6 6 6 6 6 6 6 6</td>
</tr>
<tr>
<td>oe</td>
<td>7 7 7 7 7 7 7 7 7</td>
</tr>
<tr>
<td>oe</td>
<td>8 8 8 8 8 8 8 8 8</td>
</tr>
<tr>
<td>oe</td>
<td>9 9 9 9 9 9 9 9 9</td>
</tr>
</tbody>
</table>

co – core, oe – offshore eng, ce – coastal eng, or – ocean resources, el – electives

E. Documentation

Rubrics used to measure the effectiveness and achievement of the outcomes:

1. The Master’s qualifying exam: All graduating students passed this FE equivalent exam demonstrating mastery of engineering math and science fundamentals.

2. Committee verification of undergraduate ABET requirements and assignment of remedial action: All graduating students have an ABET certified undergraduate degree or have taken the equivalent make up courses.

3. Capstone Design Class: Professional engineering community evaluation of student design work. Evaluations have been uniformly positive.

4. Master’s thesis defense and evaluation of thesis for outcome elements: Faculty verification of students fully addressing the learning outcomes, verifies a large number of outcomes.

5. Circulation and review of thesis proposals by all faculty: Wide faculty verification of students fully addressing the learning outcomes.

6. Student employment, placing particular emphasis on repeat hires by employers: Very high, over 90% placement of graduates in engineering positions on graduation.

7. Local and international advisory panels: Strong support by a range of local, national and international advisory bodies.
8. Employer surveys: Employers generally very pleased with the knowledge and attitude of graduates.

9. Student exit interviews: Students generally felt that they have achieved the program outcomes and will reach the program objectives.

10. ABET course outcome evaluations done at the end of each course by both students and faculty: Courses are generally on track for achieving the outcomes selected for that course.

11. Alumni Surveys: Alumni are pleased generally with their progress in the engineering profession and credit this in part to the ORE program.

12. Student advising meeting to determine fulfillment of undergraduate requirements and progress: Annual and periodic progress meeting with students show students to understand, support and generally be on track with the program.

Summaries of some of this material are provided in the next section (3F). Full documentation will be available at the site visit to assess the achievement of the program in each of the outcomes.

The following materials will be available for review during the ABET visit:

1. Ocean and Resources Engineering Newsletters
2. Student portfolios including records of exit interviews
3. MS General Examination questions
4. Course notes, assignments, and examinations
5. Capstone design reports
6. List of seminars
7. Thesis/research reports
8. Student publications and awards
9. Alumni, employer, and exit survey results
10. Alumni employment data
11. Original panel reports
12. Worksheets used in compiling the statistics presented in this report

Other materials will be available upon request.

F. Achievement of Program Outcomes

Tables 3-9 and 3-10, respectively, list the internal and external assessments and show how they determine whether the MS graduates of Ocean and Resources Engineering have the attributes listed in the Program Outcomes. The internal assessment is conducted and gauged by the faculty to maintain the standard of the curricular elements. The external assessment results, which are obtained from the constituencies including the students at the time of graduation, indicate the effectiveness of the curricular elements in achieving the stated
Program Outcomes. Not all of the Program Outcomes are quantitatively measurable and not all students achieve the same level of competency in each Program Outcome.

The preliminary conference is the first step of the internal assessment process. It determines any pre-program deficiencies in general education, mathematics, science, and basic engineering and identifies remedial courses if necessary. The MS General Examination further assures that students can apply basic mathematics, science, and mechanics in the solution of engineering problems. The examination results of the core and option-area courses provide indications of the learning outcome, while the course evaluations by the students provide feedback on the course contents and curricula. The capstone design project tests the students’ ability to integrate the course materials, optimize engineering design, work in a team, and communicate to technical and non-technical audiences. The course is team-taught with practicing professional engineers, who also provide an independent assessment. All students are required to attend 15 approved seminars and submit reports to show their understanding of the topics covered. The thesis or research project tests the students’ ability to work independently and to communicate orally and in writing. The MS final exam validates the student’s study in the program, while the exit interview and survey allow feedback from the student.

Table 3-9. Internal Assessment Process for Program Outcomes

<table>
<thead>
<tr>
<th>Assessment Process</th>
<th>Program Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Preliminary conference</td>
<td>✓</td>
</tr>
<tr>
<td>MS General Examination</td>
<td>✓</td>
</tr>
<tr>
<td>Course examinations</td>
<td></td>
</tr>
<tr>
<td>Course eval by students</td>
<td></td>
</tr>
<tr>
<td>Capstone design project</td>
<td></td>
</tr>
<tr>
<td>Seminar reports</td>
<td></td>
</tr>
<tr>
<td>Thesis/research report</td>
<td></td>
</tr>
<tr>
<td>Defense/final exam</td>
<td></td>
</tr>
</tbody>
</table>

Table 3-10. External Assessment Process for Program Outcomes

<table>
<thead>
<tr>
<th>Assessment Process</th>
<th>Program Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Competition &amp; publication</td>
<td></td>
</tr>
<tr>
<td>Placement data</td>
<td>✓</td>
</tr>
<tr>
<td>Exit interview</td>
<td>✓</td>
</tr>
<tr>
<td>Exit survey</td>
<td>✓</td>
</tr>
<tr>
<td>Alumni survey</td>
<td>✓</td>
</tr>
<tr>
<td>Employer survey</td>
<td>✓</td>
</tr>
</tbody>
</table>
Students are encouraged to submit papers to national and international competitions and for publications as an external assessment. This allows feedback from the national and international professional communities on the quality of the student’s work in the program. The percentage of students obtaining jobs in the ocean and resources engineering fields provides a strong indication of the effectiveness of the program. The exit interview conducted by the Department Chair provides a comprehensive assessment of the Program Outcomes. The exit, alumni, and employer surveys are the most objective and comprehensive external assessments. In addition, a portfolio records the progress of each student from the preliminary conference to the exit interview. The faculty members touch base with the students and keep track of their employment history for three years after graduation. This provides data to assess the Educational Objectives and close the loop of the assessment process.

The qualitative and quantitative data gathered from the assessment process is used on a continuing basis to monitor the Program Outcomes. This section summarizes the external assessment results obtained from the constituencies. Additional materials including assessments by the faculty will be provided to the ABET team during the visit. Table 3-11 summarizes the exit survey results. They rated 10 out of the 12 Program outcomes as having above average importance and indicated they received average or above average preparation in 9 of the Program Outcomes. The results are consistent with previous surveys and indicate that some of the Program Outcomes are up to one point below their expectation. The department has been encouraging students to become active members of professional societies, sponsoring membership fees. The department will continue this practice as a way to encourage their recognition of the need for life long learning through participation in professional society activities.

### Table 3-11. Exit Survey Results on the Program Outcomes

<table>
<thead>
<tr>
<th>Program Outcome</th>
<th>Importance</th>
<th>Preparation</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. General education</td>
<td>1.5</td>
<td>1.3</td>
<td>-0.2</td>
</tr>
<tr>
<td>2. Basic science, math, &amp; engineering</td>
<td>2.8</td>
<td>2.5</td>
<td>-0.3</td>
</tr>
<tr>
<td>3. Ocean engineering core</td>
<td>2.8</td>
<td>2.3</td>
<td>-0.5</td>
</tr>
<tr>
<td>4. Ocean engineering specialization</td>
<td>2.5</td>
<td>3.0</td>
<td>0.5</td>
</tr>
<tr>
<td>5. Use of latest tools</td>
<td>2.5</td>
<td>2.1</td>
<td>-0.4</td>
</tr>
<tr>
<td>6. Problem formulation &amp; solution</td>
<td>3.0</td>
<td>2.5</td>
<td>-0.5</td>
</tr>
<tr>
<td>7. Design &amp; optimization</td>
<td>2.8</td>
<td>2.3</td>
<td>-0.5</td>
</tr>
<tr>
<td>8. Independent &amp; team work</td>
<td>2.8</td>
<td>2.0</td>
<td>-0.8</td>
</tr>
<tr>
<td>9. Professional issues</td>
<td>2.5</td>
<td>2.0</td>
<td>-0.5</td>
</tr>
<tr>
<td>10. Communication skills</td>
<td>2.5</td>
<td>2.0</td>
<td>-0.5</td>
</tr>
<tr>
<td>11. Research &amp; contemporary issues</td>
<td>1.5</td>
<td>1.5</td>
<td>0.0</td>
</tr>
<tr>
<td>12. Life-long learning</td>
<td>2.5</td>
<td>1.5</td>
<td>-1.0</td>
</tr>
</tbody>
</table>
2008-2009 EBI Surveys

Educational Benchmarking, Inc. (EBI) was hired to survey alumni, graduates and employers in 2008-2009. They sent survey questionnaires to 34 ORE students who graduated between 2003 and 2009 and asked for employer input. Of the 86 questions, 26 questions pertained to the 11 ABET $a$ through $k$ criteria. Numerical answers were on a scale from 0 to 7 (poor to excellent). For comparison purposes EBI used corresponding data from one peer program. For each question, the mean and standard deviation of the responses were given. We presume that the number of students responding from the peer program is similar; for our program four students responded. Thus, we are dealing with small sample sizes statistics.

Summary statistics are presented in Table 3-12. Columns 1 and 2, and 3 and 4 give the averages and standard deviations for ORE and the peer institution (Oregon State), respectively. Columns 5 and 6 give the average of the difference and the corresponding standard deviation. Lastly, column 7 gives the weighted difference (average difference / standard deviation) between the two programs. The last line gives the average values over all the criteria.

In total, ORE has a slightly higher overall average rating ($5.5 \pm 0.8$) than the peer program ($5.0 \pm 1.3$) with a difference of ($0.5 \pm 1.5$) and a weighted difference of 0.4. The magnitudes of the weighted differences (column 7) are all less than unity. We conclude from these results that the ORE is generally slightly superior as rated by its graduates. EBI data showed similar general satisfaction by the employers surveyed.

Table 3-12. EBI survey summary results - Graduates’ responses to ABET questions

<table>
<thead>
<tr>
<th>ABET Criteria</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ave</td>
<td>std</td>
<td>ave</td>
<td>std</td>
<td>ave</td>
<td>std</td>
<td>diff</td>
</tr>
<tr>
<td>a Apply math and science</td>
<td>6.5</td>
<td>0.6</td>
<td>5.5</td>
<td>1.0</td>
<td>1.0</td>
<td>1.2</td>
<td>0.8</td>
</tr>
<tr>
<td>b Design and conduct experiments</td>
<td>5.4</td>
<td>0.7</td>
<td>5.2</td>
<td>1.0</td>
<td>0.3</td>
<td>1.2</td>
<td>0.3</td>
</tr>
<tr>
<td>c Design system components</td>
<td>4.1</td>
<td>1.4</td>
<td>4.4</td>
<td>1.2</td>
<td>-0.3</td>
<td>1.8</td>
<td>-0.1</td>
</tr>
<tr>
<td>d Multi-disciplinary teams</td>
<td>4.8</td>
<td>1.1</td>
<td>4.5</td>
<td>1.7</td>
<td>0.3</td>
<td>2.1</td>
<td>0.1</td>
</tr>
<tr>
<td>e Formulate problems</td>
<td>6.1</td>
<td>0.9</td>
<td>5.7</td>
<td>0.9</td>
<td>0.4</td>
<td>1.3</td>
<td>0.3</td>
</tr>
<tr>
<td>f Professional/ethical responsibility</td>
<td>5.3</td>
<td>0.8</td>
<td>5.0</td>
<td>1.6</td>
<td>0.3</td>
<td>1.8</td>
<td>0.1</td>
</tr>
<tr>
<td>g Communicate</td>
<td>5.8</td>
<td>0.4</td>
<td>5.0</td>
<td>1.3</td>
<td>0.8</td>
<td>1.3</td>
<td>0.6</td>
</tr>
<tr>
<td>h Global/societal context</td>
<td>4.8</td>
<td>0.4</td>
<td>4.5</td>
<td>1.3</td>
<td>0.3</td>
<td>1.4</td>
<td>0.2</td>
</tr>
<tr>
<td>i Life-long learning</td>
<td>6.0</td>
<td>0.7</td>
<td>5.2</td>
<td>1.2</td>
<td>0.8</td>
<td>1.4</td>
<td>0.6</td>
</tr>
<tr>
<td>j Contemporary issues</td>
<td>5.8</td>
<td>0.8</td>
<td>4.3</td>
<td>1.4</td>
<td>1.4</td>
<td>1.6</td>
<td>0.9</td>
</tr>
<tr>
<td>k Use engineering tools</td>
<td>6.0</td>
<td>0.7</td>
<td>5.3</td>
<td>1.3</td>
<td>0.7</td>
<td>1.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Averages</td>
<td>5.5</td>
<td>0.8</td>
<td>5.0</td>
<td>1.3</td>
<td>0.5</td>
<td>1.5</td>
<td>0.4</td>
</tr>
</tbody>
</table>
Placement (2003-2009)

The Ocean and Resources Engineering program graduated 34 MS students during the 2003-2009 academic years. Table 3-13 provides the placement data of the graduates. Over 90% of the graduates obtained employment or continued to study in engineering fields immediately after graduation. The number of graduates directly employed in ocean-related engineering fields increased from 50% to 62% over time. This indicates the positive influence of the program on the graduates and their inclination to work in ocean engineering fields.

Table 3-13. Placement and Employment Data of 2003-2009 MS Graduates

<table>
<thead>
<tr>
<th></th>
<th>At Graduation</th>
<th>Spring 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ocean-related engineering jobs</td>
<td>17</td>
<td>21</td>
</tr>
<tr>
<td>Engineering PhD program</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Other engineering jobs</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Non-engineering jobs or not known</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>34</td>
<td>34</td>
</tr>
</tbody>
</table>

Companies and government agencies that have provided engineering employment to these graduates include:

- Coastal Systems International, Florida
- GMP Inc, Honolulu
- Hawaii Undersea Research Laboratory, Waimanalo, Hawaii
- Honolulu Seawater Air Conditioning LLC, Honolulu
- Kapiolani College, Honolulu
- Makai Ocean Engineering, Inc., Hawaii
- NOAA, Honolulu, Hawaii
- Navatek, LTD, Honolulu
- Naval Facilities Engineering Service Center, California
- Ocean Engineering Consultants, Inc., Hawaii
- Oceanit Laboratory Inc., Hawaii
- OCEES Inc, Honolulu
- Pearl Harbor Naval Shipyard, US Navy, Hawaii
- Sea Engineering, Inc., Hawaii
- University of Hawaii Research Associate, Hawaii
- US Army Corps of Engineers, Hawaii
- US Army Corps of Engineers, Vicksburg
- US Navy Facilities Engineering Service, Virginia
- WJCI Inc, California
- Zodiac Aerospace, California
Government agencies currently employ 25% of the 2003-2009 graduates and for this reason government agencies are properly represented in the program’s local and international advisory panels. Of the three graduates who presently are not working in engineering fields, one is teaching math and science at a community college, one has just returned to China but has several engineering prospects lined up, and one is working in the Coral Reef program at NOAA. Many employers, including Oceanit, Makai Ocean Engineering and Sea Engineering consistently return to the department to hire new graduates and in some cases have half a dozen ORÉ graduates on staff. This is a major vote of confidence by three employers for the quality of our graduates.

Alumni Survey

The responses of the alumni on the 22 curricular questions in the survey are grouped according to the Program Outcomes and the results are summarized in Table 3-14. The results mirror those for the Educational Objectives, as both are compiled from the same source. The difference between the “importance” and “preparation” ratings provides a quantitative indication of the program effectiveness. The results show that the program generally achieves its Program Outcomes on the technical aspects, but falls somewhat short of meeting the expectation of the alumni on the non-technical issues.

In addition, the alumni were asked to answer additional questions as listed in Table 3-15. The results show the alumni, in general, work in ocean-related engineering fields. They give a high rating on their satisfaction with the Ocean and Resources Engineering program. However, only 24% of the alumni are registered Professional Engineers. Although the alumni state in Table 3-14 that the program did not sufficiently motivate them for life-long learning, Table 3-15 shows that, in fact, 39% of them participated in continuing education and 72% attended professional or technical conferences.

Table 3-14. Alumni Survey Results on the Program Outcomes

<table>
<thead>
<tr>
<th>Program Outcome</th>
<th>Importance</th>
<th>Preparation</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Broad education</td>
<td>3.3</td>
<td>3.1</td>
<td>-0.2</td>
</tr>
<tr>
<td>2. Basic science, math, &amp; engineering</td>
<td>3.7</td>
<td>3.9</td>
<td>0.2</td>
</tr>
<tr>
<td>3. Ocean engineering core</td>
<td>3.8</td>
<td>3.5</td>
<td>-0.3</td>
</tr>
<tr>
<td>4. Ocean engineering specialization</td>
<td>3.9</td>
<td>4.2</td>
<td>0.3</td>
</tr>
<tr>
<td>5. Use of latest tools</td>
<td>4.1</td>
<td>3.9</td>
<td>-0.2</td>
</tr>
<tr>
<td>6. Problem formulation &amp; solution</td>
<td>3.7</td>
<td>3.7</td>
<td>0.0</td>
</tr>
<tr>
<td>7. Design &amp; optimization</td>
<td>3.8</td>
<td>3.6</td>
<td>-0.2</td>
</tr>
<tr>
<td>8. Independent &amp; team work</td>
<td>4.4</td>
<td>3.6</td>
<td>-0.8</td>
</tr>
<tr>
<td>9. Professional issues</td>
<td>4.2</td>
<td>3.4</td>
<td>-0.8</td>
</tr>
<tr>
<td>10. Communication skills</td>
<td>4.5</td>
<td>3.9</td>
<td>-0.6</td>
</tr>
<tr>
<td>11. Research &amp; contemporary issues</td>
<td>3.6</td>
<td>3.0</td>
<td>-0.6</td>
</tr>
<tr>
<td>12. Need for Life-long learning</td>
<td>4.3</td>
<td>3.5</td>
<td>-0.8</td>
</tr>
</tbody>
</table>
### Table 3-15. Additional Questions in Alumni Survey related to the Program Outcomes

<table>
<thead>
<tr>
<th>Questions</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are you working in a field related to ocean and resources engineering?</td>
<td>3.5</td>
</tr>
<tr>
<td>(1 = not related at all, 5 = very related)</td>
<td></td>
</tr>
<tr>
<td>Overall, how satisfied are you with the education you received at UH?</td>
<td>4.1</td>
</tr>
<tr>
<td>(1 = not satisfied at all, 5 = very satisfied)</td>
<td></td>
</tr>
<tr>
<td>Are you a licensed professional engineer?</td>
<td>24%</td>
</tr>
<tr>
<td>Have you passed the Fundamentals of Engineering Exam?</td>
<td>67%</td>
</tr>
<tr>
<td>Did your employer hire other ORE graduates within the last 10 years?</td>
<td>41%</td>
</tr>
<tr>
<td>Have you participated in continuing education activities?</td>
<td>39%</td>
</tr>
<tr>
<td>Have you attended professional or technical conferences?</td>
<td>72%</td>
</tr>
</tbody>
</table>

### Employer Survey

The responses of the employers on the 20 curricular questions in the survey are grouped according to the Program Outcomes and the results are summarized in Table 3-16. Likewise, the results mirror those for the Educational Objectives, as both are compiled from the same source. The data indicates that while the expectation of the employers is higher than what the program achieved in the past, the program is producing satisfactory graduates. One area was noted in particular for improvement. The employers rated highly the importance of communication skills and non-technical engineering issues but indicated a lower-than-expected preparation the graduates received from the program. This echoes the results of the alumni survey and prompted the department to increase emphasis on communication skills and non-technical engineering issues in the program.

### Table 3-16. Employer Survey Results on the Program Outcomes

<table>
<thead>
<tr>
<th>Program Outcome</th>
<th>Importance</th>
<th>Preparation</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Broad education</td>
<td>3.0</td>
<td>3.0</td>
<td>0.0</td>
</tr>
<tr>
<td>2. Basic science, math, &amp; engineering</td>
<td>3.8</td>
<td>3.5</td>
<td>-0.3</td>
</tr>
<tr>
<td>3. Ocean engineering core</td>
<td>3.8</td>
<td>3.4</td>
<td>-0.4</td>
</tr>
<tr>
<td>4. Ocean engineering specialization</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5. Use of latest tools</td>
<td>4.1</td>
<td>3.9</td>
<td>-0.2</td>
</tr>
<tr>
<td>6. Problem formulation &amp; solution</td>
<td>4.3</td>
<td>3.9</td>
<td>-0.4</td>
</tr>
<tr>
<td>7. Design &amp; optimization</td>
<td>4.1</td>
<td>3.8</td>
<td>-0.3</td>
</tr>
<tr>
<td>8. Independent &amp; team work</td>
<td>4.0</td>
<td>3.4</td>
<td>-0.6</td>
</tr>
<tr>
<td>9. Professional issues</td>
<td>4.1</td>
<td>3.4</td>
<td>-0.7</td>
</tr>
<tr>
<td>10. Communication skills</td>
<td>4.3</td>
<td>3.6</td>
<td>-0.7</td>
</tr>
<tr>
<td>11. Research &amp; contemporary issues</td>
<td>2.9</td>
<td>2.8</td>
<td>-0.1</td>
</tr>
<tr>
<td>12. Need for life-long learning</td>
<td>3.9</td>
<td>3.5</td>
<td>-0.4</td>
</tr>
</tbody>
</table>
Exit Survey (2003-2009)

The Department conducted exit interviews with the graduates in the 2003 – 2009 academic year. The survey questionnaire is in the Appendix and Table 3-17 summarizes the responses in regard to the Program Outcomes. The results are consistent with the alumni survey. There is general satisfaction that Outcomes are achieved.

### Table 3-17. Exit Survey Results on the Program Outcomes

<table>
<thead>
<tr>
<th>Program Outcome</th>
<th>Importance</th>
<th>Preparation</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Broad education</td>
<td>3.7</td>
<td>2.7</td>
<td>-1.0</td>
</tr>
<tr>
<td>2. Basic science, math, &amp; engineering</td>
<td>3.5</td>
<td>3.8</td>
<td>0.3</td>
</tr>
<tr>
<td>3. Ocean engineering core</td>
<td>4.0</td>
<td>3.3</td>
<td>-0.7</td>
</tr>
<tr>
<td>4. Ocean engineering specialization</td>
<td>4.5</td>
<td>3.8</td>
<td>-0.7</td>
</tr>
<tr>
<td>5. Use of latest tools</td>
<td>4.4</td>
<td>3.6</td>
<td>-0.8</td>
</tr>
<tr>
<td>6. Problem formulation &amp; solution</td>
<td>4.0</td>
<td>4.0</td>
<td>0.0</td>
</tr>
<tr>
<td>7. Design &amp; optimization</td>
<td>4.5</td>
<td>3.8</td>
<td>-0.7</td>
</tr>
<tr>
<td>8. Independent &amp; team work</td>
<td>3.6</td>
<td>3.4</td>
<td>-0.2</td>
</tr>
<tr>
<td>9. Professional issues</td>
<td>4.5</td>
<td>4.0</td>
<td>-0.5</td>
</tr>
<tr>
<td>10. Communication skills</td>
<td>4.4</td>
<td>3.6</td>
<td>-0.6</td>
</tr>
<tr>
<td>11. Research &amp; contemporary issues</td>
<td>3.5</td>
<td>2.5</td>
<td>-1.0</td>
</tr>
<tr>
<td>12. Life-long learning</td>
<td>3.1</td>
<td>3.4</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Comprehensive Course Outcome Survey Matrix Results - 2003-2009

The Ocean and Resources Engineering program offers an advanced-level program that includes a core program, an option area, electives, and a thesis or independent project. Appendix A provides a complete listing of the courses offered in the program. At the end of each semester, the faculty members assess the learning outcomes of their courses on a scale of 0 to 4. The information is consolidated at the end of each academic year. Table 3-18 shows the average assessment results for the last two academic years (2007/08 – 2008/09) in the form of a course outcome matrix. The results show adequate coverage of all 12 Program Outcomes by the coursework. While the core and option-area coursework delivers Program Outcomes 2 to 10, the seminar, MS research, and participation in professional activities also facilitate achievement of Program Outcomes 1, 11, and 12.
Table 3-18. Course Outcome Matrix

<table>
<thead>
<tr>
<th>Program Outcome</th>
<th>Program Coursework</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co</td>
<td>Co</td>
</tr>
<tr>
<td>Outcomes</td>
<td>Co</td>
</tr>
<tr>
<td>1</td>
<td>Co</td>
</tr>
<tr>
<td>2</td>
<td>Co</td>
</tr>
<tr>
<td>3</td>
<td>Co</td>
</tr>
<tr>
<td>4</td>
<td>Co</td>
</tr>
<tr>
<td>5</td>
<td>Co</td>
</tr>
<tr>
<td>6</td>
<td>Co</td>
</tr>
<tr>
<td>7</td>
<td>Co</td>
</tr>
<tr>
<td>8</td>
<td>Co</td>
</tr>
<tr>
<td>9</td>
<td>Co</td>
</tr>
<tr>
<td>10</td>
<td>Co</td>
</tr>
<tr>
<td>11</td>
<td>Co</td>
</tr>
<tr>
<td>12</td>
<td>Co</td>
</tr>
</tbody>
</table>

Co – core, oe – offshore eng, ce – coastal eng, or – ocean resources; el - electives

Course Outcome Survey

Effective Fall 2003, students are required to fill out a Course Outcome Questionnaire for all Ocean and Resources Engineering courses at the end of each semester. The questionnaire asks the students to rate the level of achievement of the Program Outcomes in each course with a scale of 0 to 4 (see Appendix I).

Table 3-19 summarizes the average ratings of each Program Outcome for the courses offered in the 2003/04 – 2008/09 academic years. The survey results are different from those of a course evaluation. Low ratings in some Program Outcomes do not reflect negatively on a course, but instead indicate a larger portion of the course is dedicated to the other Program Outcomes. As a result, it is necessary to measure the relative contributions to the Program Outcomes from each course. Table 3-20 summarizes the survey results, which have been normalized by the rating sum in the bottom row and multiplied by the number of credits for each course. One can interpret a numeric value in Table 3-20 as the portion of a credit in a course that contributes to a specific Program Outcome. The sum of each column is thus equal to the credit hours of the course. This approach of data presentation is preferable as it captures the trend of the ratings instead of the ratings themselves, which are more subjective. The normalized results can more accurately measure the impact of focused courses that only cover a few of the Program Outcomes. The standard deviation indicates the focus of each course in terms of the Program Outcomes. For example, ORE 783 Capstone Design Project has the lowest standard deviation, as the course is designed to integrate the program materials in a real-world setting and addresses all Program Outcomes and their inter-relationships.
Table 3-19. Summary of 2003/04-2008/09 Course Outcome Surveys

<table>
<thead>
<tr>
<th>Program Outcome</th>
<th>Program Coursework</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 7 7 7 7</td>
</tr>
<tr>
<td>1</td>
<td>1 0 0 0 0 0 1 3 4 4 6 6 6 7 7 6 8 9 9 2 0 1 2 1 4 7 8 8 3 2</td>
</tr>
<tr>
<td>2</td>
<td>3.2 2.3 2.9 3.2 3.5 3.0 3.4 2.6 3.6 3.1 3.4 2.6 3.6 3.6 3.0 3.4 3.6</td>
</tr>
<tr>
<td>3</td>
<td>3.4 2.5 2.8 3.2 3.6 3.5 3.5 3.1 3.7 2.3 3.5 3.3 2.6 2.1 4.0 3.4 2.2</td>
</tr>
<tr>
<td>4</td>
<td>3.3 2.8 3.0 3.3 3.4 3.5 3.4 3.0 3.6 3.2 3.6 3.1 2.8 3.0 3.7 3.5 1.5</td>
</tr>
<tr>
<td>5</td>
<td>3.3 3.0 2.8 3.4 3.4 3.4 3.6 3.7 3.5 3.7 3.4 3.6 3.7 3.2 3.6 3.5</td>
</tr>
<tr>
<td>6</td>
<td>3.0 2.7 2.6 3.2 3.5 3.2 3.5 2.8 3.7 2.7 3.5 2.6 3.0 2.6 3.7 3.5 2.0</td>
</tr>
<tr>
<td>7</td>
<td>2.4 2.0 1.8 2.8 2.8 2.1 3.2 3.1 2.7 1.9 3.5 1.5 2.6 2.0 3.8 3.4 1.3</td>
</tr>
<tr>
<td>8</td>
<td>2.5 3.0 2.5 3.0 3.0 2.3 2.7 2.5 2.8 2.8 3.1 2.6 2.6 2.5 3.5 3.4 0.7</td>
</tr>
<tr>
<td>9</td>
<td>2.7 2.0 1.9 2.6 2.4 2.0 2.7 1.9 2.9 3.3 3.0 1.7 3.3 3.4 2.5 3.3 2.8</td>
</tr>
<tr>
<td>10</td>
<td>2.3 2.6 3.0 2.3 2.5 2.2 3.1 1.7 3.0 2.4 2.7 2.9 2.3 3.9 3.3 3.4 2.7</td>
</tr>
<tr>
<td>11</td>
<td>2.6 2.2 3.0 2.7 3.0 2.5 3.0 1.6 3.4 3.3 3.3 3.0 3.1 3.9 3.9 3.2 3.3 9</td>
</tr>
<tr>
<td>12</td>
<td>2.9 2.2 3.0 3.1 2.8 3.1 2.1 4.6 3.4 3.1 2.7 3.7 3.9 2.8 3.5 3.6 0.3</td>
</tr>
<tr>
<td>Sum</td>
<td>34.1 30.4 31.7 35.9 37.7 33.2 38.3 30.5 39.9 34.4 39.5 32.1 36.5 37.0 30.0 41.1 29.3</td>
</tr>
</tbody>
</table>

Table 3-20. Normalized Ratings of 2003/04-2008/09 Course Outcome Surveys

<table>
<thead>
<tr>
<th>Program Outcome</th>
<th>Program Coursework</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 7 7 7 7</td>
</tr>
<tr>
<td>1</td>
<td>1 0 0 0 0 0 1 3 4 4 6 6 6 7 7 6 8 9 9 2 0 1 2 1 4 7 8 8 3 2</td>
</tr>
<tr>
<td>2</td>
<td>0.28 0.23 0.28 0.27 0.27 0.26 0.26 0.27 0.27 0.25 0.25 0.25 0.29 0.29 0.23 0.24 0.12</td>
</tr>
<tr>
<td>3</td>
<td>0.30 0.25 0.26 0.27 0.28 0.31 0.27 0.31 0.28 0.20 0.27 0.30 0.21 0.17 0.30 0.25 0.07</td>
</tr>
<tr>
<td>4</td>
<td>0.29 0.28 0.28 0.27 0.32 0.26 0.29 0.27 0.28 0.27 0.29 0.23 0.24 0.28 0.25 0.05</td>
</tr>
<tr>
<td>5</td>
<td>0.29 0.29 0.26 0.28 0.27 0.31 0.28 0.28 0.28 0.31 0.28 0.32 0.30 0.30 0.24 0.26 0.12</td>
</tr>
<tr>
<td>6</td>
<td>0.23 0.29 0.23 0.26 0.28 0.24 0.26 0.33 0.26 0.23 0.28 0.25 0.21 0.19 0.25 0.26 0.05</td>
</tr>
<tr>
<td>7</td>
<td>0.27 0.27 0.25 0.28 0.27 0.28 0.27 0.28 0.23 0.27 0.24 0.24 0.21 0.28 0.26 0.07</td>
</tr>
<tr>
<td>8</td>
<td>0.21 0.20 0.17 0.24 0.22 0.19 0.25 0.30 0.20 0.16 0.27 0.14 0.22 0.16 0.29 0.25 0.04</td>
</tr>
<tr>
<td>9</td>
<td>0.22 0.30 0.24 0.25 0.24 0.21 0.21 0.25 0.21 0.24 0.23 0.24 0.21 0.21 0.26 0.25 0.02</td>
</tr>
<tr>
<td>10</td>
<td>0.24 0.20 0.18 0.21 0.19 0.18 0.21 0.18 0.22 0.28 0.23 0.15 0.27 0.28 0.19 0.24 0.10</td>
</tr>
<tr>
<td>11</td>
<td>0.20 0.26 0.28 0.19 0.20 0.20 0.24 0.16 0.23 0.21 0.21 0.27 0.19 0.32 0.25 0.24 0.09</td>
</tr>
<tr>
<td>12</td>
<td>0.23 0.22 0.28 0.22 0.24 0.23 0.23 0.16 0.26 0.29 0.23 0.29 0.32 0.32 0.24 0.24 0.13</td>
</tr>
<tr>
<td>Sum</td>
<td>3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 1.00</td>
</tr>
<tr>
<td>Std Dev</td>
<td>0.03 0.04 0.04 0.03 0.03 0.05 0.02 0.06 0.03 0.04 0.02 0.05 0.04 0.06 0.03 0.01 0.04</td>
</tr>
</tbody>
</table>

Summing the contributions from the core and option-area courses provides the level of achievement of the Program Outcomes by sub-disciplines. Table 3-21 provides summary of the credit hour totals as well as the normalized totals, which are determined by dividing the entries by the column sums and multiplied by 12. The normalized totals, which have an average value of one, are more convenient for comparison. Most of the values are close to one, indicating adequate levels of achievement of the Program Outcomes.
Faculty members use the learning outcome survey and other assessment results to guide the improvement of the coursework and curriculum. A standard defines under-represented Program Outcomes as those with normalized totals less than 0.9. Based on this standard, 10 of the 12 Program Outcomes are well covered by the program. Program Outcomes 7 (Design and optimization) and 9 (Professional and non-tech issues) may not have been adequately covered by the coursework offered by the program. The faculty continue to identify and implement changes to the curriculum to improve results in these areas, for example, by:

- Introducing design elements to ORE 664 and ORE 678, which are engineering science classes, to strengthen Program Outcome 7 in the Coastal and Ocean Resources Engineering option areas.
- Increasing emphasis on professional and non-technical issues in the core courses ORE 411, 607, and 609 to strengthen Program Outcome 9.
- Inviting practicing professional engineers to discuss professional and non-technical issues at the department seminar series ORE 792 to strengthen Program Outcome 9.

Such curriculum changes have successfully improved ratings for other Program Outcomes. For example, Table 3-22 shows results from academic year 2003/04 in which Program Outcomes 8 (Independent and team work) and 10 (Communication skills) were also inadequately covered. These were improved in subsequent years by making specific changes to the curriculum. In general, the survey results are consistent with other assessment results and identify the areas that the faculty members are focusing on for improvement.

**Table 3-21. Learning Outcomes in 2003/04-2008/09 Academic Years**

<table>
<thead>
<tr>
<th>Program Outcomes</th>
<th>Total Credit Hours</th>
<th>Normalized Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CE</td>
<td>OE</td>
</tr>
<tr>
<td>1. General education</td>
<td>2.2</td>
<td>2.2</td>
</tr>
<tr>
<td>2. Basic science, math &amp; eng</td>
<td>2.3</td>
<td>2.3</td>
</tr>
<tr>
<td>3. Ocean engineering core</td>
<td>2.3</td>
<td>2.3</td>
</tr>
<tr>
<td>4. Ocean engineering specialization</td>
<td>2.4</td>
<td>2.4</td>
</tr>
<tr>
<td>5. Use of latest tools</td>
<td>2.1</td>
<td>2.1</td>
</tr>
<tr>
<td>6. Problem formulation and solution</td>
<td>2.2</td>
<td>2.2</td>
</tr>
<tr>
<td>7. Design and optimization</td>
<td>1.7</td>
<td>1.9</td>
</tr>
<tr>
<td>8. Independent and team work</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>9. Professional and non-tech issues</td>
<td>1.7</td>
<td>1.7</td>
</tr>
<tr>
<td>10. Communication skills</td>
<td>1.9</td>
<td>1.9</td>
</tr>
<tr>
<td>11. Research and contemporary issues</td>
<td>2.1</td>
<td>1.9</td>
</tr>
<tr>
<td>12. Need for life-long learning</td>
<td>2.1</td>
<td>2.1</td>
</tr>
<tr>
<td>Sum</td>
<td>25.0</td>
<td>25.0</td>
</tr>
<tr>
<td>Program Outcomes</td>
<td>Total Credit Hours</td>
<td>Normalized Total</td>
</tr>
<tr>
<td>------------------</td>
<td>--------------------</td>
<td>------------------</td>
</tr>
<tr>
<td></td>
<td>CE</td>
<td>OE</td>
</tr>
<tr>
<td>1. General education</td>
<td>2.1</td>
<td>2.1</td>
</tr>
<tr>
<td>2. Basic science, math &amp; eng</td>
<td>2.5</td>
<td>2.4</td>
</tr>
<tr>
<td>3. Ocean engineering core</td>
<td>2.4</td>
<td>2.4</td>
</tr>
<tr>
<td>4. Ocean engineering specialization</td>
<td>2.5</td>
<td>2.4</td>
</tr>
<tr>
<td>5. Use of latest tools</td>
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</tr>
<tr>
<td>6. Problem formulation and solution</td>
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<tr>
<td>7. Design and optimization</td>
<td>1.7</td>
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<tr>
<td>8. Independent and team work</td>
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<tr>
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<tr>
<td>10. Communication skills</td>
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<tr>
<td>11. Research and contemporary issues</td>
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<tr>
<td>12. Need for life-long learning</td>
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</table>
CRITERION 4. CONTINUOUS IMPROVEMENT

A. Information Used for Program Improvement

The ORE program is committed to a process of continuous improvement. This commitment has been instilled in the faculty, students, office staff and student helpers. We have indicated its importance to the higher levels of the administration of SOEST with some success. The information used for program improvement comes from a variety of sources. These include our student, faculty and alumni and employer surveys. They particularly include our student, local and international panels of advisors and businesses. They also include professional societies and student exit interviews. We solicit information from all of these sources and then filter it as to what is needed and what we can accomplish in the current time frame. Obviously, many of the recommendations involve expenditures well beyond what can be made available in the current budget climate. Nonetheless, even in the current tight fiscal times much real progress has been made. In no case is this more evident than the support of the school in growing the faculty from four to eight.

B. Actions to Improve the Program

As part of the accreditation procedure ORE undertakes a process of continuous improvement. This includes improvements in faculty, courses, equipment and administrative processes. These improvements are rigorously documented.

Courses

The international advisory panel and several students identified and mentioned that more instruction in the area of acoustics would be beneficial. For this reason, a new acoustics course, ORE 654, has been put together by our new acoustics faculty member, Dr. Bruce Howe. The syllabus for ORE 654 is in the Appendix. This course was given final approval in May, 2009 after one year of effort to develop it. A major course modification has been undertaken in ORE 766 (Numerical Methods) taught by new professor, Dr. Eva Marie Nosal. The modification was introduced in December, 2008 and taught to very positive reviews in Spring 2009. This responds to the demand by the advisory panels for greater basic mathematical training and access to computer programs packages. The student panel requested more ocean energy courses. In August 2008, the OTEC course, ORE 677, was redesign as a Marine Renewable Energy course. The new syllabus is in the Appendix. It was taught very successfully in Fall 2008.

Facilities

One of the other notations of the advisory panels was the lack of access to experimental facilities. After much deliberation, the department chooses to handle this in several ways. First the Kilo Nalu Nearshore Observatory was established using NSF money. This is a state of the art instrumented facility for the direct measurement of sediment-ocean interactions. It is used in our ORE 601 lab class which is mandatory for all master’s students. This is a major international facility housed within the department. Related to this is the enhanced fluid dynamics laboratory run by Professor Pawlak. It is fully described in the facilities section. Associated with this is the purchase of a 25-ft coastal boat for dive and near-shore operations.
Further support has been given to the department through the University of Hawaii Marine Center (UMC), which is providing a 57-foot vessel. UMC also just did $2 million upgrade of the 225-foot research vessel, *Kaʻimikai-o-Kanaloa*, which is used by the Department for deeper water work.

In 2008, the department hired two new faculty, Dr. Bruce Howe a specialist in ocean observatories, acoustics and undersea glider technology and Dr. Eva Marie Nosal, a specialist in acoustics and applied mathematics. In addition, an eighth faculty member, Dr. Gerard Nihous, a specialist in ocean energy, will begin service in August 2009. The hiring of three new faculty members over the course of just over one year is unprecedented and represents a major commitment by the school to the continuous upgrading of the Department of Ocean and Resources Engineering (ORE).

ORE has also implemented several new processes and process committees to verify departmental procedures. All transcripts of incoming students are checked to verify that ABET undergraduate requirements have been met. This is done jointly by the Chairman and Professor Fai Cheung, PE, a senior faculty member. Students not meeting the requirements are assigned courses in the UH College of Engineering to make up deficiencies. Other Departmental committees deal with the admission and ongoing monitoring of students to insure their progress.

ORE has also forged a very close working relationship with the Hawaii Undersea Research Lab (HURL). HURL senior staff provide 2 of 8 ORE faculty positions. HURL provides 2-3 student research assistantships with student activities working on submersible equipment design.

One should note the continuing evolution of the Ocean and Resources Engineering program in response to the changing needs of the constituencies over the years. The major program revisions implemented in the last ten years were in the early 2000’s and commended by our advisory panels. This section outlines the follow-on program revisions.

**Early Program Revisions and Initiatives**

Some alumni commented that the program emphasized mathematics and theories instead of practical issues needed for engineering practice. Both the Local and International Professional Advisory Panels commented on the small size of the faculty and recommended the Department leverage resources from within the University of Hawaii and from the local professional community. The faculty members were aware of the situation and have continually implemented change where possible.

**Actions taken:**

1. Developed a new elective course, ORE 608 Probability and Statistics for Ocean Engineers, which covers stochastic processes and time series analyses such as multiple regression, correlation, auto-covariance, and cross-spectra. This elective course provides additional coverage for students interested in at-sea experiments and ocean data analysis and supports the core course ORE 601 Ocean Engineering Laboratory. This course is offered every year by cooperating faculty Prof. Mark Merrifield of Oceanography. It has been very well reviewed by students over the half dozen years it has now been taught.
2. Modified the format of the capstone design to introduce real-world engineering experience into the curriculum. Since this modification, it has since been team-taught by departmental and affiliate faculty members including:

- David Rezachek, PhD, PE, Alternate Energy Specialist, Energy Division, Department of Business, Economic Development and Tourism, State of Hawaii
- Joe Van Ryzin, PhD, PE, Vice President of Makai Ocean Engineering, Inc.
- Dayananda Vithanage, PhD, PE, Vice President of Oceanit Laboratories, Inc.
- Warren Bucher, PhD, PE, Vice President of Oceanit Laboratories, Inc.

The project varies every semester to reflect the latest engineering experience of the affiliate faculty members. The students work on a real-life engineering projects in a consulting-firm setting that emphasizes teamwork, communication skills, and consultant-client relations. The course covers all typical steps of an engineering project from the proposal to the final report and incorporates realistic constraints that include economic, environmental, ethical, social, and liability considerations.

3. Initiated Ocean Engineering Internships. The internship is in the form of a research assistantship. These were initially with Navatek Ship Ltd. and Honolulu Shipyard Ltd. Since the initial internship program in the early 2000’s this program has grown to provide 6 internships in 2008 and several additional companies have expressed interest for 2009-2010. The outstanding success of this program has been noted by both the student advisory and local industrial advisory panels.

4. Modified ORE 603 Oceanography for Ocean Engineers to include major underwater acoustics sections. The course is now taught by acoustics specialist Dr. Eva Marie Nosal.

Many of these changes have addressed the concerns expressed by the alumni survey and were applauded by both panels as well as the students. The total extramural funding awarded directly to the departmental faculty during 2003-2009 is over $18M not including funds awarded to HURL. The large number of recent projects address the concerns raised by the advisory panels by providing numerous research assistantships to the students and opportunities to interact with the public and private sectors. The enrollment has increased since the previous review.

Later Program Revisions

The panel reports and survey results both indicate that the program should place more emphasis on the students’ communication skills and their awareness of non-technical engineering issues. The Department responded with the following measures:

1. Require students to present their proposals and report the progress of their research at the Department seminar series ORE 792 or special session. This provides additional experience to the students on public speaking and the use of presentation media.

2. Allow students to take graduate-level business administration courses as electives and use the credits to satisfy the MS degree requirements in Ocean and Resources Engineering. In
addition to covering important business issues related to engineering, these courses also provide training on teamwork and public speaking.

3. Added “ALPHA” designation to ORE 783 Capstone Design Project, with ORE 783B, 783C, and 783D for the coastal, offshore, and ocean resources options respectively. This allows the students, who prefer a more professionally oriented program, to take the capstone design course twice and receive six credits for their MS degree. It also tailors the capstone design experience to the Departmental specialty areas.

4. Designated a design-oriented course in each option area that would stress non-technical aspects of engineering design. These courses involve major design projects taught by faculty members holding a PE designation. ORE 661 Coastal and Harbor Engineering is the design-oriented course in the coastal engineering option, ORE 630 Structural Analysis in Ocean Engineering in the offshore engineering option, and ORE 677 Marine Renewable Energy in the ocean resources engineering option.

5. Offered new elective courses ORE 654 Acoustics and ORE 766 mathematical techniques. These new courses are in line with areas of increasing demand in the ocean engineering community.

Although not publicized in the department literature, the core courses ORE 411, 601, 607, and 609 also address non-technical engineering issues. Both the panel and survey findings encourage the faculty to increase this component in their classes. In addition, the Department initiated a number of small program revisions over the last several years mainly to specific classes. These include:

1. Reviewed the Educational Objectives and Program Outcomes of peer programs and modified the wording slightly according to the International Professional Advisory Panel.

2. Added hydrostatics, oceanography, and underwater acoustics into the core program. Both oceanography and underwater acoustics are covered by the core course ORE 603.

3. Augmented the core course ORE 411 Buoyancy and Stability to include dimensional analysis. The course as it has been taught already included basic naval architecture topics as suggested by the International Professional Advisory Panel.

4. Implemented and maintained the new advising forms and procedures for all current students after 2003. This assures that all students satisfy the ABET requirements.

5. Augmented the core course ORE 601 Ocean Engineering Laboratory to leverage the resources made available through the Hawaii Undersea Research Laboratory. The course now covers laboratory modeling, ocean measurements, at-sea experience, and submersible and ROV operations.

6. Started the Ocean and Resources Engineering Enrichment Fund Campaign. The donated funds pay for student (first-time) professional society dues and support student professional activities. The students formed and continue the student chapters of the Marine Technology Society and the Society of Naval Architects and Marine Engineers.
7. Began publication of the Ocean and Resources Engineering newsletter *Hana O Ke Kai* “Work of the Ocean” in 2003-2004. The newsletter informs the alumni of the latest developments in the Department. It also serves as an open forum for the faculty and alumni to exchange ideas and develops a sense of community and belonging.

8. Increased the use of engineering tools such as Ship Hydrostatics and Stability Program (SHCP) and Coastal Engineering Manual (CEM) in classes.

9. Effective 2003-2004, ORE 609 Hydrodynamics of Fluid-body Interaction was reclassified as a core course as suggested by the Local Professional Advisory Panel.

The revisions to the curricular elements address most of the comments made by the three panels. Although the impact of all of these revisions will not be fully measured until the next comprehensive survey, the exit interviews and surveys provide a continuous stream of data on the Program Outcomes that may allude to the Educational Objectives.

**Suggestions by Panels Considered but Declined by the Department**

The Department carefully considered some of the comments from the panels but decided not to implement the changes suggested for the following reasons:

1. The faculty believes it’s too stringent to mandate publication of MS thesis work at professional conferences or in journals as a degree requirement. Students, however, are encouraged to submit their thesis work for publication or participation in paper competitions organized by professional societies.

2. The Department declined the suggestion to admit students on the basis of market need. The Department admits students solely based on their scholastic records. Most students, however, require financial support to enroll. The awards of research assistantships match the students’ interest with funded research projects. This encourages enrollment in areas that have the most funded research projects, and in a way, responds to market needs as suggested by the International Professional Advisory Panel.

3. The Department’s off-campus laboratory the JKK Look Laboratory of Ocean Engineering was closed due to budget cuts and re-development of the downtown waterfront area. The deteriorating facilities at the laboratory and its remote location are no longer an issue as was raised by one panel member. SOEST has provided an on-campus laboratory to the Department and made arrangement for the faculty to conduct fieldwork through the much superior facilities at the University Marine Center at Snug Harbor, through the Kilo Nalu Nearshore Observatory and through the Hawaii Undersea Research Laboratory.

4. The Department does not agree with the Local Professional Advisory Panel’s suggestion to replace ORE 677 and 678 in the ocean resources option by 609 and 641. Instead ORE 677, originally OTEC Systems, has been redesignated Marine Renewable Energy Systems and ORE 678 Marine Mineral Resources Engineering is unique to this option area and strongly supported by some of the offshore mining companies with interest in
our program. The faculty incorporated ORE 609 into the core program in 2003 so that all students, including those in ocean resources, will take this course.

These last four items are minor and in no way affect the effectiveness of the program in delivering the Educational Objectives. The Department has instituted a viable system of continuous improvement, which over time should lead to an even stronger department.
CRITERION 5. CURRICULUM

A. Program Curriculum

Ocean and Resources Engineering is an advanced-level program and relies on the students’ undergraduate education or remedial courses offered at the University of Hawaii to fulfill the Professional Component, which includes:

1. a general education component including economics, management, and humanities;
2. one year of college level mathematics and basic science; and
3. one and one-half years of engineering science and design.

For administrative purpose, these are classified as pre-program requirements that all students entering the advanced-level program must satisfy. Students with ABET undergraduate engineering degrees satisfy these requirements and can directly proceed to the Ocean and Resources Engineering program. In some cases, students with an electrical or chemical engineering degree are required to make up some undergraduate courses required by the program such as fluid mechanics and solid mechanics.

Students with undergraduate engineering degrees from foreign countries are carefully evaluated to assure that they satisfy the requirements in the Professional Component. The Department Chair reviews the transcript along with the student at the preliminary conference. All the courses taken by the student are categorized according to the three areas of the Professional Component and additional requirements of the Program Criteria for an ocean engineering program. Based on past experience, all foreign students have more rigorous training in mathematics, science, and engineering topics than their US counterparts. All of these students have extensive experience in the use of design code and most have a capstone design or practical training (similar to co-op in the US) every year complementing their coursework. Most of the foreign students, however, have a general education component that focuses on economics, management, and engineering practice. The Department views that being from a different culture itself is a general educational experience that serves the Educational Objectives well, and therefore, does not require these students to take additional courses in humanities.

The Department also accepts students with undergraduate degrees in mathematics and science. These students usually have a broad-based general education component and satisfy the requirement for mathematics and science. Some students knew they would enter graduate engineering programs and had taken basic courses in engineering mechanics before being admitted into the program. Similar to the foreign students, the Department Chair reviews the transcript with each student at the preliminary conference and categorizes all the courses according to the three areas of the Professional Component and additional requirements of the Program Criteria. These students are required to make up deficiencies in undergraduate engineering courses. The Department Chair serves as the advisor to these students to assure that all pre-program requirements are satisfied consistently. Students can structure their pre-programs based on their intended specialization in the Ocean and Resources Engineering program.
**Credit Hours**

The program provides a 31 credit hour degree. The University requires that Master’s degrees be 30 credit hours. The ORE department has a required seminar, which takes one credit hour longer.

**Design Experience**

The design experience in the program is in two parts. The first is the capstone design class ORE 783. The second is the masters thesis (plan A) or project (plan B). All students do both of these things. Students normally take the capstone design class near the end of their program. It requires the knowledge and skill acquired in earlier course work. The design class is the design of a real-world engineering problem. It is supervised by professional engineers who are part of our adjunct faculty. The design is written up and presented in a seminar environment. The students are made used to the fact that they will have to publicly defend their designs. The design work is done as a team. The design involves costs, permits, environmental impacts and all of the other constraints of a real world project. In fact, many of the projects are planned or ongoing projects taken from the files of consulting engineering companies. There is a separate design course for each of the three option areas. Each of these design projects tries to incorporate as much as possible of the course work related to the option area.

The second and final design project is the thesis. While ORE 783 is purely a design course, the design elements of a thesis will vary considerably from one thesis to the next. Recent Master’s theses involving almost solely design elements include a 2009 thesis designing a hybrid AUV- underwater glider and a second thesis designing a remote bottom camera system for quantitative fisheries management. All theses have some design element. Theses must go through a proposal defense stage, an individual research stage and then a final examination and public defense. These various stages of scrutiny clearly force serious thinking and clear examination of the design process. The thesis committee insists that realistic constraints based on faculty experience are incorporated at each stage.

**Curricular Components**

The pre-program provides a broad-based education that prepares students for the engineering profession as well as the advanced-level program. The advanced-level Ocean and Resources Engineering program offers:

1. one year of engineering science and design that include a laboratory course, a capstone design project, and attendance of 15 seminars; and requires

2. a thesis or an independent research project.

The one-year of coursework consists of the core, option-area, and elective courses. The core and option-area courses cover 50% of engineering science and 50% of design. Students can slightly shift the emphasis on engineering science or design by choosing appropriate elective courses. The appendix lists the Ocean and Resources Engineering course syllabi. The following is a list all of the department’s courses.
Ocean and Resources Engineering (ORE)

School of Ocean and Earth Science and Technology

ORE 202 Ocean Technology—Man in the Sea (3) Survey of human activities in the ocean, from the most traditional to the most innovative technical and engineering accomplishments.

ORE 330 Mineral and Energy Resources (3) Hard material and petroleum origins, exploration and exploitation. Renewable and non-renewable resources distribution. Political and scientific constraints. A-F only. Pre: 202 or OCN 201, or consent. (Cross-listed as OCN 330)

ORE 411 Buoyancy and Stability (3) Ship nomenclature and geometry, hydrostatic principles of surface ships and underwater vehicles in free-floating, partially waterborne, and damaged conditions. Subdivision of ships. Launching. Pre: CEE 270 or equivalent.

ORE 500 Master’s Plan B/C Studies (1) Enrollment for degree completion. Pre: master’s Plan B candidate and consent.

ORE 601 Ocean and Resources Engineering Laboratory (3) Design, construction, and evaluation of an engineering system. Laboratory and field experience and data analysis supplemented with appropriate theory. Pre: 603 and 607, or consent.

ORE 603 Oceanography for Ocean Engineers (3) Physical, chemical, biological, and geological ocean environments for ocean engineers. Introduction to ocean dynamical processes and general circulation. Ocean measurement techniques, theory of underwater acoustics. Sonar, swath bathymetry, and tomography applications. Pre: consent.

ORE 607 Water Wave Mechanics (3) Governing equations in free surface flow, deterministic and probabilistic wave theories, wave transformation, wave-induced coastal currents, tides, ocean engineering operational sea state, and design wave criteria. Pre: consent.

ORE 608 Probability and Statistics for Ocean Engineers (3) Probability and statistical analysis including distributions, multiple regression and correlation, autocovariance, cross-spectra, and practical applications in ocean engineering. Pre: 607 or consent.


ORE 612 Dynamics of Ocean Structures (3) Response of floating platforms and vessels to wave action, spectral analysis in sea keeping. Frequency and time domain analyses of rigid body motions in six degrees of freedom. Pre: 411 or consent. Co-requisite: 609 or consent.

ORE 630 Structural Analysis in Ocean Engineering (3) Structural and finite element analyses and design of ocean structures to withstand hydrostatic and hydrodynamic loading of the sea. Considerations include material type, safety factor, stress concentration, and fatigue. Pre: consent. Co-requisite: 411.


ORE 642 Marine Environmental Remediation (3) Thermodynamics, chemistry and measurements of marine pollutants, biodegradation and biotransformation of pollutants, symbiosis and mass transfer in biofilms, bioremediation of oil spills, hazardous sediments, algae control, regulations on marine environment. Pre: consent.

ORE 654 Acoustics (3) Using sound to observe the ocean. Fundamentals of propagation, sources and receivers, radiated sound and scattering, bubbles, waveguides, scattering at rough surfaces, and bioacoustics. Topics include: marine mammals, fish and plankton imaging, navigation and communication, sound of seismics, ships, wind and rain, using sound to study ocean dynamics, flow imaging and measurement, mapping the seafloor and the combined forward/inverse problem.

ORE 661 Coastal and Harbor Engineering (3) Planning and design of seawalls, groins, jetties, breakwaters, and layout of ports. Design requirements for harbor entrances and channels. Littoral drift and sedimentation problems. Navigation and mooring requirements. Pre: 607 or consent.

ORE 664 Nearshore Processes and Sediment Transport (3) Sediment transport by waves and currents in coastal areas and its effect on morphological processes. Effect of man-made structures on littoral drift and shoreline. Pre: 607 or consent.

ORE 677 Marine Renewable Energy (3) Ocean thermal energy conversion (OTEC) systems: applicability, thermodynamics, design challenges; wave energy converters: floating devices, oscillating water column, optimal hydrodynamic performance; current, tidal and offshore wind power. Prerequisite: ORE 607; basic knowledge of thermodynamics desirable.

ORE 678 Marine Mineral Resources Engineering (3) Activities in marine minerals development are examined in a multidisciplinary systems approach involving engineering, Earth and environmental sciences and economics. Pre: consent.

ORE 695 Plan B Master’s Project (3) Independent study for students working on a Plan B master’s project. A grade of Satisfactory (S) is assigned when the project is satisfactorily completed. Pre: master’s candidacy in ORE.

ORE 699 Directed Reading or Research (V) Pre: graduate standing and consent.

ORE 700 Thesis Research (V) Pre: candidacy for MS in ocean and resources engineering.


ORE 766 Numerical Methods in Ocean Engineering (3) Formulation and application of numerical methods for simulating and solving ocean engineering problems. Mathematical and computational fundamentals; accuracy and stability; numerical interpolation, differentiation, and integration; boundary element, finite difference, and finite element methods. Pre: consent.

ORE 783 (Alpha) Capstone Design Project (3) Major design experience based on knowledge and skills acquired in earlier coursework and incorporating realistic constraints that include economic, environmental, ethical, social, and liability considerations. Emphasis is placed on teamwork and consultant-client relationship. (B) coastal engineering; (C) offshore engineering; (D) ocean resources engineering. Pre: 411, 601, 603, and 607; or consent.

ORE 791 Special Topics in Ocean and Resources Engineering (V) Content will reflect special interests of visiting and permanent faculty. Pre: consent.

ORE 792 Seminar in Ocean and Resources Engineering (1) Attendance at 15 approved seminars is required along with submission of notes.

ORE 800 Dissertation Research (V) Pre: candidacy for PhD in ocean and resources engineering.
The core courses, along with the basic-level engineering courses in the pre-program, cover the subject matters essential to an ocean engineering program as outlined in the ABET Engineering Criteria. The option-area and elective courses allow students to specialize in an Ocean and Resources Engineering discipline. The capstone design project integrates the pre-program and the advanced-level program coursework into a major design experience and introduces students to non-technical issues commonly encountered by practicing engineers. The project simulates work in a consulting firm and prepares students for professional practice. The students gain research techniques and learn the latest technologies in an Ocean and Resources Engineering discipline through the thesis or independent project.

Cooperative Program and Internships

The Department does not provide a formal cooperative studies program. There are a number of internships at various local engineering companies. At the moment there are six of these. They provide tuition for the student and 20 hours a week of employment. The local engineering community is seeking more of these internships, so this is likely a program that will expand.

Additional Materials

The following materials will be available for review during the ABET visit.

a. Ocean and Resources Engineering Newsletters
b. Student portfolios including records of exit interviews
c. MS General Examination questions
d. Course notes, assignments, and examinations
e. Capstone design reports
f. List of seminars
g. Thesis/research reports
h. Student publications and awards
i. Alumni, employer, and exit survey results
j. Alumni employment data
k. Original panel reports
l. Worksheets used in compiling the statistics presented in this report

Other materials will be available upon request.

B. Prerequisite Flow Chart

A flow chart is attached showing the prerequisite structure of the program’s courses and the required 30 (usually 31) credit progression toward a master’s in Ocean and Resources Engineering followed by the students.
**I. Apply**

- i) accepted by the UH Grad Division (transcript verification)
- ii) accepted by ORE Dept (GPA, GRE, recommendation letters)
- iii) optional awarded financial aid:
  - TA (1-2 awarded by Department)
  - Tuition Waiver (2 awarded by Chairman)
  - R.A. (awarded on individual grants)
  - internships (6 awarded by department committee)

**II. Admission**

- ABET certified undergraduate program
  - No
  - Remedial Courses
  - Yes

**III. Courses**

- Core Courses: 411, 601, 603, 607, 609
  - option area courses

  - Coastal: 661, 664, 783B
  - Offshore: 612, 630, 783C
  - Resources: 677, 678, 783D

  - Seminar 792 and Thesis 700 or 695

**IV. Graduate**
C. Course Syllabi

In Appendix A, a syllabus is included for each course showing how it satisfies the mathematics, science, and discipline-specific requirements required by Criterion 5 and the other applicable Program Criteria. The syllabi contain the following information:

- Department, course number, and title of course
- Designation as a Required or Elective course
- Course (catalog) description
- Prerequisites
- Textbook(s) and/or other required material
- ABET Course learning outcomes
- Topics covered
- Class/laboratory schedule, i.e., number of sessions each week and duration of each session
- Contribution of course to meeting the requirements of Criterion 5
- Relationship of course to Program Outcomes
- Person(s) who prepared this description and date of preparation
### Table 5-1. Curriculum

**OCEAN AND RESOURCES ENGINEERING**

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<td>ORE 330 Mineral &amp; Energy Resources (3)</td>
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<td>ORE 500 Master’s Plan B/C Studies (1)</td>
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<td>ORE 601 Ocean &amp; Resources Engineering Lab (3)</td>
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<td>2008-2009 Fall</td>
<td>ORE 603 Oceanography for Ocean Engineers (3)</td>
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<td>2008-2009 Fall</td>
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<td>ORE 608 Probability &amp; Statistics for Ocean Engineers (3)</td>
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<td>C) offshore engineering</td>
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<td>D) ocean resources engineering</td>
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<tr>
<th>2008-2009 Spring cancelled</th>
<th>ORE 791 Special Topics in Ocean &amp; Resources Engineering (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2008-2009 Fall/spring</th>
<th>ORE 792 Seminar in Ocean &amp; Resources Eng. (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
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</table>

<table>
<thead>
<tr>
<th>2008-2009 Fall/Spring</th>
<th>ORE 800 Dissertation Research (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>V✔</td>
</tr>
</tbody>
</table>

Most ABET requirements met from Undergraduate studies

OVERALL TOTAL FOR DEGREE 31 required credits for Masters

PERCENT OF TOTAL For Masters in ORE Normally 100%

Minimum semester credit hours undergrad 32 hrs 48 hrs

Minimum percentage 25% 37.5%

Note that instructional material and student work verifying course compliance with ABET criteria for the categories indicated above will be required during the campus visit.
<table>
<thead>
<tr>
<th>Course No.</th>
<th>Title</th>
<th>Responsible Faculty Member</th>
<th>No. of Sections Offered in Current Year</th>
<th>Avg. Section Enrollment</th>
<th>Lecture, Lab, Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORE/OCN 330</td>
<td>Mineral and Energy Resources</td>
<td>Wiltshire</td>
<td>1</td>
<td>13</td>
<td>100</td>
</tr>
<tr>
<td>ORE 411</td>
<td>Buoyancy and Stability</td>
<td>Ertekin</td>
<td>1</td>
<td>6</td>
<td>100</td>
</tr>
<tr>
<td>ORE 500</td>
<td>Master’s Plan B/C Studies</td>
<td>various</td>
<td>as needed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ORE 601*</td>
<td>Ocean &amp; Resources Engineering Lab</td>
<td>Pawlak</td>
<td>1</td>
<td>5</td>
<td>100</td>
</tr>
<tr>
<td>ORE 602</td>
<td>Oceanography for Ocean Engineers</td>
<td>Nosal/Pawlak</td>
<td>1</td>
<td>14</td>
<td>95</td>
</tr>
<tr>
<td>ORE 607*</td>
<td>Water Wave Mechanics</td>
<td>Cheung</td>
<td>1</td>
<td>5</td>
<td>100</td>
</tr>
<tr>
<td>ORE 608</td>
<td>Probability and Statistics for Ocean Eng.</td>
<td>Merrifield</td>
<td>1</td>
<td>5</td>
<td>100</td>
</tr>
<tr>
<td>ORE 609</td>
<td>Hydrodynamics of Fluid-Body Interaction</td>
<td>Ertekin</td>
<td>1</td>
<td>5</td>
<td>100</td>
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<tr>
<td>ORE 611</td>
<td>Dynamics of Ocean Structures</td>
<td>Greeson</td>
<td>1</td>
<td>5</td>
<td>100</td>
</tr>
<tr>
<td>ORE 630</td>
<td>Structural Analysis of Ocean Engineering</td>
<td>Knapp</td>
<td>2010</td>
<td>8 (Fall 2006)</td>
<td>100</td>
</tr>
<tr>
<td>ORE 641*</td>
<td>Environmental Fluid Dynamics</td>
<td>Pawlak</td>
<td>2010</td>
<td>3 (Spring 2007)</td>
<td>90</td>
</tr>
<tr>
<td>ORE 642</td>
<td>Marine Environmental Remediation</td>
<td>Krock - retired</td>
<td>4 (Spring 2005)</td>
<td>80</td>
<td>20</td>
</tr>
<tr>
<td>ORE 654</td>
<td>Applications in Ocean Acoustics</td>
<td>Howe</td>
<td>fall 09</td>
<td>80</td>
<td>20</td>
</tr>
<tr>
<td>ORE 661</td>
<td>Coastal and Harbor Engineering</td>
<td>Cheung</td>
<td>2010</td>
<td>10 (Spring 2008)</td>
<td>100</td>
</tr>
<tr>
<td>ORE 664*</td>
<td>Nearshore Processes &amp; Sediment Transport</td>
<td>Pawlak</td>
<td>2010</td>
<td>9 (Spring 2006)</td>
<td>80</td>
</tr>
<tr>
<td>ORE 677</td>
<td>Marine Renewable Energy</td>
<td>Nihous</td>
<td>1</td>
<td>9</td>
<td>100</td>
</tr>
<tr>
<td>ORE 678</td>
<td>Marine Mineral Resources Engineering</td>
<td>Wiltshire</td>
<td>1</td>
<td>5</td>
<td>50</td>
</tr>
<tr>
<td>ORE 695</td>
<td>Plan B Master’s Project</td>
<td>various</td>
<td>as needed</td>
<td></td>
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</tr>
<tr>
<td>ORE 699</td>
<td>Directed Reading/Research</td>
<td>various</td>
<td>8</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>ORE 700</td>
<td>Thesis Research</td>
<td>various</td>
<td>as needed</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>ORE 707</td>
<td>Non-linear Wave Theories</td>
<td>Ertekin</td>
<td>2010</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>ORE 766</td>
<td>Numerical Ocean Engineering</td>
<td>Nosal</td>
<td>1</td>
<td>6</td>
<td>50</td>
</tr>
<tr>
<td>ORE 783B</td>
<td>Capstone Design – coastal engineering</td>
<td>Cheung</td>
<td>1</td>
<td>4</td>
<td>80% Group Discussion</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20% Student Presentation</td>
</tr>
<tr>
<td>ORE 783C</td>
<td>Capstone Design – off-shore engineering</td>
<td>Cheung</td>
<td>1</td>
<td>3</td>
<td>80% Group Discussion</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20% Student Presentation</td>
</tr>
<tr>
<td>ORE 783D</td>
<td>Capstone Design – ocean resources engr.</td>
<td>Cheung</td>
<td>1</td>
<td>3</td>
<td>80% Group Discussion</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20% Student Presentation</td>
</tr>
<tr>
<td>ORE 792</td>
<td>Seminar in Ocean and Resources Engineer.</td>
<td>Pawlak/Nosal</td>
<td>2</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>ORE 800*</td>
<td>Dissertation Research</td>
<td>various</td>
<td>as needed</td>
<td></td>
<td>100</td>
</tr>
</tbody>
</table>

* Enter the appropriate percent for each type of class for each course (e.g., 75% lecture, 25% laboratory).

* ORE 601, 641 and 664 is taught by Dr. Eugene (Geno) Pawlak who is presently on sabbatical leave.
A. Leadership Responsibilities

The program is lead by the Departmental Chairman. Since 2007, this has been Dr. John Wiltshire. Dr. Wiltshire is a professionally trained manager currently also serving as Director of the Hawaii Undersea Research Laboratory, a National Deep Submergence Laboratory under NOAA’s National Undersea Research Program. After his PhD, Dr. Wiltshire was trained in public administration and served as the State of Hawaii’s Ocean Resources Manager. In ORE, Dr. Wiltshire is responsible for supervising the faculty, including assigning faculty teaching and committee responsibilities, as well as overseeing that University polices and regulations are complied with in an efficient manner. Dr. Wiltshire is closely assisted by Dr. Kwok Fai Cheung, P.E., who was Departmental Chairman from 2001-2007. Dr. Cheung turned the department around in the early 2000’s and is responsible for most of the innovative change that has allowed the department to meet ABET requirements and move forward.

B. Authority and Responsibility of Faculty

Courses are developed by qualified faculty members in response to an identified need or opportunity. The latest course created (2009) in the Ocean and Resources Engineering Department is ORE 654, our new acoustics course. This was created in response to a demand from our advisory panels, IEEE Oceanic Engineering Society guidelines and ABET advisors. It was given final approval by the University’s Graduate Division in May 2009.

Once created, the course is evaluated by a standing SOEST curriculum committee. The committee evaluates the course for level, excellence of the instructor, consistency and appropriateness for the program. ORE has one member on the curriculum committee. All new courses and major course changes must be evaluated by the curriculum committee. The curriculum committee then makes a recommendation to the Dean’s office, which forwards it to the Vice Chancellor for Academic Affairs and the Graduate Division. If the course is approved at all levels, it then goes in the University Course Catalog and becomes part of the ORE program.

Ongoing course evaluation is done by on-campus review teams reporting to the Vice Chancellor’s Office. They periodically review all courses for appropriateness of level and content. All courses are required to be evaluated by students each semester they are taught. Poor student evaluations or complaints would trigger a departmental review, as well as overall university review immediately. The initial departmental review would entail evaluation of the syllabus, discussion with the instructor, remarking of assignments and sitting in the class by the chairman or other members of the ad hoc evaluation team. Such a process was recently undertaken for ORE 607 as taught by Janette Frandsen in Fall 2007. The course was found to be adequately, but not optimally, taught in this semester. This course was reassigned to be subsequently taught by Professor Cheung as it is a central core course.
C. Faculty

The Ocean and Resources Engineering program has eight state-funded positions in its faculty. These are augmented by 13 cooperating faculty appointments from other units at the University of Hawaii and four affiliate faculty members from the local marine industry. Appendix B lists the current curriculum vitae of all the faculty. The departmental faculty members were hired through international searches following the rigorous selection procedure set by the University. All cooperating and affiliate faculty members, prior to their appointments to the Department, must demonstrate their communication skills by giving a presentation in the department seminar series. They must also demonstrate their enthusiasm and willingness to contribute to the Ocean and Resources Engineering program through an interview conducted by the departmental faculty.

There are eight Faculty Members in the Ocean and Resources Engineering Department. This is up from four during the last ABET review and in this challenging economic time represents a major commitment by the School to the growing importance of the Department. Of these eight faculty, six are tenured or tenure-track. All departmental faculty members are responsible for the instruction, research, and administration of the Ocean and Resources Engineering program:

- K.F. Cheung, PhD, PE, Professor of Ocean and Resources Engineering – Coastal and offshore engineering, hydrodynamics, computational methods, water wave mechanics, sediment transport
- R.C. Ertekin, PhD, Professor of Ocean and Resources Engineering – Hydrodynamics, hydroelasticity, computational methods, nonlinear water waves, offshore mechanics
- B.D. Greeson, PhD, U.S. Navy Captain (Ret.), Specialist and Chief Engineer, Hawaii Undersea Research Laboratory – Offshore engineering, hydrodynamics ROV/submersible operations
- B.M. Howe, PhD, Researcher, Ocean and Resources Engineering – Ocean observation, glider technology, acoustics
- G.C. Nihous, PhD, Associate Professor Ocean and Resources Engineering, Project Manager, Pacific International Center for High Technology Research (PICHTR) – OTEC, offshore renewable energy
- E.-M. Nosal, PhD, Assistant Professor of Ocean and Resources Engineering – Acoustics, applied mathematics
- E. G. Pawlak, PhD, Associate Professor of Ocean and Resources Engineering – Coastal mixing processes, fluid dynamics, sediment transport
- J.C. Wiltshire, PhD, Chair of the Department of Ocean and Resources Engineering; Specialist and Director, Hawaii Undersea Research Laboratory – Submersibles, ROVs, deep-sea mining technology, ocean energy systems

They provide coverage of the three option areas in coastal, offshore engineering, and ocean resources engineering. Their research projects include laboratory and fieldwork, as well as computer simulation, and enrich the research component of the academic program.
The Ocean and Resources Engineering program has strong ties with the Hawaii Undersea Research Laboratory (HURL) at the University of Hawaii. The Director of HURL, John Wiltshire, has been Chair of Ocean and Resources Engineering since 2007. B.D. Greeson, PhD, US Navy Captain (Ret.), Certified Chief Engineer, is also the chief engineer of HURL.

These two faculty members who have joint positions with the Hawaii Undersea Research Laboratory bring in expertise in acoustics, marine engineering, marine mining technology, ship-ROV-submersible operations and have a wealth of at-sea experience. Most importantly, their involvement provides students access to the HURL facilities, including sea going vessels, submersibles, ROVs and a range of deep-sea equipment and test facilities, and active hands-on experience with oceanographic instrumentation.

The program has 13 additional Cooperating Faculty members from other research or academic units at the University of Hawaii. These include:

- J.M. Becker, PhD, Associate Professor of Geology and Geophysics – Coastal processes, currents
- B.S. Bingham, PhD, Assistant Professor of Mechanical Engineering – AUVs, navigation and control systems
- M. Chyba, PhD, Professor of Mathematics – Robotic control theory and systems
- B.T. Glazer, PhD, Assistant Professor of Oceanography – Instrumentation
- R.H. Knapp, PhD, PE, Professor of Mechanical Engineering – Solid mechanics, design
- H.J. Krock, PhD, PE, Emeritus Professor of Ocean and Resources Engineering – Offshore energy systems, OTEC
- A. Malahoff, PhD, Emeritus Professor of Oceanography, former Director of the Hawaii Undersea Research Laboratory – Submersibles, seafloor engineering, energy systems
- S.M. Masutani, PhD, PE, Associate Researcher, Hawaii Natural Energy Institute – Thermodynamics, energy systems
- G.M. McMurtry, PhD, Associate Professor of Oceanography – Deep sea instrumentation
- M.A. Merrifield, PhD, Professor of Oceanography; Director, UH Sea Level Center – Statistics, coastal circulation, current flows and mixing
- H.R. Riggs, PhD, Professor of Civil and Environmental Engineering – Structural engineering, numerical methods
- J.R. Smith, PhD, Specialist (Marine Geophysical) and Science Program Director, Hawaii Undersea Research Laboratory – Marine mapping technology and instrumentation
- J. Yu, PhD, Associate Professor, Hawaii Natural Energy Institute – Marine byproducts engineering
Their research areas include: Applied mathematics, marine acoustics, marine bioprocesses, coastal processes, nonlinear water waves, ocean currents, ocean resources, seafloor mapping, sedimentology, and structural mechanics. The cooperating faculty members give seminars on their research, serve on student research committees, and advise students on their theses or independent research projects. Their involvement is critical in supporting students and rounding out thesis committee structure. Their research enlarges the research base of the education program and provides a more diversified selection of research projects for the students.

Four Affiliate Faculty members from local engineering and scientific communities are currently serving on the faculty:

- W. Bucher, PhD, PE, Oceanit Laboratories, Inc., Honolulu, Hawaii
- D. Rezachek, PhD, PE, Alternate Energy Specialist, Energy, Resources, and Technology Division, Department of Business, Economic Development and Tourism, State of Hawaii, Honolulu, Hawaii
- J. Van Ryzin, PhD, PE, President and Senior Engineer, Makai Ocean Engineering, Inc., Kailua, Hawaii
- D. Vithanage, PhD, PE, Technical Director and Vice President, Oceanit Laboratories, Inc., Honolulu, Hawaii

These practicing professionals volunteer their time and bring in real-world engineering experience to the academic program. Most of them serve on student research committees and especially team-teach the capstone design project with the faculty. Their involvement is instrumental in preparing the students for the engineering profession.

Table 6-1 shows the distribution of faculty in the three option areas and three supporting disciplines. The distribution is based on the faculty members’ primary teaching duties and research in relation to the Ocean and Resources Engineering program. Most faculty members have research expertise in multiple disciplines, but only one is listed in the table for programmatic reasons. The faculty members with teaching duties in the program are indicated by an asterisk (*). The departmental faculty members cover all the core courses and most of the required courses in the three option areas. Three cooperating faculty members cover the one remaining required course (ORE 630) (Knapp) and provide additional electives and team teaching support (McMurtry and Merrifield). The affiliate faculty members team-teach the capstone design with the departmental faculty to integrate the coursework in a major design experience. Cooperating graduate faculty members can chair student research committees and their diverse backgrounds are instrumental to the graduate education program. Although the departmental faculty is relatively small and spread thin in the three option areas, the department provides a truly first rate education program with sufficient breadth and depth by leveraging of resources within the university and from the local marine industry.
### Table 6-1. Distribution of faculty in the three option areas and supporting disciplines

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Faculty Departmental</th>
<th>Faculty Cooperating</th>
<th>Faculty Affiliate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coastal Engineering</td>
<td>K.F. Cheung*</td>
<td>E. Pawlak*</td>
<td>M.A. Merrifield*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D. Vithanage*</td>
</tr>
<tr>
<td>Ocean Resources Engineering</td>
<td>G.C. Nihous*</td>
<td>J.C. Wiltshire*</td>
<td>H.J. Krock</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S.H. Masutani</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D. Rezachek*</td>
</tr>
<tr>
<td>Offshore Engineering</td>
<td>R.C. Ertekin*</td>
<td>B.S. Bingham</td>
<td>W. Bucher*</td>
</tr>
<tr>
<td></td>
<td>B.D. Greeson*</td>
<td>R.H. Knapp*</td>
<td>J. Van Ryzin*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>H.R. Riggs</td>
<td></td>
</tr>
<tr>
<td>Oceanographic Engineering</td>
<td>B. Howe*</td>
<td>B.T. Glazer</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>A. Malahoff</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>G.M. McMurtry*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>J.R. Smith</td>
<td></td>
</tr>
<tr>
<td>Applied Mathematics</td>
<td>E.-M. Nosal*</td>
<td>J.M. Becker</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>M. Chyba</td>
<td></td>
</tr>
<tr>
<td>Marine Bioprocesses</td>
<td></td>
<td></td>
<td>J. Yu</td>
</tr>
</tbody>
</table>

*Faculty members with teaching duties in the Department

### D. Faculty Competencies

The activities of each faculty member are summarized in Appendix B. An updated report for the current year will be provided at the time of the visit. Table 6-2 below summarizes the faculty teaching load. The teaching load is lower compared to other engineering departments at the University of Hawaii because of the emphasis on research in the Ocean and Resources Engineering program. The full-time departmental faculty members teach between 3 and 6 credit hours per semester and cover the bulk of the coursework. Drs. Greeson and Wiltshire (the two HURL faculty members) and Dr. Bruce Howe on a research appointment, teach 3 credit hours per academic year consistent with their appointments. Two of the Ocean and Resources Engineering courses are cross-listed with courses in Mechanical Engineering and Oceanography and are taught by Profs. Knapp and Merrifield, respectively. Drs. Rezachek, Van Ryzin, Bucher and Vithanage take turns team-teaching the capstone design with Prof. Cheung.

Ocean and Resources Engineering is an advanced-level program. The faculty members spend a significant portion of their time advising students on their research work at the MS and PhD levels. Table 6-3 summarizes the master’s level advising duties of the faculty for the students in the Department. The departmental faculty members are primarily responsible for academic advising and carry a major portion of the research advising duties by serving as research committee chairs. The cooperating faculty members are also actively involved in the students’ research work. Many of them have chaired and served on research committees. They bring in research expertise not covered by the departmental faculty and provide additional research funding to support graduate students. Profs. Becker and Merrifield were formally Ocean and Resources Engineering faculty and continue to work closely with the Department. Several of the affiliate faculty members have also served on student research committees and provide insights from the perspective of the industry.
Table 6-2. Teaching Assignments from Fall 2007 – Spring 2009

<table>
<thead>
<tr>
<th>Faculty</th>
<th>Number of Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fall 2007</td>
</tr>
<tr>
<td>K.F. Cheung</td>
<td>3</td>
</tr>
<tr>
<td>R.C. Ertekin</td>
<td>3</td>
</tr>
<tr>
<td>J. Frandsen</td>
<td>3</td>
</tr>
<tr>
<td>E. Pawlak</td>
<td>6</td>
</tr>
<tr>
<td>E. Nosal</td>
<td>-</td>
</tr>
<tr>
<td>B.D. Greeson</td>
<td>0</td>
</tr>
<tr>
<td>J.C. Wiltshire</td>
<td>3</td>
</tr>
<tr>
<td>G. Nihous</td>
<td>-</td>
</tr>
<tr>
<td>R.H. Knapp</td>
<td>3</td>
</tr>
<tr>
<td>M.A. Merrifield</td>
<td>0</td>
</tr>
<tr>
<td>G.M. McMurtry</td>
<td>3</td>
</tr>
<tr>
<td>D. Rezachek</td>
<td>0</td>
</tr>
<tr>
<td>J. Van Ryzin</td>
<td>0</td>
</tr>
<tr>
<td>D. Vithanage</td>
<td>3*</td>
</tr>
<tr>
<td>W. Bucher</td>
<td>3*</td>
</tr>
</tbody>
</table>

*Team-taught with K.F. Cheung

Table 6-3. Advising Load of Faculty for Students in Ocean and Resources Engineering

<table>
<thead>
<tr>
<th>Faculty</th>
<th>2003 – 2008 Graduates</th>
<th>Students in Spring 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Committee Chair</td>
<td>Committee Member</td>
</tr>
<tr>
<td>K.F. Cheung</td>
<td>20</td>
<td>9</td>
</tr>
<tr>
<td>R.C. Ertekin</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>J. Frandsen</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>J.C. Wiltshire</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>E. Pawlak</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>H.J. Krock</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>E. Nosal</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>B.D. Greeson</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>B.M. Howe</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>G. Nihous</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>R.H. Knapp</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>A. Malahoff</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>R. Riggs</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>M.A. Merrifield</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>D. Rezachek</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>J. Van Ryzin</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
An analysis of the departmental faculty is presented in the Appendix. This section highlights the background and experience of the departmental faculty and discusses their qualification in administering the Ocean and Resources Engineering program.

Six of the departmental faculty members have education backgrounds in civil engineering, mechanical engineering, and naval architecture. These three distinctly different disciplines provide a broad coverage of the Ocean and Resources Engineering program. The faculty have a combined 88 years of experience at the University of Hawaii in addition to 6 and 63 years of post-doctoral research and industry experience respectively. The prior industry experience includes oil companies, shipyards, and consulting firms specializing in coastal, offshore, harbor, and environmental engineering. Faculty were involved in a variety of engineering projects that range from preliminary design and feasibility assessment to detailed design and construction worldwide. One current and one emeritus faculty member are registered Professional Engineers in the state of Hawaii.

Research is one of the strengths of the Ocean and Resources Engineering program. Two of the faculty members received the Young Investigator Awards from the National Science Foundation and the Office of Naval Research. During the period 2003–2009, the faculty members received $18.0M ($29 million when HURL is also included) of research grants and contracts as University of Hawaii Principal Investigators (see tables under Criterion 8). They published over 145 articles, 85 in refereed journals, during the same period (see complete Departmental publication list in the Appendix). The articles were published in the best national and international journals of direct relevance to the Ocean and Resources Engineering program. These journals included:

- Engineering Analysis with Boundary Elements
- Fluid Dynamics Research
- Fluids and Structures
- Geophysical Research Letters
- IEEE Journal of Oceanic Engineering
- International Journal of Heat and Fluid Flow
- International Journal for Numerical Methods in Fluids
- International Journal of Offshore Mechanics and Polar Engineering
- Journal of the Acoustical Society of America
- Journal of Coastal Research
- Journal of Energy Resources Technology
- Journal of Engineering Mathematics
- Journal of Engineering Mechanics
- Journal of Fluid Mechanics
- Journal of Geophysical Research
- Journal of Hydraulic Engineering
- Journal of Hydraulic Research
- Journal of the Marine Acoustics Society
- Journal of Marine Environmental Engineering
- Journal of Offshore Mechanics and Arctic Engineering
- Journal of Physical Oceanography
• Journal of Waterway, Port, Coastal, and Ocean Engineering
• Marine Technology Society Journal
• Marine Georesources and Geotechnology
• Mechanical Engineering
• Ocean Engineering
• Wave Motion

Many of the publications were co-authored by students, who worked on their MS theses and PhD dissertations under the guidance of faculty members.

The faculty members are also actively interacting with community groups. They are members of national and international professional societies, including:

• Acoustical Society of America
• American Geophysical Union
• American Society of Engineering Education
• American Society of Civil Engineers
• American Society of Mechanical Engineers
• IEEE Oceanic Engineering Society
• International Ship Structure Congress
• International Society of Offshore and Polar Engineers
• Marine Technology Society
• Society of Naval Architects and Marine Engineers
• Society of Mining, Metallurgy and Exploration (formerly Society of Mining Engineers)
• The Oceanography Society

Some faculty members have served as officers of these organizations and organized international conferences, such as:

• International Conference on Offshore Mechanics and Arctic Engineering, Mexico, 2003
• International Conference on Offshore Mechanics and Arctic Engineering, Honolulu, Hawaii 2009
• IEEE/MTS Oceans Conference, Honolulu, 2001 and 2011 (co-chaired)
• International Workshop on Very Large Floating Structures, Honolulu, Hawaii, 1999

The faculty members are also active in community service and serve on various advisory committees, including:

• Ala Wai Canal Improvement Advisory Committee, Department of Land and Natural Resources, State of Hawaii
• Coastal Erosion Advisory Group, Department of Business, Economic Development and Tourism, State of Hawaii
• Land Erosion Control Advisory Committee, City and County of Honolulu
• Multi-Hazards Science Advisory Committee, Department of Defense, State of Hawaii
Faculty members in professional fields of study, such as engineering, are better teachers and researchers, if they continue to practice and apply their knowledge in the real world. This is also the most direct way to interact with the professional communities. Recently the faculty members have been involved in engineering projects with:

- Applied Technology Corporation
- Bishop Museum
- Belt Collins Hawaii, Ltd.
- Booz Allen Hamilton
- Dept. of Business, Economic Development and Tourism, State of Hawaii
- Martin & Chock, Inc.
- Makai Ocean Engineering, Inc.
- Navatek Ltd.
- Ocean Engineering Consultants, Inc.
- Oceanit Laboratories, Inc.
- PACE Technologies
- Pacific Disaster Center
- Sea Engineering, Inc.
- SSFM International
- Trex Enterprises Corporation - Maui
- U.S. Army Corps of Engineers, Mississippi Valley Division

In addition, the faculty members have worked as visiting researchers or professors at various institutes worldwide, including:

- Fluid Mechanics Research Group, Universidad de Jaen, Jaen, Spain
- Naval Surface Warfare Center Carderock Division, Maryland
- Department of Applied Physics, Christian Albrechts University, Kiel, Germany
- Department of Naval Architecture and Offshore Engineering, University of California, Berkeley, California
- Fluid Engineering Department, Universidad Carlos III de Madrid, Spain
- Royal Technical University, Stockholm, Sweden
- University of Washington, Applied Physics Laboratory

These research, scholarship, and professional activities are instrumental in maintaining the timeliness and diversity of the Ocean and Resources Engineering program. The cooperating and affiliate faculty members, who have backgrounds in biochemical engineering, civil engineering, geophysics, oceanography, ocean engineering, and mechanical engineering, and the same level of professional competency, add to the diversity of the program.
E. Faculty Size

The School of Ocean and Earth Science and Technology has committed to the expansion of the ORE Department. The faculty have gone from four active members to eight in the last several years. Although the world economic situation is making things difficult, the plan would be to expand further. For a specialized, graduate only, department such as ORE this represents a more than adequate size. Faculty are very closely involved with students. Students have no trouble in finding willing faculty members to advise them and serve on their committees. The faculty are involved with many service projects particularly to State agencies and professional societies in terms of bringing major conferences to Hawaii.

F. Faculty

Appendix B contains an abbreviated resume for each program faculty member. The following information is listed:

- Name and academic rank
- Degrees with fields, institution, and date
- Number of years of service on this faculty, including date of original appointment and dates of advancement in rank
- Other related experience, i.e., teaching, industrial, etc.
- Consulting, patents, etc.
- States in which professionally licensed or certified, if applicable
- Principal publications of the last five years
- Scientific and professional societies of which a member
- Honors and awards
- Institutional and professional service in the last five years
- Percentage of time available for research or scholarly activities
- Percentage of time committed to the program

G. Faculty Development

The Department is most fortunate in that of its 8 faculty, five are at the highest rank. These faculty are very active with professional societies. They are reviewed every five years during a rigorous post tenure review process. The faculty are awarded sabbaticals every seven years to help sharpen their skills and better acquaint them with the modern engineering world and state of the art practices. They are encouraged to undertake consulting activities and interface closely with the tight-knit Hawaii ocean engineering community.

One faculty member, Dr. Eva-Marie Nosal, was hired a year ago as a new assistant professor. She will come up for tenure in three years. In order to help her progress she is being mentored by several senior faculty members. She is assigned classes and senior committee responsibility to challenge her and bring her into contact with senior university officials. Department members are also very active in several ocean engineering professional societies. She is strongly encouraged to actively participate in these societies.
Two other members of the department are at the associate professor level. One is tenured (Pawlak) and one just hired (Nihous). The same mentoring process is undertaken with them.

Dr. Hans Krock retired from the ORE department in 2005 after 24 years. Cooperating Faculty member and former Department Chairman, Dr. Alexander Malahoff retired in 2008. Both are still active in the Department as emeritus members. Dr. Janette Frandsen was hired by the Department in 2006 but resigned in early 2008 to take a position at the University of Sydney. Between July 2008 and August 2009, three new faculty members were hired: Drs. Nosal, Howe and Nihous. No retirements are anticipated in the next five years. The Department Office Manager, Mrs. Edith Katada also retired in 2008 after 41 years of service. She was replaced by Ms. Natalie Nagai who has over 20 years of university experience and has efficiently taken on the task of revamping the department’s records and filing procedures. The department has stabilized its personnel changes and is well positioned for positive growth.
### Table 6-4. Faculty Workload Summary

**OCEAN AND RESOURCES ENGINEERING – Academic year 2008 - 2009**

<table>
<thead>
<tr>
<th>Faculty Member (name)</th>
<th>FT or PT⁴</th>
<th>Classes Taught (Course No./Credit Hrs.) Fall 2008 – Spring 2009¹</th>
<th>Total Activity Distribution²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Teaching</td>
</tr>
<tr>
<td>Cheung, Kwok Fai</td>
<td>FT</td>
<td>ORE 607/3, Fall</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ORE 783/3, Fall and Spring</td>
<td>20%</td>
</tr>
<tr>
<td>Ertekin, R. Cengiz</td>
<td>FT</td>
<td>ORE 411/3, Fall</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ORE 609/3, Spring</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ORE 677/3, Fall</td>
<td></td>
</tr>
<tr>
<td>Greeson, B. Dandridge</td>
<td>FT</td>
<td>No classes taught this period – Out at sea</td>
<td></td>
</tr>
<tr>
<td>Howe, Bruce</td>
<td>FT</td>
<td>New faculty member, ORE 654 planned for F’2009</td>
<td></td>
</tr>
<tr>
<td>Nihous, Gerard C.</td>
<td>FT</td>
<td>Assigned to ORE Dept as of 08/01/09</td>
<td></td>
</tr>
<tr>
<td>Nosal, Eva-Marie</td>
<td>FT</td>
<td>ORE 603/3, Fall</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ORE 766/3, Spring</td>
<td>5%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ORE 792/1, Spring</td>
<td></td>
</tr>
<tr>
<td>Pawlak, Eugene (Geno)</td>
<td>FT</td>
<td>ORE 792/1, 2008</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>On sabbatical, Spring 2009</td>
<td>20%</td>
</tr>
<tr>
<td>Wiltshire, John C.</td>
<td>FT</td>
<td>ORE 330/3; Fall</td>
<td></td>
</tr>
</tbody>
</table>

---

1. Indicate Term and Year for which data apply (the academic year preceding the visit).
2. Activity distribution should be in percent of effort. Members’ activities should total 100%.
3. Indicate sabbatical leave, etc., under “Other.”
4. FT = Full Time Faculty       PT = Part Time Faculty
<table>
<thead>
<tr>
<th>Name</th>
<th>Rank</th>
<th>Type of Academic Appointment</th>
<th>FT or PT</th>
<th>Highest Degree and Field</th>
<th>Institution from which Highest Degree Earned &amp; Year</th>
<th>Years of Experience</th>
<th>Level of Activity (high, med, low, none)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cheung, Kwok Fai</td>
<td>Prof I-5</td>
<td>T</td>
<td>FT</td>
<td>PhD, Civil Engineering</td>
<td>University of British Columbia; 1991</td>
<td>2 16 16 PE Hawaii</td>
<td>Low High Med</td>
</tr>
<tr>
<td>Ertekin, R. Cengiz</td>
<td>Prof I-5</td>
<td>T</td>
<td>FT</td>
<td>PhD, Naval Architecture &amp; Offshore engineering</td>
<td>University of California – Berkeley; 1984</td>
<td>5 23 23 None</td>
<td>High Med Med</td>
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<tr>
<td>Greeson, Bernard</td>
<td>Specialist S-5</td>
<td>NTT</td>
<td>FT</td>
<td>PhD, Ocean &amp; Resources Engineering</td>
<td>University of Hawaii – Manoa; 1997</td>
<td>28 13 11 Merchant Mariner, U.S. Coast Guard</td>
<td>Low Low High</td>
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<tr>
<td>Howe, Bruce</td>
<td>Research R-5</td>
<td>T</td>
<td>FT</td>
<td>PhD, Oceanography</td>
<td>University of California – San Diego; 1986</td>
<td>0 22 1 None</td>
<td>Low High None</td>
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<tr>
<td>Nihous, Gérard C.</td>
<td>Assoc. Prof. I-4</td>
<td>TT</td>
<td>FT</td>
<td>PhD, Ocean Engineering</td>
<td>University of California – Berkeley; 1983</td>
<td>20 5 5 None</td>
<td>None High Low</td>
</tr>
<tr>
<td>Nosal, Eva-Marie</td>
<td>Asst. Prof. I-3</td>
<td>TT</td>
<td>FT</td>
<td>PhD, Geology &amp; Geophysics</td>
<td>University of Hawaii; 2007</td>
<td>0 1.5 1.5 None</td>
<td>Med High None</td>
</tr>
<tr>
<td>Pawlak, Eugene (Geno)</td>
<td>Assoc. Prof – I-4</td>
<td>T</td>
<td>FT</td>
<td>PhD, Mechanical Engineering</td>
<td>University of California at San Diego; 1997</td>
<td>0 8 8 None</td>
<td>Low High Low</td>
</tr>
<tr>
<td>Wiltshire, John</td>
<td>Specialist S-5</td>
<td>NTT</td>
<td>FT</td>
<td>PhD, Oceanography</td>
<td>University of Hawaii – Manoa; 1983</td>
<td>8 23 23 MTS Fellow</td>
<td>High High Low</td>
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</table>

Column 3 Code: TT = Tenure Track   T = Tenured   NTT = Non Tenure Track
<table>
<thead>
<tr>
<th>Last Name</th>
<th>First</th>
<th>Thesis Title</th>
<th>Committee Members</th>
<th>Plan</th>
<th>Graduated</th>
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<tbody>
<tr>
<td>Blinde</td>
<td>Geoffrey</td>
<td>Static and Dynamic Analyses of a Swath Ship Structure</td>
<td>K.F. Cheung (Chair), R. Knapp, H.J. Krock</td>
<td>B</td>
<td>2003</td>
</tr>
<tr>
<td>Douyere</td>
<td>Yann M.J.</td>
<td>Analysis of Harbor Oscillation with a Boussinesq Model</td>
<td>K.F. Cheung (Chair), H.J. Krock, M.A. Merrifield</td>
<td>A</td>
<td>2003</td>
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<tr>
<td>Ramsey</td>
<td>Melanie D.</td>
<td>Basic Component Design of Research Submersibles</td>
<td>A. Malahoff (Chair), R.H. Knapp, H.J. Krock</td>
<td>B</td>
<td>2003</td>
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<tr>
<td>Winsley</td>
<td>Jon</td>
<td>Review and Design of NOAA Fisheries Honolulu Laboratory Underwater Imaging Tow Vehicles</td>
<td>J. Wiltshire (Chair), J.R. Smith, H.J. Krock</td>
<td>B</td>
<td>2003</td>
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<tr>
<td>Yang</td>
<td>Jinghai</td>
<td>Time Domain, Nonlinear Theories on Ship Motions</td>
<td>R.C. Ertekin (Chair), K.F. Cheung, G. Pawlak</td>
<td>B</td>
<td>2004</td>
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<tr>
<td>Yamazaki</td>
<td>Yoshiki</td>
<td>Forecast of Tsunamis from the Japan-Kuril-Kamchatka Source Region</td>
<td>K.F. Cheung (Chair), H.J. Krock, G. Pawlak</td>
<td>A</td>
<td>2004</td>
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<tr>
<td>Carter</td>
<td>Richard</td>
<td>Wave Energy Converter Situated Beneath the Waves</td>
<td>R.C. Ertekin (Chair), K.F. Cheung, G. Pawlak</td>
<td>A</td>
<td>2005</td>
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<tr>
<td>Cheifet</td>
<td>Jordan</td>
<td>Durability, Repair, and Service Life of Concrete in Marine Environment</td>
<td>K.F. Cheung (Chair), G. Fischer, H.J. Krock</td>
<td>B</td>
<td>2005</td>
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<tr>
<td>Crabtree</td>
<td>Robert</td>
<td>Hindcast Modeling of Storm Surge and Waves in the Gulf Coast Region</td>
<td>K.F. Cheung (Chair), H.J. Krock, M. Merrifield</td>
<td>A</td>
<td>2005</td>
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<tr>
<td>Merritt</td>
<td>Daniel W.</td>
<td>BOTCAM Design, Testing, and Development of a Fully Automated Stereo-Video Bottom Camera Bait Station for Ecosystem of Bottom Fish Species</td>
<td>J. Wiltshire (Chair), G. Pawlak, C. Kelley</td>
<td>A</td>
<td>2005</td>
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<tr>
<td>Nunes</td>
<td>Vasco</td>
<td>Survey and Statistical Parameterization of Bed Roughness of a Coral Reef</td>
<td>G. Pawlak (Chair), K.F. Cheung, M. Merrifield</td>
<td>A</td>
<td>2005</td>
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<tr>
<td>Wycklendt</td>
<td>Andrew J.</td>
<td>Evaluation of a Coastal Ocean Model for Oahu, Hawaii</td>
<td>K.F. Cheung (Chair), G. Pawlak, S. Choi</td>
<td>A</td>
<td>2005</td>
</tr>
<tr>
<td>Name</td>
<td>Affiliation</td>
<td>Title</td>
<td>Chair(s)</td>
<td>Year</td>
<td></td>
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<tr>
<td>Chen</td>
<td>Long</td>
<td>An Efficient Parallel Scheme and its Applications in CFD Problems</td>
<td>K.F. Cheung, D. Yun, H.J. Krock</td>
<td>B</td>
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<td>Higa</td>
<td>Scott T.</td>
<td>Feasibility Study of Seawater Air Conditioning In California</td>
<td>D. Rezachek, H.J. Krock, K.F. Cheung</td>
<td>B</td>
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<td>Looney</td>
<td>Chris</td>
<td>Investigation of the Use of Alphaflex® / High Density Polyethylene Composites as suitable Materials for Large Diameter Deep Ocean Cold Water Pipes</td>
<td>H.J. Krock, K.F. Cheung, D. Rezachek</td>
<td>A</td>
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<td>Sanchez</td>
<td>Alejandro</td>
<td>Tsunami Forecast Using an Adaptive Inverse Algorithm for the Chile-Peru Source Region</td>
<td>K.F. Cheung, G. Pawlak, I. Robertson</td>
<td>A</td>
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<tr>
<td>Goo</td>
<td>Justin</td>
<td>Validation of Spectral Coastal Models for Fringing Reef Environments</td>
<td>K.F. Cheung, M. Merrifield, G. Pawlak</td>
<td>A</td>
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<td>Stopa</td>
<td>Justin E.</td>
<td>Effect of Wind Resolution on Spectral Wave Modeling in the Hawaii Region</td>
<td>K.F. Cheung, Y.-L. Chen, M.A. Merrifield</td>
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<tr>
<td>Munger</td>
<td>Sophie</td>
<td>Oscillation Modes of Hawaii Waters from the 2006 Kuril Islands Tsunami</td>
<td>K.F. Cheung, J. Wiltshire, G. Pawlak</td>
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<td>Mohamed</td>
<td>Abdullah</td>
<td>Characterization of Tsunami-Like Bores in Support of Loading on Structures</td>
<td>G. Pawlak, I. Robertson, K.F. Cheung</td>
<td>A</td>
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<tr>
<td>Namekar</td>
<td>Shailesh</td>
<td>Artificial Neural Network for Tsunami and Runup Forecast</td>
<td>K.F. Cheung, G. Pawlak, J.C. Wiltshire</td>
<td>A</td>
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<tr>
<td>Wong</td>
<td>Gregory E.</td>
<td>Comparison of Inboard Versus Outboard Counter Rotating Surface Piercing Propellers via Prototype Tests</td>
<td>K.F. Cheung, J.C. Wiltshire, Y.-T. Lee</td>
<td>A</td>
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<td>Yan</td>
<td>Lei</td>
<td>Resonance in Hawaii Waters from the 1996 Andreanov and 2003 Rat Island Tsunamis</td>
<td>K.F. Cheung, J.C. Wiltshire, E.M. Nosal</td>
<td>A</td>
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<tr>
<td>Bablinskas</td>
<td>Krystin K.</td>
<td>Design and Analysis of a Hybrid AUV-Glider Undersea Vehicle for Research and Exploration</td>
<td>J. Wiltshire, G. Pawlak, B.D. Greeson</td>
<td>A</td>
<td></td>
</tr>
</tbody>
</table>
CRITERION 7. FACILITIES

A. **Space**

The Department of Ocean and Resources Engineering has access to the facilities needed to deliver the Program Outcomes and achieve the Educational Objectives. Students are provided hands-on experience that includes laboratory experiments, in-ocean measurements, submersible/ROV and AUV operations. The program requires extensive use of engineering tools and computers in the coursework. Some students are exposed to state-of-the-art computing infrastructure and high-fidelity simulation models through research work. The following sections outline the available facilities. These facilities are available for a variety of instructional and research uses, depending on which classes a student takes and what topic they choose for their research.

**Offices**

Every faculty member has a well-appointed private office of a required minimum of 150 square feet. This allows each faculty member to comfortably meet with and advise students. Most of the faculty offices are in the departmental complex on the fourth floor of Holmes Hall. A few faculty offices are in adjoining SOEST buildings. Post Docs and technicians are normally housed two to the equivalent of one faculty office. There is also office space for all graduate students in the department. There are four large rooms and four smaller ones partitioned into individual graduate student space. The graduate student spaces are: Holmes 407 and 407A (12 students), 408 (10 students), POST 132 and 132A (12 students), HIG 321 and 322 (4 students) and MSB 318 (3 students). Each graduate student is assigned a desk and is provided a broadband Internet connection at no cost. Most of the rooms also have file cabinets, bookshelves, tables, general-purpose computers, and printers for student use. Clerical staff are assigned to the main office. The office is run by a secretary, administrative assistant and up to two student assistants. The office also contains the department files, reference books and office supplies cabinet. The space is adequate for a department of 8 faculty and 35 graduate students.

**Classrooms**

The department offers up to 8 courses per semester during the academic year. The enrollment in each course ranges from 2 to 13. The Department has a reserved 15-seat classroom in Holmes Hall, where the department is located. Additional classrooms can be assigned to the department. Each classroom in Holmes Hall has audio-video equipment, as well as an overhead projector and at least one large blackboard. The facilities are adequate for instructional purposes. The capstone design class meets in the department conference room and occasionally at the off-campus offices of affiliate faculty members to simulate actual work environments.

**Fluid Dynamics Laboratory**

The Fluid Dynamics Laboratory focuses on the study of coastal and marine hydrodynamics including turbulent dispersal of pollutants and nutrients, wave dynamics, flow over rough boundaries, sediment transport, and performance of hydrofoils. In addition, the laboratory is home to the Fluid Dynamics Education Laboratory, which serves as a center for teaching of fluids phenomena in support of courses within the Department and SOEST and is available to the general University community. Laboratory instrumentation includes a number of Acoustic Doppler Velocimeters (ADVs), which obtain high frequency, single point, 3-component velocity measurements. A laser-based Particle Imaging Velocimetry (PIV) system obtains two-
dimensional fluid velocity via laser imaging techniques. A pulsed YaG laser with digital still and video cameras is used for flow visualization and measurement.

The laboratory houses a number of experiment tanks, which are used for both research and teaching demonstrations. These include a 10-meter long, 30 × 10 cm wave channel and a rotating table. The tanks allow demonstration of a range of fluid flow phenomena including wave breaking, down-slope currents, and internal waves in stratified fluids along with rotational effects such as spin-up, Ekman flow and geostrophy.

New ORE faculty member, Bruce Howe, is currently developing a laboratory that will be used in the teaching of the new acoustics course, ORE 654, as well as ocean glider development and support for the Aloha Cabled Observatory and Ocean Observation program. This laboratory will certainly provide data and support for a number of master’s students and provide a catalyst for their thesis projects.

Kilo Nalu Ocean Observatory, AUV and In-ocean Experiments

The Department maintains research facilities at Snug Harbor and offshore of Kewalo Basin for staging and in-ocean experiments. These facilities include field research equipment and instrumentation, a 25-ft motorboat (R/V Kilo Kai) and access to a 57-ft coastal research vessel (R/V Klaus Wyrtki), as well as machine shop support. The state-of-the-art Kilo Nalu Reef Observatory on the south shore of Oahu provides a window into the nearshore coral reef physical, biological and chemical environment. The setting for Kilo Nalu is the region offshore of Kakaako Waterfront Park, east of downtown Honolulu and west of Waikiki and Ala Moana. The observatory is managed and maintained by ORE and is being actively used in numerous research projects focusing on water quality variability, benthic boundary layer physics and geochemistry, stratified turbulence, internal wave dynamics and sediment porewater processes. Research at the observatory involves collaborations with numerous units across UH (Oceanography, HIMB, HIGP, Mechanical Engineering), as well as outside the University (Stanford University, Naval Postgraduate School, Oregon State University, NOAA CRED and NOAA PMEL) with funding from a range of agencies (National Science Foundation, NOAA Coastal Services Center, Office of Naval Research, UH Sea Grant Foundation, City and County of Honolulu). In addition, Kilo Nalu is a key component in the Hawaii Ocean Observing System (HIOOS) providing real-time observations for online access and for numerical model validation.

Kilo Nalu provides data and power connections to a suite of observational instruments. Baseline observations include water currents and temperature versus depth, directional wave spectra, salinity, acoustic backscatter, turbidity, dissolved oxygen, and chlorophyll fluorescence. Meteorological data is collected at the observatory’s shore station. The 7-acre in-ocean test range off Kewalo Basin extends from 5 to 20 meters depth with test platforms equipped with shore-cabled power supply outlets and data connections. The Kilo Nalu equipment suite includes acoustic current profilers, current meters, wave gauges, thermistors, pressure sensors, conductivity-temperature-depth (CTD) sensors, anemometers, buoys, mooring equipment, and SCUBA diving gear.

The ORE field program operates a REMUS (Remote Environmental Monitoring UnitS: Hydroid, Inc.) autonomous underwater vehicle (AUV) in support of research and teaching programs. The AUV can operate at depths of up to 100 m (328 feet) and is equipped with two ADCPs (Acoustic Doppler Current Profilers), one upward looking and one downward looking, and sidescan sonar. The UH REMUS is additionally outfitted with underwater modem
ORE researchers carry out monthly REMUS AUV surveys focusing on the south shore of Oahu as part of the HIOOS program. In addition, AUV surveys also target specific water quality 'events', such as effluent spills and high run-off periods. REMUS provides critical spatial context for the nearshore/offshore sensor network and water sampling programs.

In addition, the ORE field program operates a Seabotix LBV150 remotely-operated vehicle (ROV). The LBV150 is equipped with two video cameras and a grabber arm and can operate to depths of 150m from small vessels.

**Aloha Cabled Observatory (ACO)**

In 2002, the National Science Foundation funded a Major Research Instrumentation proposal to design, construct and emplace infrastructure for a cabled ocean bottom observatory at a long-term, deep-ocean research site 100 km north of Oahu known as Station Aloha. During a five-day cruise, a 513-foot US Navy cable repair ship cut and recovered a retired electro-optical telecommunications cable, pulled aboard 20 km of cable, laid it back out to Station Aloha, spliced the cable to the ACO cable termination frame, tested the system, and lowered the frame and initial observatory module to the ocean floor in 4,700 m of water. The full observatory will have eight connectors on it to power and supply a 2-way data path to for up to eight experiment systems.

After the full installation of the Aloha Cabled Observatory, periodic cruises to Station Aloha will still be required to obtain water samples, to provide broader spatial coverage, and to install new systems at the observatory. However, the capabilities of the observatory will greatly expand the opportunities for research by allowing data from subsurface instruments to be retrieved continuously, to allow commands to be sent to the instruments to modify their sampling, and by providing power to instruments thus extending their duration. The Aloha Observatory will provide power and broadband communications capability necessary for real-time continuous monitoring of the ocean environment for at least a decade. These capabilities will also support short-duration, state-of-the-art experiments. ORE faculty are heavily involved in the instrumentation and design aspects of the Aloha Cabled Observatory.

Investigators from institutions around the world are encouraged to propose additional infrastructure and individual experiments. Observatory investigators will be able to monitor their experiments and modify them remotely as conditions warrant via Internet connection. Web access will allow students and the public to observe the ocean alongside the researchers.

### B. Resources and Support

**Computing Facilities and Software**

The Department and the faculty operate four AIX and six Linux systems and a network of Pentium-based PCs. All students are given computer accounts and email access on at least one of the Unix systems and the PC network. All PCs are installed with the current version of
Windows and MS Office. All research assistants have assigned PCs. A number of software packages are available to the students for coursework and research. These include:

- ARC-GIS
- AutoDesk Mech
- AutoCAD
- Automated Coastal Engineering System (ACES)
- CEM (Coastal Engineering Manual) 1.02
- CFX (a RANS CFD package)
- COSMOS/M (a finite element package)
- HYDRAN (a ship motion and hydroelasticity model package)
- Matlab
- MathCAD
- Mathematica (symbolic algebra)
- Microsoft Office
- Microstation SE
- Photoshop
- SAP2000 (a structural analysis package)
- Tecplot (graphics)
- Visual Fortran

Students taking ORE 630 are also given access to the finite element package ANSYS, which is maintained by the Department of Mechanical Engineering.

Hawaii Undersea Research Laboratory

The Hawaii Undersea Research Laboratory (HURL) is one of six national laboratories comprising the National Oceanic and Atmospheric Administration’s National Undersea Research Program (NOAA/NURP). HURL operates two deep diving (2000 m) submersibles, the PISCES IV and PISCES V and a remotely operated vehicle. The ROV and submersibles operate off the 225-foot research vessel, Ka’imikai-o-Kanaloa (KOK), obtained for the University and largely supported by HURL. In late 2008, the School of Ocean and Earth Science and Technology put a $2 million dollar upgrade into the marine systems aboard the KOK. The submersibles, ROV, and their mothership conduct a wide range of engineering and oceanographic research activities. Time on the submersibles and ROV is available to the faculty and students through submission of proposals. In addition, many students in the Ocean and Resources Engineering program find thesis projects, financial support and advisors studying various aspects of the dynamics of submersible and ROV operations, as well as new instrumentation, control, and equipment applications. The number of full research assistantships provided by HURL to ORE students varies from 2-5 per year. The HURL facilities, test site, pier and machine shop are available to the students of the department for a range of projects working or instrumentation beyond those directly funded by HURL. HURL is one of the central participants in the Department of Energy’s new $5 million grant to the University for alternate ocean energy research. The machinists and technicians of HURL will be actively working on this grant. Many theses in the area of ocean energy resources will find support in this work. HURL and the Department of Ocean and Resources Engineering have a very close working relationship at all levels.
Maui High Performance Computing Center

The Maui High Performance Computing Center (MHPCC) is an Air Force Research Laboratory Center. It is also a Distributed Center of the Department of Defense High Performance Computing Modernization Program and ranked as one of the top 20 supercomputer sites in the world. Its tera-scale, high-performing computing resources showcase a range of technologies, from IBM Power3 16-way configurations to the largest Linux Supercluster in the Department of Defense inventory. The Department of Ocean and Resources Engineering has a joint research project with MHPCC, which provides computer accounts, CPU time, and technical support to faculty members and research assistants working on the project.

In general, computer and laboratory equipment are adequate for most students to complete their Master’s studies. A few students rely on equipment in other departments, especially Civil Engineering or at other universities through research exchange programs. Several students, for example, will be going to the University of Oregon to use their wave tank facilities in the summer of 2009.

As ORE is a graduate department with a small number of students doing highly specialized research in focused labs, the acquisition of laboratory equipment is not a departmental process but is focused on the individual lab. Each of these labs has its own plan and acquires equipment in relation to the number of grants coming in and the progress of these grants. Most labs have technicians and lab engineers on the grants carrying out maintenance and upgrades. This is certainly true of Kilo Nalu, the Fluid Dynamics Lab, the Aloha Cabled Observatory and HURL. This has proved adequate for the needs of most research.

SOEST also has an engineering support facility of half a dozen, machinists, electrical and mechanical engineers who can be engaged at cost to provide support services of all types on short notice or for a longer term.

The department employs one or two departmental Teaching Assistants who look after the department’s computers and network connections. The network is also supported by the SOEST Research Computing Facility (RCF) and its several technicians who are paid solely to maintain all SOEST computer connections.

C. Major Instructional and Laboratory Equipment

- **Vessels:**
  - 25 ft outboard motor boat (R/V *Kilo Kai* managed by Prof. Pawlak)
  - 57 ft Coastal Vessel (R/V *Klaus Wrytki*)
  - 225 foot Ocean Going research Vessel (R/V *Ka‘imikai-o-Kanaloa*)
- **Kilo Nalu Nearshore Reef Observatory and Aloha Cabled Observatory** - major shallow and deep cabled observatories
- **Makai Research Pier** – instrumented in ocean test facility for the Department of Energy’s new $5M ocean renewable energy center
- **University of Hawaii Marine Center** - ROV and AUV support facilities
- **Hawaii Undersea Research Laboratory** - staff of nine technicians, two submersibles and a machine shop and instrumentation facility
A. **Program Budget Process and Sources of Financial Support**

The vast majority of the funds in the non-research budget is in faculty and office staff salaries. Faculty salaries are negotiated at the time of hire by the Dean’s office. Although the Department recommends to the Dean’s office to hire a candidate or not, the Department is not part of the salary negotiation process. Further adjustments to salary are largely by contract negotiations between the faculty union and university. In times of more abundant financial resources, small merit increases were possible. Faculty involvement was sought for such increases. Departmental office staff are also hired on a salary scale fixed by the school’s business manager. Once negotiated and fixed, salaries are simply added into the department’s budget allocation. Supplies are bought on an as needed basis. A small budget is established for this on the basis of past expenditures.

B. **Sources of Financial Support**

**Institutional Support**

The institutional funding for the Ocean and Resources Engineering program has three categories: state general fund, tuition special fund, and research and training revolving fund. The state general fund contribution is calculated based on the number and rank of full-time equivalent positions in the Department. The state general fund and tuition special fund, in principle, cover the salaries of the faculty, staff, and teaching assistants as well as the operations of the Department. The research and training revolving fund derives from the indirect cost generated by extramural research projects in the Department. The revolving fund varies year to year depending on the amount generated by the faculty and the amounts retained by the University and SOEST administrations. Currently most projects have a 38% overhead, half of which is returned to the Dean’s Office. Half of the Dean’s share is typically returned to the department, which in fiscally abundant times, returned all of this share to the principal investigator and in the present fiscally challenging times returns half. This portion of the revolving fund overhead return is very important to the principal investigators as it supports research-related activities not covered by grants or contracts.

Tables in Appendix D summarize the support expenditures of the Department. The tuition special fund, supplemented by state general fund and research and training revolving fund, is the main source of this budget. Unlike other academic units with high undergraduate teaching load and high tuition revenue, the Department does not have a regular budget for faculty travel. Since the emphasis of the Department is graduate education and research, the faculty members have lighter teaching loads compared to their peers and spend more time working on extramurally funded research projects, which in turn provide support for faculty travel. In addition, the University Research Council provides travel grants to faculty. The department’s operational expenditures decreased dramatically in the late 1990s due to the closing of the off campus Look Laboratory of Ocean Engineering. The Department has a new on-campus laboratory, which is covered by the regular university maintenance budget at no cost to the Department. The allotment for equipment purchase varies depending on the amount of funds left at the end of each fiscal year and in general meets the need of the Department. The
Department has been supporting one-to-two graduate teaching assistants; recently an additional assistant was hired to update the department’s website. The department budget covers a portion of the cost of part-time office assistants and the reminder is supported by research projects.

Research Funding

A significant source of funding for graduate education and research training is extramural. The funded research projects awarded to the departmental faculty members as principal investigators during the last five academic years or since they joined the department are listed below (Table 8-1).

**Table 8-1. Recent Funding**

<table>
<thead>
<tr>
<th>Agency</th>
<th>Proposal Title</th>
<th>Award Amount</th>
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<tbody>
<tr>
<td>Sea Engineering, Inc</td>
<td>Ocean Engineering Internship</td>
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<tr>
<td>Hawaii-Civil Defense Division</td>
<td>Tsunami Forecast and Inundation Map for Hawaii</td>
<td>103,020</td>
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<td>Environment for Design of Advanced Marine Vehicles and Operations Research - ENDEAVOR</td>
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<td>Ocean Engineering Internship</td>
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<td>American Society for Engineering Education</td>
<td>National Defense Science and Engineering Graduate Fellowships</td>
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<td>Validation of Coastal Wave Models for Tropical Island Conditions</td>
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<td>Response of Marine Vehicles Advancing in a Seaway and in the Surf Zone</td>
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<td>Tsunami Inundation Map for Hawaii</td>
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<td>Pacific and Hawaii Catastrophic Hurricane Readiness Response Planning</td>
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<td>Elastic Response of Marine Vehicles</td>
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<td>ENDEAVOR Program N0001405C0392</td>
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<td>TREX Enterprises Corp.</td>
<td>Modeling and Simulation of an Ocean Wave Energy Extraction Device for Sensor Applications</td>
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<td>ALOHA Cabled Observatory - Supplement</td>
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<td>The HOT Profiler: Supporting Activities at the University of Hawaii</td>
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<td>The ALOHA-MARS Mooring: Supporting Activities at the University of Hawaii</td>
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<td>A Smart Sensor Web for Ocean Observation: Supporting Activities at the University of Hawaii</td>
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<td>Office of Naval Research</td>
<td>Acoustic Seagliders: Mobile Tomography Receivers for the ONR Philippine Sea Experiment</td>
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<td>Coastal Margin Observation and Prediction: Supporting Activities at the University of Hawaii</td>
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<td>Acoustic Seaglider: Planning for the Philippine Sea Experiment 2010 - 2011</td>
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<td>Collaborative Research: Characterization of Benthic Boundary Layer Geochemistry and Physics at the Kilo Nalu Observatory</td>
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<td>Effects of Offshore Forcing in the Nearshore Environment</td>
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<td>Wave Boundary Layer Processes over an Irregular Bottom</td>
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<td>Florida Institute of Technology</td>
<td>Dynamics of Wave-Current Boundary Layers Over Very Rough Boundaries</td>
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<td>Effects of Offshore Forcing in the Nearshore Environment</td>
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<td>Enhanced Spatial Mapping Capabilities for the Kilo Nalu Observatory</td>
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<td>Collaborative Research: Benthic Boundary Layer Geochemistry and Physics at the Kilo Nalu Observatory</td>
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<td>Department of the Navy</td>
<td>Enhanced Spatial Mapping Capabilities for the Kilo Nalu Observatory</td>
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<td>National Science Foundation</td>
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<td>Enhanced Spatial Mapping Capabilities for the Kilo Nalu Observatory</td>
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<td>Pangolin Pictures, Inc</td>
<td>Submersible Support for 'Loihi Seamount: A Film Documentary'</td>
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<td>Submersible Support for 'Voyage Discovery in the Pacific Ocean'</td>
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<td>Marine Minerals Industry Development: Phase III</td>
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<td>University of Mississippi</td>
<td>Seabed Characterization and Sea Floor Instrument Testing</td>
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<td>Ocean Exploration South Pacific Cruise to the New Zealand EEZ</td>
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<td>Coral Reef Research Grants Program for Hawaii and the Western Pacific</td>
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<td>U.S. Fish &amp; Wildlife Service/Department of the Interior</td>
<td>Dive Proposal for Rose Atoll</td>
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<td>National Oceanic &amp; Atmosc Admin, Dept of Commerce</td>
<td>Development of a GIS for Use in Establishing a Pearl Harbor Deepwater Maritime Heritage Resources Database</td>
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<tr>
<td>National Park Service/Department of the Interior</td>
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<td>National Oceanic &amp; Atmosc Admin, Dept of Commerce</td>
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<td>HURL Annual Funding: Phase I (FY 2007)</td>
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<td>Dive Proposal to Investigate the Deep Coral Reefs of Hawaii</td>
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<td>Wildlife Productions</td>
<td>Deep Investigation of Mauna Kea: Part I</td>
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<td>SCUBAnauts International</td>
<td>Deep Investigation of Mauna Kea: Part II</td>
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<td>Natural Energy Lab of Hawaii (NELH)</td>
<td>Deep Cold Water Pipe Inspection and Survey</td>
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<td>Deep Coral Reef Ecosystem Studies (C81390)</td>
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<td>Hawaii-Dept of Land &amp; Natural Resources</td>
<td>Black Coral Density and Uncertain Taxonomy: What are the Implications for the Black Coral Fishery? (C91912)</td>
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<td>DLNR-Division of Aquatic Resources</td>
<td>Black Coral Density and Uncertain Taxonomy: What are the implications for the black coral fishery?</td>
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<td>Marine Archeological Investigation and Survey of the I-400 and I-401</td>
<td>70,368</td>
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<td>Black Coral Density and Uncertain Taxonomy: What are the Implications for the Black Coral Fishery</td>
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<td>Lone Wolf Documentary Group</td>
<td>Marine Archeological Investigation and Survey of Japanese Midget Submarines off Pearl Harbor</td>
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Table 8-1 shows that in the last five years, the department has brought in over $18 million of research funding (over $29 million when the associated HURL program is also included). The figures include an upward trend in the research expenditures (since July 2008) with the addition of three new faculty members and the new grants and contracts they have brought. One of the most significant aspects of this research funding is the research assistantships it provides for ORE students. In the Spring semester of 2009, all but two students in the department had some form of financial support, most by research assistantships. The research projects also acquired laboratory equipment and computers that have been used, in turn, by graduate students working on their theses and research projects. The funding also provided support for the faculty to attend conferences and meetings. Although state general funds are limited, the research funding base obtained by the ORE faculty represents a key financial resource that vastly enriches the graduate program.

Being a graduate education program that emphasizes research, the funding structure for Ocean and Resources Engineering is different from many other undergraduate engineering programs at the University of Hawaii. ORE is heavily focused on the large number of grants brought in by faculty who have been particularly successful in their grant applications over the last several years.
C. Adequacy of Budget

While more funding is always desired and can be profitably spent, the current funding is adequate to meet the basic teaching needs of the department. Research funding is sufficient and serves the needs of the various research projects.

D. Support of Faculty Professional Development

The school provides funding for faculty members to take a fully paid six-month sabbatical every seven years. Normally faculty members take advantage of the offer and conduct their sabbatical at another institution.

The University Research Council provides travel grants to faculty. Most ORE faculty regularly attend one to three professional conferences each year. Generally, attendance costs for these conferences is written into their grants. However, in the absence of a relevant grant, University Research Council funding is relatively easy to apply for to attend relevant conferences once per year, particularly if a paper is being presented.

The University has a training and teaching center to help faculty develop their teaching skills. They also lend a great deal of assistance in the way of teaching technologies and methodologies. The center staff will work one on one with an individual faculty member to improve teaching delivery style.

E. Support of Facilities and Equipment

The School of Ocean and Earth Science and Technology maintains four groups dedicated to facilities support. These include: The Research Computing Facility, the Ocean Technology Group, the Engineering Support Facility, and the Physical Plant Support Facility of SOEST. Each of these groups deals with a certain aspect of facilities support.

The Research Computing Facility (RCF) supports the school’s 1,100 computers and network connections. RCF staff are responsible for repair, upgrade and reestablishing computer connections, upgrading systems, and are generally available within an hour’s notice to assist with all network hardware problems.

The Ocean Technology Group (OTG) maintains all of the school’s seagoing equipment and will operate it, if requested, as well as handle maintenance and repair of systems assigned to them. OTG are available for consultation.

The Engineering Support Facility (ESF) will design and machine unique components for many applications. They maintain a skilled staff of mechanical and electrical engineers. ESF also maintains contacts worldwide to undertake any projects beyond their skill. This group is currently being reorganized and may be reduced in the current economic downturn.

On the other end of the scale is the Physical Plant Support Facility (PPSF). They handle room maintenance issues from burned out lights to broken doors and leaking plumbing. They repaint and upgrade rooms and lab areas. They will also provide or build office and lab furniture.
Quality staff are available to provide the services sought. All of the above services are provided free or at-cost, depending on the nature of the request. If there is a cost, it comes out of the department or laboratory budget of the requesting unit. Services provided at no cost are essentially paid for by the Dean’s office from general school funds to support facilities and equipment.

F. Adequacy of Support Personnel and Institutional Services

The support personnel and institutional services are adequate to meet all of the ORE Department’s needs. Issues of cost do arise. ORE is essentially assigned a budget by the school through a range of institutional processes, including collective bargaining, formula allocation of tuition funds and return of overhead funds on research grants. This budget is adequate to maintain all critical functions. There are times when the department would like to upgrade facilities beyond what the assigned funds would provide. There is no easy way for the department to obtain funds to do this, although we have been getting an increasing level of tax free donations from local engineering companies, alumni and others, which can be applied to facilities through the use of the support groups described above. The department currently has $6,000 in its donation account (held at the University of Hawaii Foundation) and hopes to engage in another fund raising drive in the winter of 2010 in hopes of raising another $10,000. Most donations are small, in the range of $50-$500, largely from University of Hawaii alumni.
CRITERION 9. PROGRAM CRITERIA

While the University of Hawaii has the only Ocean and Resources Engineering Department in the U.S., there are 7 other programs that fall under the general ocean engineering description. There are two specific program criteria for programs carrying the designator of Ocean Engineering and related programs. These are:

1. Curriculum

   The program must demonstrate that graduates have: 1) Knowledge and the skills to apply the principles of fluid and solid mechanics, dynamics, hydrostatics, probability and applied statistics, oceanography, water waves, and underwater acoustics to engineering problems; and 2) the ability to work in groups to perform engineering design at the system level, integrating multiple technical areas and addressing design optimization.

2. Faculty

   Program faculty must have responsibility and sufficient authority to define, revise, implement, and achieve the program objectives.

Curriculum

For the curriculum, many of these requirements are met by pre-program undergraduate requirements. Specifically, fluid and solid mechanics, dynamics and probability and statistics are covered in ABET approved undergraduate programs or, if missing, are part of the make-up courses assigned to a student at the beginning of the Master’s program. The Department Chair and Department ABET committee verifies completion of these requirements. Hydrostatics is covered in core course ORE 411 (Buoyancy and Stability), oceanography in core course ORE 603 (Oceanography for Ocean Engineers), waves in core course ORE 607 (Water Wave Mechanics), acoustics in core course ORE 601 (Ocean Engineering Lab) and ORE 603, as well as elective course ORE 654 (Acoustics). Work in groups, design and design optimization are covered in ORE 783, the Capstone Design class. A design element is further incorporated into student theses. All of these requirements are documented as completed by each student on the student progress form (copy in the appendix). The curriculum is fully described in Criterion 5 and the appendix.

Faculty

At the University of Hawaii the faculty have a great deal of independence in setting objectives and tailoring the program to suit the changing needs of students and the greater engineering community. This right is preserved by contract in the collective bargaining agreement between the University of Hawaii and the Faculty Union. This contract is available on line at http://www.uhpa.org/uhpa-bor-contract. The program and its objectives are reviewed every few years by the faculty in conjunction with both the Department’s local and national/international advisory committees. The faculty has full authority to revise the objectives. If the objectives involve redesigning courses, the School of Ocean and Earth Science curriculum committee must approve the change in the courses. This is a standing faculty committee that meets every few months to review all courses and proposed course changes in the school. If the changes involve course selection for completing the graduate
program, then the university’s graduate division approval must be sought. In general, the Graduate Division always approves program changes requested by the department, after a due process of deliberation has been followed. The rubrics used to measure achievement of program objectives and outcomes are solely selected at the discretion of the department.
A. Satisfaction of Criteria

Great effort is placed on insuring that all undergraduate ABET requirements are fulfilled, even though these courses are not taught by the ORE Department. The undergraduate’s transcripts are closely scrutinized by the Chairman and one other senior Professor (Dr. Kwok Fai Cheung) for adherence to ABET criteria. Clearly, this is easier if the student has graduated from an ABET approved engineering program. Transcript review is done as soon as the student is admitted. The student is informed even before acceptance that there are pre program requirements that need to be fulfilled before the formal Master’s program can start. The exact requirements of the pre-program are published on the Department’s website. Any pre-program deficiencies are noted on the student progress form. These must be resolved before the student can proceed to the formal Master’s program.

The Master’s program requirements are clearly spelled out in Table 5-1. These are noted on the student progress form and checked by the chairman as well as the department’s administrative assistant. Before a student can graduate, the University’s Graduate Division verifies all of the Master’s requirements. The chairman must sign a form that all degree requirements have been completed. The student progress form is also completed as a second check.

B. Advanced Level Knowledge in a Specialized Area

The department offers specialized knowledge in Ocean and Resources Engineering. This specialty is further broken down into offshore, coastal and resources tracks. The students demonstrate that they have this advanced knowledge by passing the core courses and Master’s qualifying exam. The students demonstrate that they have the ability to apply this knowledge by formally applying it to their Master’s level capstone design project and thesis.

Typically, the capstone design class will involve a real world project, for example, a pier design for the major harbor on Maui to accommodate Hawaii’s new Superferry or the design of a seawater air-conditioning system for downtown Honolulu. These design projects are overseen by practicing engineers who serve on our adjunct faculty. The students are held to a standard expected from a professional engineer. Without passing the capstone design project they cannot graduate.

The second demonstration of the ability to apply advanced knowledge is the thesis. Each student writes a thesis (plan A) or major project (plan B) involving original and significant work. This is the second clear demonstration of the ability to put together many of the aspects of what was learned in the courses.

The specialized areas of engineering mastered by our students include: Buoyancy and stability, hydrodynamics, acoustics, water wave mechanics, coastal engineering, offshore energy systems engineering, deep sea resources engineering, and the efficient use of standard ocean engineering measuring tools. The students have a professional level of attainment in these fields such that they could undertake a typical project coming to an ocean engineering company relying on knowledge of the specialty field. The confidence of our many ocean engineering company supporters is a testament to this attainment by our students.
1. Department, Course Number, Title

ORE 202, Ocean Technology - Man in the Sea

2. Designation as a Required or Elective Course

Undergraduate Service Course
Undergraduate Diversification Requirements for Physical Sciences

3. Course Catalog Description

Survey of human activities in the ocean, from the most traditional to the most innovative technical and engineering accomplishments.

4. Prerequisites

None

5. Textbooks and/or Other Reading Material


6. ABET Course Learning Outcomes

(Course Objectives) To introduce the ocean environment and human activities therein to undergraduates with and without a technical background. To introduce the methods used by scientists and engineers to explore and utilize the ocean.

Assessment
4 exams (60%)
Student research paper (30%)
Class participation (10%)

Usage of Engineering Tools and Computers
Computer used to research topic for student paper and produce a report.

7. Topics Covered

1. Historical perspective.
2. Energy flux and transformation in the atmosphere/ocean system.
3. Material flux and transformation in the earth/ocean/atmosphere system.
4. Chemical aspects of the ocean.
5. Biological systems in the ocean.
6. Fishing and aquaculture.
7. Coastal engineering.
8. Offshore engineering and naval architecture.
9. Ocean resources engineering.
10. Future developments.
8. **Class/laboratory schedule**
   Two 1.25-hour sessions per week.

9. **Contribution of Course to Meeting the Requirements of Criterion 5**
   
   (Contribution to Professional Component: Engineering science: 3 credits)

10. **Relationship to Program Outcomes**
    Program Outcome 2: Basic science, mathematics, & engineering
    Program Outcome 6: Problem formulation & solution
    Program Outcome 9: Professional issues
    Program Outcome 11: Research & contemporary issues

11. **Prepared by and date of preparation**
    H.J. Krock, Spring 2003 (course not currently offered)
1. **Department, Course Number, Title**

ORE 330, Mineral & Energy Resources of the Sea

2. **Designation as a Required or Elective Course**

Elective

3. **Course Catalog Description**

Hard material and petroleum origins, exploration and exploitation. Renewable and non-renewable resources distribution. Political and scientific constraints. Pre: 202 or OCN 201, or consent. (Cross-listed as OCN 330)

4. **Prerequisites**

ORE 202 Ocean Technology—Man in the Sea, or OCN 201 Science of the Sea, or consent

5. **Textbooks and/or Other Reading Material**


6. **ABET Course Learning Outcomes**

Upon successful completion of ORE 330, the student should be able to:

1. Understand the various types of marine minerals, their mode of formation and their importance geologically and economically.
2. Understand the various options for deriving energy from the ocean and the potential advantages and disadvantages of each.
3. Understand the legal, environmental, economic and technical difficulties in extracting minerals and energy from the ocean.

7. **Topics Covered**

- Peak Everything, Parts I (Population & Fossil Fuels) & II (Minerals)
- Mid-ocean ridges, basins and trenches
- Overview of submarine hydrothermal systems
- Origins of high and low-temperature hydrothermal deposits
- Recycling of ocean crust and the Geostill Concept
- Chemistry of hydrothermal vents and polymetallic sulfides, Parts I & II
- Introduction to Ocean Energy
- Oil and gas deposits; Future oil provinces
- Oil and Gas: Resources & politics of oil & gas, oil spills & oil spill recovery
- Methane hydrates
- OTEC (Ocean thermal energy conversion)
- Wind power
- Wave power
- Current and tidal power
- Energy futures, hydrogen, fuel cells
- Placer deposits
• Fresh water and desalination
• Geology of ferromanganese crusts and nodules
• Chemistry of crusts and chemical variability with age
• Platinum and phosphorite-rich layers: Seawater vs. extraterrestrial sources
• Phosphorites, Parts I & II
• Mining technology for manganese nodules, crusts and sulfides
• Marine minerals development - Legal and environmental issues
• Marine minerals as possible economic deposits, world metal markets

8. Schedule
Two 1.25-hour sessions per week.

9. Contribution of Course to Meeting the Requirements of Criterion 5

Assessment
Assignments (20%)
Class participation (10%)
Midterm and Final exams (70%)

Usage of Engineering Tools and Computers
Matlab and Excel

Contribution to Professional Component
Engineering Science: 3 credits

10. Relationship to Program Outcomes
Program Outcome 1: Broad Education
Program outcome 2: Basic science, mathematics, & engineering
Program Outcome 6: Problem formulation & solution
Program Outcome 9: Professional issues
Program Outcome 10: Communication skills
Program Outcome 11: Research & contemporary issues
Program Outcome 12: Life-long learning

11. Prepared by
J.C Wiltshire, Spring 2009
1. Department, course number, title

ORE 411 Buoyancy and Stability

2. Designation

Required Core course

3. Course Catalog Description

Buoyancy and Stability (3) Ship nomenclature and geometry, hydrostatic principles of surface ships and underwater vehicles in free-floating, partially water-borne and damaged conditions. Subdivision of ships. Launching. Pre: CE 270 or equivalent. DP

4. Prerequisites

Calculus
Applied Mechanics

5. Textbooks and/or other required material

Lecture Notes by R.C. Ertekin

Reference books

6. ABET Course Learning Outcomes

1. Understand the mathematical principles of buoyancy and stability of floating and submerged bodies,
2. Understand the design principles of intact or damaged ships, offshore platforms, or submersibles to overcome external forces that can overturn them, and
3. Understand the safety of vessels during drydocking and grounding, and their longitudinal strength in calm waters.

7. Topics Covered

1. INTRODUCTION
2. IRREGULAR SHAPES AND NUMERICAL METHODS
3. BUOYANCY AND STABILITY
4. LIST AND BALLAST FREE-SURFACE AND DENSITY EFFECTS
5. STABILITY AT LARGE ANGLES OF INCLINATION
6. LONGITUDINAL STABILITY, TRIM AND HYDROSTATIC CURVES
7. DRY DOCKING AND GROUNDING
8. STABILITY IN DAMAGED CONDITION (or BILGING)
9. HYDROSTATICS OF OFFSHORE PLATFORMS
10. STABILITY OF SUBMERSIBLES
11. STABILITY CRITERIA AND STANDARDS
12. LONGITUDINAL STRENGTH CALCULATIONS (PRIMARY STRENGTH)
13. LAUNCHING

8. Schedule
Two 1.25-hour sessions per week.

9. Contribution of course to meeting the requirements of Criterion 5

   Assessment
   9 Assignments (30%)
   Midterm Exam (35%)
   Final Exam (35%)

Usage of Engineering Tools and Computers
   MS Excel Spreadsheet usage for calculations used in homework
   Use of ship hydrostatics and stability program SHCP to determine hydrostatic and stability
   features of an actual seagoing vessel

Contribution to Professional Component
   Engineering science: 1 credit
   Engineering design: 2 credits

10. Relationship of the Course to Program Outcomes
   Program Outcome 2: Basic science, mathematics, & engineering
   Program Outcome 3: Ocean engineering core
   Program Outcome 5: Use of latest tools in ocean engineering
   Program Outcome 6: Problem formulation & solution
   Program Outcome 9: Professional issues

11. Prepared by
    R.C. Ertekin – April 13, 2009

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Course Objectives
To familiarize students with the hydrostatics and stability of floating and underwater vehicles.
1. **Department, Course Number, Title**

ORE 601 Ocean and Resources Engineering Laboratory

2. **Designation as a Required or Elective Course**
   
   Core course

3. **Course Catalog Description**
   
   Design, construction and evaluation of an engineering system. Laboratory and field experience and data analysis supplemented with appropriate theory. Pre: 603 and 607.

4. **Prerequisites**
   
   General oceanography
   
   Water wave mechanics

5. **Textbooks and/or Other Required Material**
   
   None

   **Reference books**
   
   1. Instrumentation manuals

6. **ABET Course Learning Outcomes**
   
   This course aims to provide ocean and resources engineering students with the fundamentals necessary for carrying out field and laboratory observations along with analysis of observational and experimental data in support of engineering endeavors. Specific objectives include:

   1. Ability to identify and apply appropriate observational, experimental techniques, instrumentation and plan/carry out basic field operations to apply these to assess engineering systems, environmental conditions. (PO: 3, 5, 6, 8, 10)
   2. Understand the fundamental principles of operation, capabilities and limitations of the latest ocean measurement systems and observational platforms and vessels. (PO: 3, 5, 6, 9)
   3. Have a basic understanding of mooring system design and analysis along with deployment/recovery methodology. (PO: 2, 3, 5)
   4. Have a basic knowledge of laboratory experimentation techniques with understanding of appropriate scaling considerations. (PO: 2, 3, 5)
   5. Ability to clearly present laboratory and field observational data and analysis in both oral presentations. (PO: 8, 9, 10)

7. **Topics Covered**

   **Experimental design**
   
   **Instrumentation:** Velocity measurement
   
   Water property measurements

   **Platforms:**
   
   Moorings
   
   Profilers
   
   Vessels
   
   AUVs / ROVs, Gliders
7. Topics Covered (continued)
   Instrument deployment
   Cabled Instrumentation
   Data collection / Sampling
   Laboratory techniques and scaling

8. Schedule
   Two 2.5 hour sessions per week.

9. Contribution of course to meeting the requirements of Criterion 5
   Assessment
   Midterm 25%
   Final 30%
   Course Project 20%
   Homework 20%

   Usage of Engineering Tools and Computers
   Acoustic Doppler current profilers; acoustic Doppler velocimeters; pressure gauges;
   thermistors; CTD; fluorometer; autonomous underwater vehicles, sidescan sonar,
   remotely operated vehicles, cabled ocean observatories, underwater housings, connectors,
   cabling; instrument frames; moorings; rigging; GPS; water sampler; instrumentation
   interfaces; cameras, photography and digital imaging; Matlab; mooring analysis software;
   literature search.

   Contribution to Professional Component
   Engineering science: 2 credits
   Engineering design: 1 credits

10. Relationship to Program Outcomes
    Program Outcome 2: Basic science, mathematics, & engineering
    Program Outcome 3: Ocean engineering core
    Program Outcome 5: Use of latest tools in ocean engineering
    Program Outcome 6: Problem formulation & solution
    Program Outcome 8: Independent & teamwork
    Program Outcome 9: Professional issues
    Program Outcome 10: Communication skills

11. Prepared by
    G. Pawlak, Spring 2009
1. **Department, course number, title**

ORE 603 Oceanography for Ocean Engineers

2. **Designation**

Core Course

3. **Course Catalog Description**

Physical, chemical, biological and geological ocean environments for ocean engineers. Introduction to ocean dynamical processes and general circulation. Ocean measurement techniques, theory of underwater acoustics. Sonar, swath bathymetry, and tomography applications. Pre: consent.

4. **Prerequisites**

Differential equations

Fluid mechanics

5. **Textbooks**

R.H. Stewart (2007), An introduction to physical oceanography

Reference books


6. **ABET Course Learning Outcomes**

7. **Topics Covered**

1. Ocean Basins and Margins
2. Properties of Water / Sea Water Chemistry
3. Water, Salt and Heat Balance
4. Physical Laws and Equations of Motion
5. Effects of Rotation
6. Atmospheric Circulation
7. Ocean Circulation
8. Coastal Oceanography
9. Biological Oceanography
10. Instruments and Methods
11. Underwater Acoustics

8. **Schedule**

Two 1.25-hour sessions per week.
9. Contribution of Course to Meeting the Requirements of Criterion 5

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Percentage</th>
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<tr>
<td>Test 2</td>
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</tr>
<tr>
<td>Course Project</td>
<td>20%</td>
</tr>
<tr>
<td>Homework</td>
<td>40%</td>
</tr>
</tbody>
</table>

Contribution to Professional Component
Engineering Science: 3 credits

10. Relationship to Program Outcomes
Program Outcome 2: Basic science, mathematics, & engineering
Program Outcome 3: Ocean engineering core
Program Outcome 6: Problem formulation & solution
Program Outcome 10: Communication skills
Program Outcome 11: Research & contemporary issues

Student Learning Outcomes
Upon successful completion of ORE 603, students will be able to:
1. Identify, describe, and relate the physical processes and dynamics processes associated with surface and deep ocean circulation
2. Describe and relate sea-water chemistry, salinity, temperature, pressure, and density
3. Summarize the basic principles and implications of plate tectonics and marine sedimentation
4. Demonstrate a basic understanding of biological processes and production in the ocean
5. Explain the key elements associated with air-sea interaction
6. Balance oceanic water, heat, and salt budgets
7. Demonstrate a basic understanding of sound propagation in the ocean
8. Formulate and communicate (in writing and orally) a critical review of a research paper

11. Prepared by
   E.-M. Nosal, Fall 2008

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Course Objectives
To provide the ocean engineering student with an understanding of the ocean environment. The course will provide an overview of the physical, chemical, biological and geological processes that determine the state of the ocean and its dynamics. Topics of discussion will include description of the world's oceans and dynamic processes, introduction to analytical description, circulation and ocean measurement techniques. Theory of underwater acoustics will be examined along with sonar, swath bathymetry and tomography applications.
1. Department, Course Number, Title

ORE 607 Water Wave Mechanics

2. Designation as a Required or Elective Course
Core Course

3. Course Catalog Description
Governing equations in free surface flow, deterministic and probabilistic wave theories, wave transformation, wave-induced coastal currents, tides, ocean engineering operational sea state, and design wave criteria. Pre: consent.

4. Prerequisites
Differential equations
Fluid mechanics

5. Textbooks and/or other required material
None

Reference Materials:

6. ABET Course Learning Outcomes
The course familiarizes students with water wave mechanics for ocean structure design and the use of measured and synthesized data to define operating and design wave conditions. Specific learning outcomes include:
1. Ability to apply knowledge of mathematics and mechanics to formulate and solve water wave problems
2. Understanding kinematics, dynamics, propagation, transformation, and statistical properties of water waves.
3. Ability to apply water wave theories in engineering design.

7. Topics Covered
1. Wave Theories. Linear, Stokes second-order, first and second-order cnoidal, solitary, and stream-function wave theories.
2. Wave Transformation. Shoaling, refraction, diffraction, reflection, breaking, and runup on beaches.
4. Operational and Design Criteria. Winds, wave hindcasting and forecasting, tides, hurricane waves, storm surge, wave setup, design wave conditions and water level.
5. Wave Induced Coastal Currents. Radiation stress, harbor oscillation, cross-shore and long-shore currents.

8. Schedule
   Two 1.25-hour sessions per week

9. Contribution of course to meeting the requirements of Criterion 5

   Assessment
   1 assignment and 3 projects (50%)
   Class participation (10%)
   Final Exam (40%)

   Usage of Engineering Tools and Computers
   Automated Coastal Engineering System (ACES), Coastal Engineering Manual (CEM), Excel, and Matlab

   Contribution to Professional Component
   Engineering Science: 2 credits
   Engineering Design: 1 credit

10. Relationship to Program Outcomes
    Program Outcome 2: Basic science, mathematics, & engineering
    Program Outcome 3: Ocean engineering core
    Program Outcome 5: Use of latest tools in ocean engineering
    Program Outcome 6: Problem formulation & solution

11. Prepared by
    K.F. Cheung, Spring 2009
1. Department, Course Number, Title
   ORE 608, Probability and Statistics for Ocean Engineers

2. Designation as a Required or Elective Course
   Elective

3. Course Catalog Description
   Probability and statistical analysis including distributions, multiple regression and correlation, autocovariance, cross-spectra, and practical applications in ocean engineering. Pre: 607 or consent.

4. Prerequisites
   Calculus
   Probability and statistics
   Water wave mechanics

5. Textbooks and/or Other Reading Material
   Textbooks: None
   Reference books:
   1. *Data Analysis Methods in Physical Oceanography* - Emery and Thomson
   2. *Extreme Value Theory in Engineering* - Castillo
   3. *Numerical Recipes* - Press, Flannery, Teukolsky, and Vetterling
   7. *Spectral Analysis for Physical Applications* - Percival and Walden
   8. *Spectral Analysis and Time Series* - Priestley

6. ABET Course Learning Outcomes
   (Course objectives) To provide an overview of statistical methods with applications using real data sets from the fields of oceanography and ocean engineering.

7. Topics Covered
   Random Variables
   Probability Density Functions
   Moments and Expected Values
   Statistics of Extreme Events
   Estimation and Sample Distributions
   Confidence Intervals
   Hypothesis Testing
   Regression and Correlation
   Degrees of Freedom
   Monte Carlo Methods
   Stochastic Processes
   Fourier Analysis
   Auto-Spectra
   Rotary Spectra
   Cross-Spectra
   Digital Filters
   Complex Demodulation
   Empirical Orthogonal Functions

8. Class/laboratory schedule
   Two 1.25-hour sessions per week.
9. Contribution of Course to Meeting the Requirements of Criterion 5

Engineering Science: 3 credits

Assessment
50% Homework
20% Midterm Exam
30% Final

Usage of Engineering Tools and Computers
Matlab

Contribution to Professional Component
Engineering Science: 3 credits

10. Relationship to Program Outcomes
Program Outcome 2: Basic science, mathematics, & engineering
Program Outcome 5: Use of latest tools in ocean engineering
Program Outcome 6: Problem formulation & solution

11. Prepared by and date of preparation
M.A. Merrifield, Spring 2009
1. **Department, course number, title**

   ORE 609 Hydrodynamics of Fluid-Body Interaction

2. **Designation as a Required or Elective Course**

   Required Core course

3. **Course Catalog Description**


4. **Prerequisites**

   Water-Wave Theories (ORE 607)
   Basic Fluid Mechanics
   Complex Variables
   Vector Calculus

5. **Textbooks and/or other required material**

   Lecture Notes by R.C. Ertekin
   Reference books:
   1. Sarpkaya and Isaacson: Mechanics of Wave Forces on Offshore Structures
   2. Newman: Marine Hydrodynamics
   4. Ippen: Estuary and Coastline Hydrodynamics
   5. Mei: The Applied Dynamics of Ocean Surface Waves
   6. Abramowitz and Stegun: Handbook of Mathematical Functions
   7. Gradshteyn and Ryzhik: Table of Integrals, Series and Products
   9. Mase: Continuum Mechanics

6. **ABET Course Learning Outcomes**

   1. Understand the theoretical and experimental principles of fluid-body interaction problems in the oceans,
   2. Understand the principles of viscous and ideal flow and be able to apply the principles to problem solving that involves rigid body movements in the oceans, and
   3. Understand the diffraction, radiation and motions of floating and submerged bodies in deterministic and irregular wave

7. **Topics Covered**

   1) INTRODUCTION
   2) DIMENSIONAL ANALYSIS
   3) VISCOUS-FLUID FLOW
   4) IDEAL-FLUID FLOW
5) WATER WAVES (The purpose is for clarification of notation and to introduce perturbation expansion)
6) WAVE DIFFRACTION AND FORCES
7) FLOWS WITH PRESCRIBED BODY MOTION AND FREELY-FLOATING BODIES
8) IRREGULAR-SEA ANALYSIS (The purpose is to apply the force and motion transfer functions in random waves)

8. Schedule
Two 1.25-hour sessions per week.

9. Contribution of course to meeting the requirements of Criterion 5

Assessment
9 Assignments (30%)
Midterm Exam (35%)
Final Exam (35%)

Usage of Engineering Tools and Computers
MS Excel Spreadsheet usage for calculations used in homework

Contribution to Professional Component
Engineering science: 2 credits
Engineering design: 1 credit

10. Relationship of the Course to Program Outcomes
Program Outcome 2: Basic science, mathematics, & engineering
Program Outcome 3: Ocean engineering core
Program Outcome 6: Problem formulation & solution

11. Prepared by
R.C. Ertekin – April 13, 2009

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Course Objectives
This course is designed to give ocean engineering students a basic background for the assessment of hydrodynamic loads acting on fixed and floating bodies in regular and irregular waves.
1. Department, Course Number, Title

ORE 612 Dynamics of Ocean Structures

2. Designation as a Required or Elective Course

Offshore Engineering Required Course

3. Course Catalog Description

Response of floating platforms and vessels to wave action, spectral analysis in sea keeping. Frequency and time domain analyses of rigid body motions in six degrees of freedom. Pre: 411 or consent. Co-requisite: 609 or consent.

4. Prerequisites

- Applied mechanics
- Differential equations
- Hydrostatics
- Water wave theories

5. Textbooks and/or Other Reading Material

Textbook: None
Reference books
1. R. Bhattacharyya, Dynamics of Marine Vehicles, John Wiley & Sons, 1978
5. J.P. Den Hartog, Mechanical Vibrations, McGraw-Hill, 1940
6. O.M. Faltinsen, Sea Loads on Ships and Offshore Structures, Cambridge University, 1990

6. ABET Course Learning Outcomes

1. Understand the wave forces which act on offshore structures
2. Be able to calculate these forces for various situations
3. Have a sound background in the mathematical tools involved
4. Have a basic understanding of offshore structure kinematics
7. **Topics Covered**
   1. Linear Oscillator. One Degree of Freedom; Free Vibration with Linear Damping; Forced Vibration – Steady State Oscillation, Transient, and Nonperiodic Vibrations; Steady State Oscillation; Time Domain Solutions
   2. Motion of Floating Bodies. Kinematics of Rigid Bodies, Linear Momentum of a Rigid Body, Angular Momentum, Dynamics of a Rigid Body
   3. Hydrodynamic Coefficients and Wave Excitation – 3D Source Distribution. Review of Ideal Fluid Theory, Green’s Theorem and Distribution of Singularities,
   5. Ship Motions in Irregular Seas. St. Denis et al. (1950)

8. **Schedule**
   Two 1.25-hour sessions per week.

9. **Contribution of Course to Meeting the Requirements of Criterion 5**

   **Assessment**
   7 Homework Assignments (30%)
   Midterm Exam (30%)
   Final Exam (40%).

   **Usage of Engineering Tools and Computers**
   MathCad, FORTRAN

   **Contribution to Professional Component**
   Engineering Science: 2 credits
   Engineering Design: 1 credit

10. **Relationship to Program Outcomes**
    Program Outcome 2: Basic science, mathematics, & engineering
    Program Outcome 4: Ocean engineering specialization
    Program Outcome 6: Problem formulation & solution

11. **Prepared by**
    B.D. Greeson, Spring 2009

Course Objectives
To familiarize students with the theoretical methods and numerical techniques in analyzing the dynamic response of floating structures in regular and irregular waves.
1. Department, Course Number, Title

ORE 630, Structural Analysis in Ocean Engineering

2. Designation as a Required or Elective Course

Required

3. Course Catalog Description

Structural and finite element analyses and design of ocean structures to withstand hydrostatic and hydrodynamic loading of the sea. Considerations include material type, safety factor, stress concentration, and fatigue. Pre: consent. Co-requisite: 411.

4. Prerequisites

Calculus and algebra
Differential equations
Numerical methods
Solid mechanics

5. Textbooks and/or Other Reading Material


6. ABET Course Learning Outcomes

(Course objectives) To familiarize students with structural analysis, finite element analysis, and their application in ocean structure design.

7. Topics Covered

1. Matrix analysis of structures.
2. Finite element method. One-dimensional element, constant-strain triangle, isoparametric 3-node and 4-node elements, numerical integration.
3. Introduction to ANSYS.

8. Class/laboratory schedule

Three 50-minute sessions per week.

9. Contribution of Course to Meeting the Requirements of Criterion 5

Assessment
8 Assignments
1 midterm
1 final exam
1 final project

Usage of Engineering Tools and Computers
ANSYS
Contribution to Professional Component
Engineering Science: 1 credit
Engineering Design: 2 credits

10. Relationship to Program Outcomes
Program Outcome 2: Basic science, mathematics, & engineering
Program Outcome 4: Ocean engineering specialization
Program Outcome 5: Use of latest tools in ocean engineering
Program Outcome 6: Problem formulation & solution
Program Outcome 7: Design & optimization in ocean engineering
Program Outcome 9: Professional issues

11. Prepared by and date of preparation
R.H. Knapp, Spring 2003
1. **Department, Course Number, Title**

   ORE 641, Environmental Fluid Dynamics

2. **Designation as a Required or Elective Course**

   Elective

3. **Course Catalog Description**

   Fluid dynamics for coastal and estuarine environments. Turbulent mixing processes in homogeneous and stratified fluids. Buoyancy driven flows, internal hydraulics, topographic effects and estuarine circulation. Spill and pollutant dispersal. Pre: 603 or consent.

4. **Prerequisites**

   - Differential equations
   - Fluid mechanics

5. **Textbooks and/or Other Reading Material**

   **Textbook:** None

   **Reference books:**

6. **ABET Course Learning Outcomes**

   (Course objectives) This course aims to provide ocean and resources engineering students with an understanding of the fundamental dynamic processes at work in the coastal marine environment. It examines how these processes lead to the transport and dispersal of properties such as salinity, temperature, pollutants and nutrients.

7. **Topics Covered**

   1. Transport processes / Diffusion
   2. Fluid dynamics review
   3. Turbulence
      a. Turbulent shear layers
      b. Stratified shear layers
      c. Boundary layers
   4. Buoyancy driven turbulent flow
   5. Downslope currents
   6. Plumes and jets
   7. Internal waves
   8. Internal hydraulics
   9. Estuarine hydrodynamics
   10. Pollutant and spill dispersal
8. Class/laboratory schedule
   Two 1.25-hour sessions per week.

9. Contribution of Course to Meeting the Requirements of Criterion 5

   **Assessment**
   Individual presentations 10%
   In class discussion 15%
   Homework 40%
   Midterm 15%
   Final Exam 20%

   **Usage of Engineering Tools and Computers**
   Matlab

   **Contribution to Professional Component**
   Engineering Science: 3 credits

10. Relationship to Program Outcomes
    Program Outcome 2: Basic science, mathematics, & engineering
    Program Outcome 5: Use of latest tools in ocean engineering
    Program Outcome 6: Problem formulation & solution

11. Prepared by and date of preparation
    G. Pawlak, Spring 2009
1. Department, Course Number, Title

ORE 642, Marine Environmental Remediation

2. Designation as a Required or Elective Course

Elective

3. Course Catalog Description

Thermodynamics, chemistry and measurements of marine pollutants, biodegradation and biotransformation of pollutants, symbiosis and mass transfer in biofilms, bioremediation of oil spills, hazardous sediments, algae control, regulations on marine environment. Pre: consent.

4. Prerequisites

Chemistry
Fluid mechanics

5. Textbooks and/or Other Reading Material

Textbook: None
Reference books:

6. ABET Course Learning Outcomes

(Course objectives) To provide students the tools to evaluate the environmental effects of engineering projects in the marine environment.

7. Topics Covered

1. Seawater chemistry
2. Marine biological systems
3. Toxic and stimulatory responses
4. Transport and mixing
5. Environmental consequences and remediation of: marine mining, oil/gas extraction, coastal engineering projects, dredging, wastewater discharges, waste heat, non-point discharges, aquaculture.
6. Global warming
7. Future developments

8. Class/laboratory schedule

Two 1.25-hour sessions per week.
9. Contribution of Course to Meeting the Requirements of Criterion 5

**Assessment**
3 exams (60%)
Engineering report (40%)

**Usage of Engineering Tools and Computers**
Computer use required for engineering report for data evaluation and word processing.

**Contribution to Professional Component**
Engineering Science: 2 credits
Engineering Design: 1 credit

10. Relationship to Program Outcomes
Program Outcome 2: Basic science, math, & engineering
Program Outcome 6: Problem formulation & solution
Program Outcome 9: Professional issues

11. Prepared by and date of preparation
H.J. Krock, Spring 2003 (course not currently offered)
1. **Department, course number, and title**

ORE 654 Applications of Ocean Acoustics

2. **Designation**

Elective

3. **Course Catalog Description**

Using sound to observe the ocean. Fundamentals of propagation, sources and receivers, radiated sound and scattering, bubbles, waveguides, scattering at rough surfaces, and bioacoustics. Topics include: marine mammals, fish and plankton imaging, navigation and communication, sound of seismics, ships, wind and rain, using sound to study ocean dynamics, flow imaging and measurement, mapping the seafloor and the combined forward/inverse problem.

4. **Prerequisites**

Consent of instructor

5. **Textbook(s)**

Textbook: *Sound in the Sea*, Medwin, Cambridge University Press, 2005

Reference Books:
- *Sound transmission through a fluctuating ocean*, Flatte, Cambridge University Press, 1979

6. **ABET Course Learning Outcomes**

7. **Topics Covered**

1. Fundamentals: Simple propagation, rays, sources and receivers, radiated sound, bioacoustics, waveguides, scattering by bubbles, interior fluctuations, and rough surfaces
2. The near surface ocean: upper ocean boundary layer and rain
3. Bioacoustics: sensing of plankton and nekton; passive acoustics and marine animals, marine mammals
4. Ocean Dynamics: tomography, time reversal, turbulence
5. Ocean Bottom: imaging hydrothermal vents, large scale mapping
8. Schedule
Two 1.25-hour sessions per week

9. Contribution of course to meeting the requirements of Criterion 5

Assessment
Assignments (40%)
Class participation (10%)
Project paper and presentation (50%)

Usage of Engineering Tools and Computers
Matlab and Excel

Contribution to Professional Component
Engineering Science: 3 credits

10. Relationship to Program Outcomes
Program Outcome 2: Basic science, mathematics, & engineering
Program Outcome 4: Ocean engineering specialization
Program Outcome 5: Use of latest tools in ocean engineering
Program Outcome 6: Problem formulation & solution
Program Outcome 9: Professional issues
Program Outcome 10: Communication skills
Program Outcome 11: Research & contemporary issues

11. Prepared by
B.M. Howe, Spring 2009

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Course Objectives
The objective of this course is to provide the ocean engineering student an understanding of how sound propagates through the ocean environment and how to use that information to observe the ocean. The course will provide an overview of the fundamentals of sound propagation, sound of seismics, ships, wind and rain, bioacoustics, using sound to study ocean dynamics, and imaging and mapping the seafloor. At the outcome, students will be able to formulate the combined forward/inverse problem, from tracing rays and estimating sound levels to solving for rainfall or current velocity, for example.
1. **Department, Course Number, Title**

   ORE 661 Coastal and Harbor Engineering

2. **Designation as a Required or Elective Course**

   Required Course

3. **Course Catalog Description**

   Planning and design of seawalls, groins, jetties, breakwaters, and layout of ports. Design requirements for harbor entrances and channels. Littoral drift and sedimentation problems. Navigation and mooring requirements. Pre: 607 or consent.

4. **Prerequisites**

   Applied mechanics
   Engineering economics
   Fluid mechanics
   Hydraulics
   Probability and Statistics
   Soil Mechanics
   Wave mechanics

5. **Textbooks and/or Other Reading Material**

   Textbook: None
   Reference books:
   2. NAVFAC DM 26.1, 26.2, and 26.3

6. **ABET Course Learning Outcomes**

   The course familiarizes students with the planning, design, and maintenance of coastal and harbor structures. Specific learning outcomes include:
   1. Ability to identify, formulate, and solve coastal and harbor engineering problems
   2. Ability to provide optimal designs of coastal structures and harbor facilities
   3. Appreciation of professional and non-technical issues

7. **Topics Covered**

   1. Planning and Design. Problem definition, site characterization and data, alternative evaluation.
   2. Breakwaters. Rubble mound structures (conventional and berm design), caissons, scour protection, and geotechnical consideration.
3. Revetments and Seawalls. Rubble mound structures, caissons, lateral earth pressure, seismic consideration.

8. **Schedule**
   Two 1.25-hour sessions per week.

9. **Contribution of Course to Meeting the Requirements of Criterion 5**

   **Assessment**
   - 3 design projects (90%)
   - Class participation (10%)

   **Usage of Engineering Tools and Computers**

   **Contribution to Professional Component**
   - Engineering Science: 1 credit
   - Engineering Design: 2 credits

10. **Relationship to Program Outcomes**
    Program Outcome 2: Basic science, mathematics, & engineering
    Program Outcome 4: Ocean engineering specialization
    Program Outcome 5: Use of latest tools in ocean engineering
    Program Outcome 6: Problem formulation & solution
    Program Outcome 7: Design & optimization in ocean engineering
    Program Outcome 9: Professional issues

11. **Prepared by**
    K.F. Cheung, Spring 2009
1. Department, Course Number, Title

ORE 664, Nearshore Processes and Sediment Transport

2. Designation as a Required or Elective Course

Coastal Engineering Required Course

3. Course Catalog Description

Sediment transport by waves and currents in coastal areas and its effect on morphological processes. Effect of man-made structures on littoral drift and shoreline. Pre: 607 or consent.

4. Prerequisites

Differential equations
Fluid mechanics
Wave mechanics

5. Textbooks and/or Other Reading Material

Textbook: None

Reference books:

6. ABET Course Learning Outcomes

(Course objectives) The aim of the course is to provide engineers working in the coastal environment with the understanding of wave and sediment processes and their effects on the morphology of beaches and coastlines. We will explore the dynamics of the nearshore environment in detail, including consideration of wave boundary layer processes and sediment particle dynamics and examine how these can be considered using engineering models.

7. Topics Covered

1. Coastal Morphology
2. Fluid Dynamics and Wave Theory Review
3. Nearshore Currents
4. Boundary Layer Dynamics
5. Sediment Dynamics
6. Cross-shore Transport
7. Longshore Transport
8. Sediment Transport Models
9. Nearshore Morphodynamics
8. Class/laboratory schedule
   Two 1.25-hour sessions per week.

9. Contribution of Course to Meeting the Requirements of Criterion 5

   **Assessment**
   - Class Participation  10%
   - Final Exam  30%
   - Homework Projects  30%
   - Lab Project  30%

   **Usage of Engineering Tools and Computers**
   Matlab, acoustic and image based velocity measurement, image processing

   **Contribution to Professional Component**
   - Engineering Science: 2 credits
   - Engineering Design: 1 credit

10. Relationship to Program Outcomes
    - Program Outcome 2: Basic science, math, & engineering
    - Program Outcome 5: Use of latest tools in ocean engineering
    - Program Outcome 6: Problem formulation & solution

11. Prepared by and date of preparation
    - G. Pawlak, Spring 2009
1. **Department, Course Number, Title**

ORE 677, Marine Renewable Energy

2. **Designation as a Required or Elective Course**

Ocean Resources Engineering Required Course

3. **Course Catalog Description**

Ocean thermal energy conversion (OTEC) systems: applicability, thermodynamics, design challenges; wave energy converters: floating devices, oscillating water column, optimal hydrodynamic performance; current, tidal and offshore wind power. Prerequisite: ORE 607; basic knowledge of thermodynamics desirable.

4. **Prerequisites**

Water Wave Mechanics

5. **Textbooks and/or Other Reading Material**

   Textbooks: None

   Reference books:


6. **ABET Course Learning Outcomes**

   1. An understanding of the principles and applicability of OTEC systems.
   2. An understanding of the design principles and engineering criteria to develop functional and efficient electrical power generation from wave, wind, current and tidal resources.
   3. An understanding of the role of ocean renewable energy within the current worldwide framework of energy production.

7. **Topics Covered**

   1. Economic, social and political context of energy production.
   2. Estimation of the OTEC resource.
   3. Thermodynamics of basic OTEC cycles.
   4. Design of pipes, pumps, heat exchangers, turbines, generators.
   5. Floating wave energy converters and oscillating water columns.
   7. Design principles and constraints.
   8. Current, tidal and wind power production.
8. Class/laboratory schedule
   Two 1.25-hour sessions per week.

9. Contribution of Course to Meeting the Requirements of Criterion 5
   
   Assessment
   Homework (50%)
   Course Project (50%)

   Usage of Engineering Tool and Computers
   Computer use required for engineering report for data and word processing.

   Contribution to Professional Component
   Engineering Science: 1 credit
   Engineering Design: 2 credits

10. Relationship to Program Outcomes
    Program Outcome 2: Basic science, mathematics, & engineering
    Program Outcome 4: Ocean engineering specialization
    Program Outcome 6: Problem formulation & solution
    Program Outcome 7: Design & optimization in ocean engineering
    Program Outcome 9: Professional issues

11. Prepared by and date of preparation
    G.C. Nihous, Spring 2009
1. Department, Course Number, Title
   ORE 678, Marine Mineral Resources Engineering

2. Designation as a Required or Elective Course
   Required for Resources track

3. Course Catalog Description
   Activities in marine minerals development are examined in a multidisciplinary systems
   approach involving engineering, Earth and environmental sciences and economics. Pre:
   Consent

4. Prerequisites
   Applied mechanics
   Engineering economics

5. Textbooks and/or Other Reading Material

6. ABET Course Learning Outcomes
   The course familiarizes students with the mineral resources of the ocean and the engineering
   challenges faced to exploit them. Specific course learning outcomes include:
   1. Ability to formulate the design issues involved in underwater mining equipment.
   2. An understanding of the range and type of ocean mineral deposits.
   3. Ability to articulate the environmental, economic and energy issues involved in ocean
      mineral development

7. Topics Covered
   • Introduction to Marine Minerals
   • Peak Everything - Running out of Commodities
   • Manganese Nodules and Marine Mining
   • Deep Sea Mining Technology
   • Minerals Processing
   • Offshore Oil and Gas
   • Oil and Gas Technology, Future Oil Sources and Issues
   • Economics of Marine Minerals
   • World Metal Markets
   • Formation Processes of Polymetallic Sulfides (PMS) on the Ocean Floor: Geology of the
     Smoker and PMS
   • Chemistry of Hydrothermal Vents and Polymetallic Sulfides
   • PMS Deposits: From Smoker to an Ore Body
   • Case Studies on the Ocean Floor: The Red Sea
   • Ferromanganese Crusts, Methane Hydrates, Placers
8. **Schedule**
   Two 1.25-hour sessions per week.

9. **Contribution of Course to Meeting the Requirements of Criterion 5**
   - **Usage of Engineering Tools and Computers**
     Matlab and Excel
   - **Contribution to Professional Component**
     - Engineering Science: 2 credits
     - Design: 1 credit

10. **Relationship to Program Outcomes**
    - Program Outcome 1: Broad Education
    - Program outcome 2: Basic science, mathematics, & engineering
    - Program Outcome 4: Ocean engineering specialization
    - Program Outcome 5: Use of latest tools in ocean engineering
    - Program Outcome 6: Problem formulation & solution
    - Program Outcome 9: Professional issues
    - Program Outcome 10: Communication skills
    - Program Outcome 11: Research & contemporary issues

11. **Prepared by**
    J.C Wiltshire, Spring 2009
1. Department, Course Number, Title

ORE 707, Nonlinear Water Wave Theories

2. Designation as a Required or Elective Course

Elective

3. Course Catalog Description

Higher-order theories. Forced oscillations. Stokes theory. Nonlinear shallow-water wave equations and hydraulic jumps; effects of rotation. Internal waves. Analytical techniques necessary will be developed as course progresses. Pre: consent.

4. Prerequisites

1. Advanced Applied Mathematics
2. Linear Water Wave Theory

5. Textbooks and/or Other Reading Material

Textbook: Notes by R.C. Ertekin
Reference books:

6. ABET Course Learning Outcomes

(Course objectives) This course is designed to introduce graduate students into the treatment of nonlinear water waves in both deep and shallow waters.

7. Topics Covered

1. Approach of Linear and nonlinear systems.
2. Higher-order approximations to water waves.
3. Perturbation methods.
4. Stokes’ theory.
5. Shallow-water waves - KdV and Boussinesq equations.
7. Internal waves.
8. Theory of directed fluid sheets.
9. Nonlinear drift forces on offshore platforms.

8. Class/laboratory schedule

Two 1.25-hour sessions per week.

9. Contribution of Course to Meeting the Requirements of Criterion 5

Usage of Engineering Tools and Computers
Write programs to solve various nonlinear wave propagation problems in time domain on workstations and micro computers.

Laboratory Projects
1. Linear-Nonlinear response model, ship and platform motions.
2. Selected shallow-water wave problems, shoaling, run-up.
3. Potential and viscous drift forces on floating bodies.

Contribution to Professional Component
Engineering Science: 2 credits
Engineering Design: 1 credit

10. Relationship to Program Outcomes
Program Outcome 2: Basic science, mathematics, & engineering
Program Outcome 6: Problem formulation & solution

11. Prepared by and date of revision/preparation
R.C. Ertekin, 2009
1. **Department, Course Number, Title**

   ORE 766 Numerical Methods in Ocean Engineering

2. **Designation as a Required or Elective Course**

   Elective Course

3. **Course Catalog Description**

   Formulation and application of numerical methods for simulating and solving ocean engineering problems. Topics include: Mathematical and computational fundamentals with implications for accuracy and stability; numerical interpolation, differentiation, and integration; boundary element, finite difference, and finite element methods. Pre: consent.

4. **Prerequisites**

   - Computer programming language
   - Differential equations
   - Basic numerical methods
   - Fluid mechanics
   - Water wave theory

5. **Textbooks**

   - Reference books:

6. **ABET Course Learning Outcomes**

7. **Topics Covered**

   1. MATLAB fundamentals
   2. Solving linear systems
   3. Curve fitting and interpolation
   4. Numerical differentiation and integration

8. **Schedule**

   Two 1.25-hour sessions per week. 50% lecture, 50% computer lab.

9. **Contribution of Course to Meeting the Requirements of Criterion 5**

   - **Assessment**
     - Homework: 60%

A-38
Final project 40%

Contribution to Professional Component
Engineering Science: 3 credits

10. Relationship to Program Outcomes
Program Outcome 2: Basic science, mathematics, & engineering
Program Outcome 5: Use of latest tools in ocean engineering
Program Outcome 6: Problem formulation & solution
Program Outcome 10: Communication skills

Student Learning Outcomes
Upon successful completion of ORE 766, students will be able to:
1. Demonstrate an understanding of the fundamental principles of digital computing, including number representation and arithmetic operations.
2. Develop and implement stable and accurate numerical methods to solve linear systems of equations and find roots of linear and non-linear equations.
3. Perform numerical interpolation, curve fitting, integration, and differentiation.
4. Develop and implement stable algorithms to solve ordinary differential equations and simple partial differential equations.

11. Prepared by
E.-M. Nosal, Spring 2009

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Course Objectives
The objective of this course is to provide students with the background and skills required to numerically simulate and solve Ocean Engineering problems. This will be a hands-on class with theory accompanied by practical implementation in MATLAB. After a review of programming in MATLAB and basic numerical methods (linear equations, interpolation, numerical differentiation, integration), methods to solve various ordinary and partial differential equations will be covered. Emphasis will be placed on application to Ocean Engineering problems such as potential flow, water waves, ocean structures, and ocean acoustics.
1. **Department, Course Number, Title**
   
   ORE 783 (Alpha) Capstone Design Project

2. **Designation as a Required or Elective Course**
   
   Coastal Engineering Required Course (B)
   
   Offshore Engineering Required Course (C)
   
   Ocean Resources Engineering Required Course (D)

3. **Course Catalog Description**

   Major design experience based on knowledge and skills acquired in earlier coursework incorporating realistic constraints that include economic, environmental, ethical, social, and liability considerations. Emphasis is placed on teamwork and consultant-client relationship. (B) coastal engineering; (C) offshore engineering; (D) ocean resources engineering. Repeatable one time.

4. **Prerequisites**

   1. All students: hydrostatics, at-sea experience, oceanography, water wave mechanics, wave-structure interaction, and engineering economics.
   2. Coastal engineering students: coastal and harbor structures, coastal processes, and sediment transport.
   4. Ocean resources engineering students: OTEC system and marine mineral resources.

5. **Textbooks and/or Other Reading Material**

   Textbook: None
   
   Reference books: Applicable design manuals

6. **ABET Course Learning Outcomes**

   The course familiarizes the students with the planning and design of a real-life engineering project in a consulting firm setting. Emphasis is placed on teamwork, risk management, decision making with insufficient information, consultant-client relation, ethics, and environmental and economic aspects of engineering design. Specific learning outcomes include:

   1. Appreciation of professional and ethical responsibilities
   2. Ability to work independently and function on multi-disciplinary teams
   3. Ability to design and optimize ocean and resources engineering systems
   4. Ability to use techniques, tools, and data necessary for ocean engineering practice
   5. Ability to communicate effectively to technical and non-technical audiences

7. **Topics Covered**

   The topic varies every semester and reflects the latest engineering projects in Hawaii. The course is team taught with practicing professional engineers including:

   1. Warren Bucher, PhD, PE, Senior Engineer, Oceanit Laboratory Inc.
   2. David Rezachek, PhD, PE, President, Rezachek and Associates, Inc.
   3. Joe Van Ryzin, PhD, PE, President (former), Makai Ocean Engineering Inc.
   4. Dayan Vithanage, PhD, PE, Vice President, Oceanit Laboratory Inc.
5. Healy Tibbitts Builders Inc., a major marine contractor in Hawaii, has been supporting the capstone design class by providing feedback to student designs and up-to-date cost and construction data.

The following is a list of capstone design projects performed by students since the last review:
1. Waikiki War Memorial Natatorium: Coastal Engineering Evaluation – Fall 2004 (Cheung/Bucher)
3. Flood Insurance Rate Map (FIRM) Modernization Project – Spring 2006 (Cheung)
4. Mitigation of Erosion at Kahala Beach – Fall 2007 (Cheung/Bucher)
5. Evaluation and Design of the Kahului Harbor Improvements – Fall 2008 (Cheung/Vithanage)
6. Preliminary Design of a Cooling Station, Seawater Pipe System, and Chilled Water Distribution System for an Up to 20,000-ton Seawater Air Conditioning (SWAC) District Cooling System for Pearl Harbor/Hickam/Honolulu International Airport – Spring 2009 (Cheung/Rezachek/Van Ryzin)

8. Schedule
The course is conducted as a series of meetings and informal presentations and culminates in a major presentation analogous to a public hearing at a department seminar attended by the faculty, students, and visitors from the local engineering community.

9. Contribution of Course to Meeting the Requirements of Criterion 5

Assessment
Informal presentations and discussions at meetings, formal presentation in front of audience, progress reports, final report, and mutual evaluation among students.

Usage of Engineering Tools and Computers
Varies and depends on the project.

Contribution to Professional Component
Engineering Design: 3 credits

10. Relationship to Program Outcomes
Program Outcome 2: Basic science, mathematics, & engineering
Program Outcome 3: Ocean engineering core
Program Outcome 4: Ocean engineering specialization
Program Outcome 5: Use of latest tools in ocean engineering
Program Outcome 6: Problem formulation & solution
Program Outcome 7: Design & optimization in ocean engineering
Program Outcome 8: Independent & teamwork
Program Outcome 9: Professional issues
Program Outcome 10: Communication skills

11. Prepared by
K.F. Cheung, Spring 2009
APPENDIX B

FACULTY RESUMES

Departmental, Cooperating and Affiliate Faculty
1. **Name and Academic Rank**
   
   Kwok Fai Cheung, Professor

2. **Education**
   
   Ph.D., Civil Engineering, University of British Columbia, 1991  
   M.A.Sc., Civil Engineering, University of British Columbia, 1987  
   B.A.Sc., Civil Engineering, University of Ottawa, 1985

3. **Service on this Faculty**
   
   Years of Service: 16 years
   Assistant Professor (1993-98); Associate Professor (1998-2001), Professor (2001-Present), Chair (2001-2007)

4. **Related Experience**
   
   Naval Surface Warfare Center Carderock Division, Maryland
   - Visiting Researcher, 2004
   Rijkswaterstaat, The Hague, The Netherlands
   - Visiting Researcher, 2001
   Danish Hydraulic Institute, Hørsholm, Denmark
   - Visiting Researcher, 1996, 1997
   Sandwell Engineering, Inc., Vancouver, British Columbia
   - Coastal Engineer, 1991-1993

5. **Consulting and Patents**
   
   Naval Facilities Engineering Service Center, California; Ocean Engineering Consultants, Inc., Hawaii; Oregon State University; Pacific Disaster Center, Hawaii; Sea Engineering, Inc., Hawaii; Sandwell Engineering, Inc., British Columbia; Tetra Tech, Virginia.

6. **Professional Registration**
   
   Professional Engineer (Civil): License No. 9791, Hawaii.
   Professional Engineer (Civil): License No. 20667, British Columbia (inactive).

7. **Principal Publications of Last Five Years**
   
   
   
   
   
   
   
   


8. Scientific and Professional Societies
   American Geophysical Union

9. Honors and Awards
   Science Advisor, Hawaii State Civil Defense (2007 – Present); Foreign Advisor, Chilean Navy Tsunami Program (2006 – Present); Senior Faculty Research Fellow, Office of Naval Research (2004); Research Initiation Award, National Science Foundation (1994).

10. Institutional and Professional Service in Last Five Years (20% time commitment)
   - Department Chair (2001-2007).
   - Reviewer for 21 international journals and five national funding agencies.

11. Research or Scholarly Activities (40% time commitment)
   Raised $9.5M of grants and contracts as Principal Investigator from FEMA, ONR, NASA, NOAA, NSF, NTHMP, USACE, Hawaii State Civil Defense, and other agencies since 1994 and participated in four major projects (over $1M each) as co-Principal Investigator or co-Investigator.

12. Commitment to Academic Program (40% time commitment)
   Raised $540K of internships from local engineering firms for on-job training of graduate students since 2000, involved practicing engineers in the capstone design class since 1999, and provided research assistantships to graduate students through funded projects since 1994.
1. **Name and Academic Rank**
   
   R. Cengiz Ertekin, Professor, full-time, tenured

2. **Education**
   
   B.S. in Naval Architecture and Marine Engineering, The Technical University of Istanbul, 1977

3. **Service on the Faculty**
   

4. **Related Experience**
   
   1998 - Present: Global Environmental Science, B.S. Degree Program, Univ. of Hawaii, Grad. Faculty.
   1997 - Present: Department of Civil & Environmental Engng., Univ. of Hawaii, Cooperating Grad. Faculty.
   1984 – 1985: Department of Naval Arch.& Offshore Engng, Univ. of Calif., Berkeley, Post-doctoral Fellow.
   1977 - 1978: Shipbuilding Inst. of the Technical Univ. of Istanbul, Model Test Engineer.

5. **Consulting & Patents**
   
   2009 U.S. Patent Pending (w/ R. Carter) Induced Surface Flow Wave Energy Converter

6. **Professional Registration**

7. **Some Publications in the Last Five Years**
   
   
   
   
   
   
   
   
   

B-4
Departmental Faculty


8. Scientific and Professional Societies

Society of Naval Architects and Marine Engineers, SNAME (Fellow '80), American Society of Mechanical Engineers, ASME (Fellow '85), American Society of Civil Engineers, ASCE (M '90), American Geophysical Union, AGU (M '92), Marine Technology Society, MTS (M '90)

9. Honors and Awards

- Recipient of the National Science Foundation's Presidential Young Investigator Award, 1989 - 1994.
- American Society of Mechanical Engineers, Offshore Mech. & Arctic Engrg. Division, Achievement Award 1993, Special Service Award, 1998, Special Service Award, 2002 for dedication and leadership as Chair of OOAE, 2001-2002, and for contributions to organizing OMAE Conferences.

10. Institutional and Professional Service in the Last Five Years

- Cancun, Mexico, ASME International. Co-Chair of OMAE 2009, ASME.
- Served in or currently serving in ORE Computer Committee, ORE Curriculum Committee member, ORE Research Committee, Ph.D. Qualifying Exam Committee, ORE Personnel Committee member, ORE Outstanding Student Award Committee member, Served as Acting Chairman on various occasions, ORE Representative for Hamilton Library, ORE Graduate Work Committee member, OE Representative for POST Building, ORE Resource Committee member, ORE Coordinator, International Professional Advisory Panel, ORE Coordinator, CAFÉ implementation at the ORE Department, ORE Coordinator, ORE Outstanding Student Award, OE Faculty Search Committee Chair

11. Percentage of Time Available for Research or Scholarly Activities

60%

12. Percentage of Time Committed to ORE:

100%
1. Name and Academic Rank
   Bernard Dandridge Greeson, Specialist

2. Education
   Ph.D. - Ocean Engineering, University of Hawaii at Manoa, December 1997
   M.S.E. - Ocean Engineering, Texas A&M University, May 1976
   B.S. - Naval Science, Mathematics (minor), U.S. Naval Academy, June 1964

3. Service on the Faculty
   Years of Service: 8 years in ORE;
   UH faculty appointment as of January 1999

4. Related Experience
   Government/Industry: 28 years;
   Total Faculty 13 years:
   2 years at Texas A&M
   11 years at University of Hawaii at Manoa (including 8 in ORE)

Graduate of Naval Submarine School and Naval Nuclear Propulsion Training
1964-1992: Served in U.S. Navy nuclear submarine force, including the following at-sea tours of duty:
1966-1967: USS Bonefish (SS-582)
1967-1970: USS Scamp (SSN-588)
1970-1974: Engineer Officer, Submarine NR-1
1977-1979: Executive Officer, USS Theodore Roosevelt (SSBN-600)
1979-1980: Executive Officer, USS Hawkbill (SSN-666)
1980-1980: Commanding Officer, USS Thomas Jefferson (SSBN-618)
1980-1983: Commanding Officer, USS Robert E. Lee (SSBN-601)
1983-1984: Commanding Officer, USS Puffer (SSN-652)
1984-1985: Commanding Officer (Acting), USS Guardfish (SSN-612)
1987-1989: Commanding Officer, USS Michigan (SSBN-727)
Retired from military in 1992 as Captain, United States Navy

5. Consulting and Patents
   None

6. Professional Registration
   Licenses:
   Licensed Merchant Mariner (U.S. Coast Guard Certification)
   Licensed by U.S. Coast Guard as:
   Chief Engineer of United States Steam Vessels of Any Horsepower
   Master of Steam or Motor Vessels of not more than 1600 Gross Tons upon Oceans
   Second Mate of Steam or Motor Vessels of any Gross Tons upon Oceans

7. Publications of Last Five Years
   None within the past five years

8. Scientific and Professional Societies

9. Honors and Awards
   Military:
   Legion of Merit (two awards), Meritorious Service Medal (three awards),
Navy Commendation Medal (two awards), and various unit awards and campaign ribbons. Qualified in Submarines and as a Deep Submersible Vehicle Operator. Qualified for Command of Submarines

Academic:
1976-present: Phi Kappa Phi Honor Society (Life Member)
1994: Outstanding Graduate Student Award, Department of Ocean and Resources Engineering, University of Hawaii

10. Institutional and Professional Service in the Last Five Years
   None within past five years

11. Percentage of Time Available for Research or Scholarly Activities
    25%

12. Percentage of Time Committed to ORE
    25%
1. Name and Academic Rank
   Bruce M. Howe, Researcher

2. Education
   Ph.D. Oceanography, Ocean Acoustic Tomography, 1986, University of California, San Diego

3. Service on this Faculty
   Years of Service: 1 year;
   Appointment: August 1, 2008

4. Related Experience
   University of Hawaii:
      Department of Ocean and Resources Engineering, School of Ocean and Earth Science and Technology
      • Researcher, 2008 – Present
   University of Washington:
      Applied Physics Laboratory, College of Ocean and Fishery Sciences
      • Affiliate Principal Oceanographer, 2008 – Present; Principal Oceanographer (1998-2008); Senior Oceanographer (1992); Oceanographer (1987)
      School of Oceanography, College of Ocean and Fishery Sciences
      • Affiliate Professor (2008-Present); Research Associate Professor (1994-2008); Research Assistant Professor (1988)
      Department of Electrical Engineering, College of Engineering
      • Affiliate Professor (2008-Present); Adjunct Research Associate Professor (2005-2008)
   University of California, San Diego
   Universität Karlsruhe:
      • Research Associate, Institut für Hydromechanik (1979-1981)
   Stanford University:
      • Research Assistant, Department of Civil Engineering (1976-1979)

5. Consulting and Patents

6. Professional Registration

7. Publications of Last Five Years

8. Scientific and Professional Societies

- American Geophysical Union
- American Meteorological Society
- The Oceanography Society (charter life member)
- IEEE Oceanic Engineering Society
- American Association for the Advancement of Science
- Acoustical Society of America

9. Honors and Awards

- Sigma Xi

10. Institutional and Professional Service in the Last Five Years

- 2008 – Member, International Ocean Network Committee
- 2008 – Member, Global-Coastal Scale Nodes/OOI Review Committee for Ocean Profilers
- 2006 – 2008 Project Scientist, Regional Scale Nodes, NSF Ocean Observatories Initiative
- 2005 – 2007 Vice Chair, ORION Engineering Committee
- 2005 – Member, NEPTUNE Canada RFP Team
- 2005 – 2008 Member, Acoustic Navigation and Communication in High-latitude Ocean Research (ANCHOR) steering committee
- 2004 – 2007 Chair, UNOLS Global Ship Class Science Mission Requirements Committee
- 2003 – 2004 Member, AGU Oceans Sciences 2004 Meeting Program Committee
- 2003 – Invited participant, Cabled Regional Observatory Workshop, San Francisco
- 2003 Chair, NEPTUNE Pacific Northwest Workshop, Portland, April 2003
- 2003 – Co-chair of ASA Committee, Integrated Acoustics Systems for Ocean Observatories
- 2003 – Member, Current Measurement Technology Committee

Reviewer for numerous journals:

- Bulletin of the American Meteorological Society
- Journal of Geophysical Research
- Geophysical Research Letters
- Journal of Marine Research
- Journal of Physical Oceanography
- Eos – Transactions of the American Geophysical Union
- Journal of the IEEE Ocean Engineering Society
- Marine Technology Society Journal
- Measurement Science and Technology
- Ocean Engineering
- Journal of the Acoustical Society of America
- Space Weather
- Radio Science


11. Percentage of Time Available for Research or Scholarly Activities

66%

12. Percentage of Time Committed to ORE

33%
1. Name and Academic Rank

Gerald C. Nihous, Associate Researcher (August 1, 2009)

2. Education

- PhD. Ocean Engineering, University of California, Berkeley, 1983
- M.S. Ocean Engineering, University of California, Berkeley, 1980
- Diplôme d’Ingénieur Ocean Engineering, École Centrale de Paris, 1979

3. Service on this Faculty

- Years of Service: 1 year; Appointment: August 1, 2008

4. Related Experience

<table>
<thead>
<tr>
<th>Year Range</th>
<th>Position and Affiliation</th>
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<tbody>
<tr>
<td>2009 (from 08/01)</td>
<td>Associate Professor, ORE, University of Hawaii at Manoa</td>
</tr>
<tr>
<td>2004 - 2009</td>
<td>Associate Researcher, Hawaii Natural Energy Institute</td>
</tr>
<tr>
<td>2004 - 2009</td>
<td>Cooperating Graduate Faculty, ORE, University of Hawaii at Manoa</td>
</tr>
<tr>
<td>1993 - 2004</td>
<td>Affiliate Graduate Faculty, ORE, University of Hawaii at Manoa</td>
</tr>
<tr>
<td>1999-2003</td>
<td>Program Manager, Pacific International Center for High Technology Research (PICHTR), Honolulu, Hawaii</td>
</tr>
<tr>
<td>1997-1999</td>
<td>Senior Researcher, PICHTR, Honolulu, Hawaii</td>
</tr>
<tr>
<td>1996-1997</td>
<td>Visiting Professor, Graduate School for International Development and Cooperation (IDEC), Hiroshima University (Japan)</td>
</tr>
<tr>
<td>1987 - 1996</td>
<td>Senior Researcher, PICHTR, Honolulu, Hawaii</td>
</tr>
<tr>
<td>1983 - 1987</td>
<td>Senior Researcher, Vega &amp; Associates, Berkeley, California</td>
</tr>
<tr>
<td>1980 - 1983</td>
<td>Research Assistant, University of California, Berkeley, Department of Naval Architecture and Offshore Engineering</td>
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5. Consulting and Patents

6. Professional Registration

7. Publication of the Last Five Years


8. Scientific and Professional Societies

9. Honors and Awards

10. Institutional and Professional Service in the Last Five Years

   1. Seminars:
      • October 27, 2004, Department of Ocean and Resources Engineering
      • April 12, 2005, Department of Ocean and Resources Engineering
      • February 27, 2007, Hawaii Natural Energy Institute:
      • November 24, 2008, Department of Ocean and Resources Engineering

   2. Organized and hosted the visit of a delegation from the Graduate School for International Development and Cooperation (IDEC), Hiroshima University, January 13-14, 2005. Meetings and talks were held at the University of Hawaii, Manoa and at the East-West Center.

   3. Served on the Scientific Committee of the 2nd International Conference on Ocean Energy (ICOE) held in Brest, France, October 15-17, 2008; chaired the technical session dedicated to Ocean Thermal Energy Conversion.

11. Percentage of Time Available for Research or Scholarly Activities

   50%

12. Percentage of Time Committed to ORE

   50%

B-11
1. **Name and Academic Rank**
   Eva-Marie Nosal, Assistant Professor

2. **Education**
   Ph.D., Geology and Geophysics, 2007, University of Hawaii at Manoa  
   M.Sc., Applied Mathematics, 2003, University of British Columbia  
   B.Sc., Pure Mathematics (first class honors), 2000, University of Calgary  
   B.Sc., Applied Mathematics (first class honors), 2000, University of Calgary  
   B.Mus., Piano Performance (with distinction), 2000, University of Calgary

3. **Service on this Faculty**
   Years of Service: 1 year; Appointment: August, 2008.

4. **Related Experience**
   University of Hawaii  
   Department of Ocean and Resources Engineering, School of Ocean and Earth Science and Technology  
   • Assistant Professor, 2008/08-current  
   Dept. of Geology and Geophysics  
   • Assistant Researcher, 2008/01-07  
   • Teaching Assistant, 2004  
   • Research Assistant, 2003-2007  
   University of British Columbia  
   Department of Mechanical Engineering  
   • Research Assistant, 2001-2002  
   Department of Math & Stats  
   • Teaching Assistant, 2000  
   University of Calgary  
   Department of Math & Stats  
   • Teaching Assistant, 1998-2000  
   • Research Assistant, 1998-2000  
   STATSCON Statistical Consulting  
   • Analyst, Modeler, Programmer, 1995-2002

5. **Consulting and Patents**

6. **Professional Registration**

7. **Publications of Last Five Years**

B-12

8. Scientific and Professional Societies

Institute of Electrical and Electronics Engineers (IEEE)
Acoustical Society of America
Marine Technology Society

9. Honors and Awards

2006-08 Graduate Traineeship in Ocean Acoustics, US Office of Naval Research
2005 Student Engagement Grant, Maui High Performance Computing Center
2005 First place, IEEE OES Poster Program, Thales Underwater Systems
2003-04 Post Graduate Scholarship, Natural Science and Engineering Research Council of Canada
2003 Fellowship, Research Corporation of the University of Hawaii
2001 Eckel Prize in Noise Control, Canadian Acoustical Association
2000-02 Post Graduate Scholarship, Natural Science and Engineering Research Council of Canada
2000 Silver medal, Department of Math & Stats, University of Calgary
2000 Gold medal, Faculty of Fine Arts, University of Calgary
1995 Bronze medal, Governor General of Canada

10. Institutional and professional service in the last 5 years


University of Hawaii committees served:

- Student committees (3 MS, 3 PhD);
- ORE secretary search committee (Spring 2008);
- ORE faculty search committee (Fall 2008);
- SOEST young investigator search committee (Fall 2008);
- SOEST curriculum committee (Fall 2008-Spring 2009);
- GG Curriculum committee (Fall 2007);
- GG relations and honors committee (Fall 2006-Spring 2007).
- Expert advice: NSF Alaska Region Research Vessel (ARRV)

11. Percentage of Time Available for Research or Scholarly Activities

35% research or scholarly activities

12. Percentage of Time Committed to ORE

65% committed to program (e.g. teaching, committee work, student advising)

*Based on first year of faculty appointment (Fall 2008-Spring 2009)
1. **Name and Academic Rank**
   
   Geno Pawlak, Associate Professor

2. **Education**
   
   University of California at San Diego
   - Ph.D.  Engineering Sciences (Mechanical Engineering)/Applied Ocean Science, September 1997
   - M. S. E. Mechanical Engineering, June 1994

   University of Minnesota
   - B.S.E.  Aerospace Engineering and Mechanics, March 1991, minor in Mathematics

3. **Service on this Faculty**
   
   Years of service: 8 years; Appointment: March 15, 2001

4. **Related Experience**
   
   Cooperating Graduate Faculty, Dept. of Oceanography, School of Ocean and Earth Science and Technology, University of Hawaii, 2002 – Present

   Visiting Professor, Fluid Mechanics Research Group, Universidad de Jaen, Jaen, Spain, Feb.-July 2009

   Visiting Professor, Department of Thermal Engineering and Fluid Mechanics, Universidad Carlos III, Madrid, Spain, June-Aug. 2003

   Research Associate, School of Oceanography, University of Washington, 1997 - 2001

   Postdoctoral Researcher, Physical Oceanography Dept., Scripps Institution of Oceanography, University of California, San Diego, 1997 - 1998


5. **Consulting**
   
   Consultant for Surface Optics Corporation

6. **Professional Registration**

7. **Principal Publications of Last Five Years**
   


8. Membership of Scientific and Professional Societies

Marine Technology Society, 2002 – Present
American Geophysical Union, 1998 - Present

9. Honors and Awards

Office of Naval Research, Young Investigator Award, 2003-2006
Charles Lee Powell Foundation Fellowship, UCSD, 1992 – 1993

10. Institutional and Professional Service in the Last Five years

Director, Kilo Nalu Observatory (2004 – Present)
UH Diving Control Board Member (2003 - Present)
SOEST Young Investigator Search Committee (2002-2008)
SOEST Engineering Support Facility Advisory Board (2005-Present)
SOEST Computer Committee, ORE Representative (2004 - 2008)
SOEST Ocean Observing Workshop co-Organizer (2005, 2006)
SOEST Ocean Observing Steering Committee (2006-Present)
SOEST Research Council (2006 - Present)
SOEST Open House Committee, ORE Representative (2001-2008)
ORE MS Exam Coordinator (2001-Present)
ORE Curriculum Committee Representative (2001-2008)
Session Organizer, Chairperson, ASME Offshore Mechanics and Arctic Engineering Conference 2005, 2007
Participant, Design and Implementation Workshop, NSF Ocean Research Interactive Observatory Networks (ORION) Program, Salt Lake City, Utah, March, 2006
Panelist, Alliance for Coastal Technology, Seabed Sensor Technology Workshop, Feb. 2006
Special Session Convenor, American Geophysical Union Ocean Sciences Meeting, Feb, 2006
Referee for:
   ASLO Limnology and Oceanography
   Journal of Fluid Mechanics
   Ocean Engineering
   Journal of Geophysical Research-Oceans
   Journal of Geophysical Research-Earth Surface
   Journal of Physical Oceanography
   National Science Foundation
   Book Reviewer, Brooks/Cole/Thomson Learning
   ASME Offshore Mechanics and Arctic Engineering Conference

11. Percentage of Time Available for Research or Scholarly Activities

80% (remaining time dedicated to university and professional service activities)

12. Percentage of Time Committed to the Program

100% (excluding sabbatical)
1. **Name and Academic Rank**
   John C. Wiltshire, Specialist (S5)

2. **Education**
   Ph.D. in Geological Oceanography, University of Hawaii, Honolulu, 1983
   B.S. in Geology, graduated with first class honors, Carleton University, Ottawa, Canada, 1976

3. **Service on this Faculty**
   Years Service at UH: 27
   - 1978-1983, Research Assistant and Lecturer; 1986-1990, Researcher; 1991-2002 Associate Director, Hawaii Undersea Research Laboratory (HURL), 2002-present, Director of HURL; Appointed Chair of the Department of Ocean and Resources Engineering (ORE) in 2007

4. **Related Experience**

5. **Consulting & Patents**
   - Current consulting to mining industry
   - Chairman, TCI Hawaii (small consulting business)

6. **Publications of the Last Five Years**

8. **Scientific and Professional Societies**
   - Marine Technology Society (Vice Chairman, Hawai‘i Section; Chairman, Mineral Resources Professional Committee; Society Fellow; Executive Co-Chairman, Oceans 2001 and 2011 international conference
   - Pacific Congress on Marine Science and Technology and PACON International -1984-present, Founding member, Vice President and Chair of Marine Minerals, Chairman of PACON ’99 Moscow, Society Fellow
   - International Marine Minerals Society (IMMS) - Member of the Executive Board and Treasurer
• Society for Mining, Metallurgy and Exploration (SME) – Member, Special Committee for Offshore Technology and Organizational Input to the Offshore Technology Conference, 2005 – present
• NOAA’s Undersea Research Program (NURP) – Member, Council of Directors since 2001

9. Honors and Awards
• Society Fellow, Marine Technology Society
• Society Fellow, Pacific Congress on Marine Science and Technology

10. Institutional and Professional Service in the Last Five Years
• Outer Continental Shelf Policy Advisory Committee: National Advisory Committee to U.S. Secretary of the Interior
• School of Ocean and Earth Science and Technology: Member of the 12 person executive committee for the direction of this $100 million/ year research unit, the largest research unit at the University of Hawaii
• Reviewer for several international scientific journals
• Journal Editorship: Co-Editor, Marine Georesources and Geotechnology; Editor, State of Hawai‘i Marine Mining Program Environmental Monograph Series

11. Percentage of time available for research or scholarly activities
50%

12. Percentage of time committed to the program
50%
1. **Name and Academic Rank**
   Janet M. Becker, Associate Professor

2. **Education**
   Ph.D. University of California, San Diego, Scripps Institution of Oceanography, 1989
   B.S., University of California, San Diego, Physics (summa cum laude), 1983

3. **Service on this Faculty**
   15 years; Original appointment: 1994; Tenured: 2001

4. **Related Experience**
   Assistant Professor, Department of Geology and Geophysics, University of Hawaii, 1997 – 2001.
   Assistant Research Oceanographer, Scripps Institution of Oceanography, University of California, San Diego, 1993.
   Research Associate, Department of Mathematics, University of New South Wales, Australia, 1989 – 1991.

5. **Consulting & Patents**

6. **Professional Registration**

7. **Membership of Scientific and Professional Societies**
   American Physical Society – DFD
   American Geophysical Union

8. **Honors and Awards**
   National Science Foundation Mathematical Science Postdoctoral Research Fellowship, 1991-1993
   Geophysical Fluid Dynamics Fellowship, WHOI, 1985
   National Science Foundation Graduate Fellowship, 1984 – 1987
   Outstanding Physics Major, Revelle College, 1983

9. **Publications of Last Five Years**
   Pequignet, A. Christine N., J. M. Becker, M. A. Merrifield, and J. Aucan, Forcing of resonant modes on a
   Zilberman, N.V., J.M. Becker, M.A. Merrifield and G.S. Carter, 2009, Model estimates of M2 Internal Tide
   Carter, G. S., M. A. Merrifield, J. Becker, K. Katsumata, M. C. Gregg, D.S. Luther, M.D. Levine. T.J. Boyd and
   Y. L. Firing, Energetics of M2 barotropic to baroclinic tidal conversion at the Hawaiian Islands, J. Phys.
   Wessel, P., and J. M. Becker, Interpolation using a generalized Green's function for a spherical surface spline in
   Becker, J.M., Y.L. Firing, J. Aucan, R. Holman, M. Merrifield and G. Pawlak, Video-based observations of
   Becker, J.M. and G. Veronis, Note on the viscous smoothing of the discontinuities in an inviscid model of the


10. Institutional and Professional Service in the Last 5 Years

11. Percentage of Time Available for Research or Scholarly Activities
   5%

12. Percentage of Time Committed to ORE
   5%
1. **Name and academic rank**
   - Brian Bingham, Assistant Professor

2. **Degrees with fields, institution, and date**
   - 2003, PhD, Mechanical Engineering, Massachusetts Institute of Technology
   - 1998, MS, Mechanical Engineering, Massachusetts Institute of Technology
   - 1996, BS, Mechanical Engineering, University of Missouri – Rolla

3. **Number of years of service on this faculty, including date of original appointment and dates of advancement in rank**
   - 0.5 years; Original appointment, Assistant Professor: 01/2009

4. **Other related experience, i.e., teaching, industrial, etc.**
   - 01/2005 – Present, Visiting Scientist, Woods Hole Oceanographic Institution
   - 01/2005 – 01/2009, Assistant Professor, Franklin W. Olin College of Engineering

5. **Consulting, patents, etc.**
   - Consulting: Axis Engineering Technologies, Cambridge, MA

6. **States in which professionally licensed or certified, if applicable**
   - N/A

7. **Principal publications of the last five years (6/2004 – 6/2009, not including papers under review)**


8. Scientific and professional societies of which a member
   - Institute of Electrical and Electronics Engineers (IEEE)
   - Marine Technology Society (MTS)

9. Honors and awards

10. Institutional and professional service in the last five years (6/2004 – 6/2009)

   Institutional
   - Banquet Committee

   Professional
   - Proposal Reviewer: NOAA-Ocean Exploration Program

11. Percentage of time available for research or scholarly activities
    50% (Research)

12. Percentage of time committed to the program
    5% (Cooperating Faculty)
1. **Name and Academic Rank**
   Monique Chyba, Associate Professor

2. **Degrees with fields, institution, and date**
   - 1997, Ph.D., University of Geneva, Switzerland
   - 1993, M.S., University of Geneva, Switzerland
   - 1989, B.S., Technicum of Geneva, Switzerland

3. **Service on this Faculty, including date of original appointment and dates of advancement in rank**
   Years Service at UH: 7; Original appointment: 2002; Tenured: 2006

4. **Other related experience, i.e., teaching, industrial, etc.**
   My main research area concerns the development of geometric methods to solve optimal control problems. One of my central objectives is to understand the role of singular extremals in optimal strategies for nonlinear control systems. More specifically, I have been lately focusing on using differential geometric techniques to exploit in the time optimal problem the particular structure of the Lie algebra formed by the vector fields describing a controlled mechanical system. My research is oriented towards applications with a special emphasis on the motion planning problem for autonomous underwater vehicles.

5. **Consulting & Patents**

6. **States in which professionally licensed or certified, if applicable**

7. **Principal publications of the last five years**

   **Books**

   **Journal Articles**


8. Scientific and professional societies of which a member

9. Honors and Awards
   - Board of Regents excellence in Teaching, UH Manoa, 2008

10. Institutional and Professional Service in the Last 5 Years
   - Associate Editor for Ocean Engineering
   - Head of Outreach educational programs: Robo–Nemo: “Educating Youth about Ocean Research” and Stomp–Hawaii: “Student Teacher Outreach Mentorship Program”.
   - Participated to Talent Development Hawaii, http://www.math.hawaii.edu/talent
   - Reviewer for many journals in Mathematics and in Engineering
   - Member of several committees with the math department (Graduate Committee, Advisory committee, etc.)
   - Member of a TPRC panel at UH in 2007

11. Percentage of Time Available for Research or Scholarly Activities
    40%

12. Percentage of Time Committed to ORE
    For the past 5 years, about 30% as I had a graduate student in ORE. He graduated in Summer 2008.
1. **Name and academic rank**
   Brian T. Glazer, PhD, Assistant Professor of Oceanography

2. **Degrees with fields, institution, and date**
   - 2004, PhD., Marine Science, University of Delaware
   - 2000, M.S., Marine Science, University of Delaware
   - 1997, B.S., Biology; Marine Science, Pennsylvania State University

3. **Number of years of service on this faculty, including date of original appointment and advancement**
   5 years of service at UH; Postdoc appointment in 2004, UH Oceanography Assistant Professor since 2006
   Member, Cooperating Graduate Faculty, Department of Ocean and Resources Engineering, 2007-present

4. **Other related experience, i.e., teaching, industrial, etc.**
   - 2007-present, Chair, Marine Geology and Geochemistry Division Curriculum Committee
   - 2007-present, Member, NOAA/CSC Regional IOOS UH Water quality/biogeochemistry working group
   - 2006, August-present, Coordinator, Biogeochemistry Brown Bag Seminar Series
   - 2006, February, Invited lecture at the Oregon Health and Science University, “In situ investigations of geomicrobial synergy within oxic-anoxic transition zones”.
   - 2004-2006, UH NASA Astrobiology Institute, Postdoctoral Fellow
   - 1997-2004, DE Center for the Inland Bays (EPA NEP), Technical Consultant
   - 1997-2004, University of Delaware, Graduate Research Assistant
   - 1997 Pennsylvania State University, Undergraduate Research Assistant

5. **Consulting, patents, etc.:** N/A

6. **States in which professionally licensed or certified, if applicable:** N/A

7. **Principal publications of the last five years**
   Glazer, BT, Chen, IC. (2008) Automated voltammetric profiling across the sediment-water interface at the Kilo Nalu coastal observatory, Oahu, Hawaii. ASLO Aquatic Sciences Meeting, Nice, France.
   Chen, IC and Glazer, BT. Real-time redox chemistry in porous coastal sediments using in situ voltammetry at a nearshore cabled observatory. in prep.

8. Scientific and professional societies of which a member
- American Association for the Advancement of Science (AAAS)
- American Chemical Society (ACS)
- American Geophysical Union (AGU)
- American Society of Limnology and Oceanography (ASLO)
- Geological Society of America (GSA)

9. Honors and awards
University of Hawaii University Research Council Faculty Travel Fund Award, 2008
University of Hawaii NASA Astrobiology Institute Postdoctoral Fellowship, 2004-2006
University of Delaware Graduate College of Marine Studies E. Sam Fitz Award, in recognition of student displaying greatest aptitude for professional development in marine studies, 2005

10. Institutional and professional service in the last five years
UH Oceanography Department Course Instructor, OCN 643 (Chemical Oceanography), OCN 401 (Biogeochemical Cycles), OCN 643 (Aquatic Geomicrobiology)
2008-present – Advisory committee chair, Jennifer Murphy, (UH-OCN)
2008-present – computing research project coadvisor, Brian Jaress (UH-Information and Computer Sciences Dept)
2007-present – M.S. advisory committee member, Patrick Drupp (UH-OCN)
2007-present – M.S. advisory committee member, Yajuan Lin (UH-OCN)
2007-present – undergraduate advisor, Sarah Yasui (UH-GES)
2007-present – undergraduate advisor, Amanda Ricardo (UH-GES)
2006-present - M.S. committee chair, In Chieh Chen (UH-Department of Ocean and Resources Engineering)
2006-present - Ph.D. advisory committee member, Rebecca Briggs (UH-OCN)
2005-2006 – M.S. research project coadvisor, Bryan Norman (UH-Information and Computer Sciences Dept)
2005-2006 – M.S. research project coadvisor, Kayo Fujiwara (UH-Information and Computer Sciences Dept)

11. Percentage of time available for research or scholarly activities
20%

12. Percentage of time committed to the program
20%
1. Name and academic rank
Ronald H. Knapp, Professor, Department of Mechanical Engineering

2. Degrees with fields, institution, and date
• B.S.M.E. University of Hawaii 6/1967
• M.S.M.E. California Institute of Technology, 6/1968
• Ph.D. O.E. University of Hawaii, 8/1973

3. Number of years of service on this faculty, including date of original appointment and dates of advancement in rank
• 34 years; Original appointment: 8/1975
• Promotion to Professor: 7/1988

4. Other related experience, i.e., teaching, industrial, etc.
• 6/1968 – 7/1975 Mechanical Engineer, Naval Undersea Center
• 1/1989 – 1/1990 Senior Research Engineer, Sumitomo Electric Industries, Ltd (Japan)

5. Consulting, patents, etc.
Consulting
• Cable and Rope Manufacturing

Patents
• Knapp, R.H., "A Smart Scuba", U.S. Patent Pending

6. States in which professionally licensed or certified, if applicable
PE 3707, State of Hawaii

7. Principal publications of the last five years

Major Software Developed and used in Industry
8. Scientific and professional societies of which a member
   - American Society for Mechanical Engineers
   - International Society of Offshore and Polar Engineering
   - Society of Automotive Engineers

9. Honors and awards
   - 1981, Fellow, Alexander von Humboldt Foundation, Germany
   - 1985, ASME Outstanding Faculty Award, Department of Mechanical Engineering, University of Hawaii
   - 2007 Hi Chang Chai Faculty Teaching Award, College of Engineering.
   - 1997, 2003 ISOPE Award, International Society of Polar and Offshore Engineering

10. Institutional and professional service in the last five years
    **Institutional**
    - Department Chair, Graduate Chair, Graduate Program Committee Chair, Graduate Council
    - Departmental Personnel Committee Chair, Tenure Promotion and Review Committees
    
    **Professional**
    - Board of Directors, Treasurer, International Society of Offshore and Polar Engineers Conference Organization
    - Session Developer and Paper Reviewer for International Society of Polar and Offshore Engineering

11. Percentage of time available for research or scholarly activities:
    20% (Research)

12. Percentage of time committed to the program:
    80% (Teaching and Service)
1. Name and academic rank
Hans J. Krock, PhD, Emeritus Professor of Ocean and Resources Engineering

2. Degrees with fields, institution, and date
PhD, Environmental Engineering, University of California at Berkeley, 1972
MS, Sanitary Engineering, University of California at Berkeley, 1967
BSE, Civil Engineering, Arizona State University, 1965

3. Service on this Faculty, including date of original appointment and dates of advancement in rank
28 years, original appointment: April 1980 as Associate Professor and Director of J.K.K. Look Laboratory
Assistant Professor, 1994-1997
Tenured: 1990
Full Professor: 1994

4. Related Experience
Lecturer, Department of Civil Engineering, University of Hawaii, 1973.
Senior Engineer, Laboratory Director and Chief Diver, Sunn, Low, Tom & Hara, Honolulu, 1972 - 1980.
Engineer, Alameda County Flood Control District, 1969.
Research Engineer, LA County Sanitation Districts, 1967 - 1968.

5. Consulting, patents, etc.
(Consulting)
President, OCEES International, 1988 to present. Recent projects include:
• Lagrangian Current Structure in Mamala Bay, for C & C of Honolulu (ongoing)

(Patents)
• With UH and Manfred Zapka, two Patents related to seawater gas exchange and application to Open Cycle
  OTEC and fresh water production.

6. States in which professionally licensed or certified, if applicable
Professional Engineer, Civil Engineering, Hawaii, 1974

7. Principal publications of the last five years
With Joseph Huang and Stephen Oney, “Revisit of Ocean Thermal Energy Conversion System”, Climate
“Optimizing OTEC Systems for the Niche Market”, Proceedings International OTEC/DOWA conference,
Imari, Japan, 1999.
“Kinetic Relationship Between Nutrients and Chlorophyll-a in Tropical Embayments and Nearshore Waters”,
With Ross Tanimoto, “Statistical Evaluation of Water Quality Parameters”, Proceedings ISOPE ’98, Honolulu,
1998.
8. Scientific and professional societies of which a member

- American Society of Civil Engineers (ASCE)
- National Society of Professional Engineers (NSPE)
- Marine Technology Society (MTS)
- Engineers and Architects of Hawaii (EAH)
- American Chemical Society (ACS)
- American Institute of Chemists (AIC)
- Federation of American Scientists (FAS)
- American Water Works Association (AWWA)
- American Society of Limnology and Oceanography (ASLO)
- The New York Academy of Sciences (NYAS)

9. Honors and awards

- B.S. Magna Cum Laude, Chi Epsilon (Civil Engineering), Tau Beta Pi (Engineering), Phi Kappa Phi (Scholastic)
- Commendation from the Governor of Hawaii for establishing State Water Quality Standards. Nominated for Hawaii Engineer of the Year
- 50th Anniversary Medal, Wroclaw Technical University, Poland

10. Institutional and professional service in the last five years

- Developed and taught two graduate courses in ORE
- Conducted briefings on latest developments in OTEC Systems and OTEC/Hydrogen to: National Academies of Science and Engineering, Department of Energy, Department of Commerce, NOAA, OAS, Institute fur Meereskunde (Kiel, Germany), Max Planck Institute (Hamburg), Technical Universities in Krakow, Wroclaw and Szczecin (Poland), KTH (Sweden).

11. Percentage of time available for research or scholarly activities

5%

12. Percentage of time committed to the program

5%
1. **Name and Academic Rank**

   Alexander Malahoff, Emeritus Professor of Oceanography, University of Hawaii

2. **Degrees with fields, institution, and date**

   - PhD in Geophysics, University of Hawaii, 1965
   - DSc (Hon.), Victoria University of Wellington, New Zealand, 2001
   - MSc in Geology (Geophysics), Victoria University of Wellington, 1962
   - BSc in Geology, University of New Zealand, 1960

3. **Years of service on this faculty, including date of original appointment and dates of advancement in rank**

   Years Service at UH: 37
   - 1963-1965, Asst in Geophysics
   - 1965-1968, Asst Professor/Asst Geophysicist, Geosciences and Oceanography
   - 1968-1976, Assoc. Professor, Geophysics and Oceanography
   - 1976, Professor, Geophysics and Oceanography
   - 1984-2008, Professor, Dept. of Oceanography
   - Includes: 1998-2001, Chair, Dept. of Ocean and Resources Engineering
   - 1998-2001, Director, Marine Bioproducts Engineering Center (MarBEC), a National Science Foundation Engineering Research Center (NSF/ERC)
   - 1984-2008, Director, Hawaii Undersea Research Laboratory (HURL), NOAA's Undersea Research Center for Hawaii & the Western Pacific

4. **Other related experience, i.e., teaching, industrial, etc.**

   - 2009-present, Professor, Victoria University of Wellington
   - 2007-present, President, Association of Crown Research Institutes (ACRI), New Zealand
   - 2002-present, Chief Executive Officer, GNS Science, New Zealand
   - 2002-present, Adjunct Professor, Te Whare Wananga O te Awanuiarangi, University of Canterbury, Victoria University of Wellington
   - 1976-1984, Chief Scientist, National Ocean Survey, Member of the Senior Executive Service of the United States (appointed by President Jimmy Carter, 1978), National Oceanic and Atmospheric Administration (NOAA), U.S. Dept. of Commerce
   - 1971-1976, Program Director, Marine Geology and Geophysics Program, Office of Naval Research
   - 1960-1963, Geophysicist, Geophysics Division, Dept. of Scientific and Industrial Research, New Zealand

5. **Consulting, patents, etc.**


6. **States in which professionally licensed or certified, if applicable**

   N/A

7. **Principal publications**


8. Scientific and professional societies of which a member

- American Geophysical Union
- Cosmos Club, Washington, D.C.
- Geological Society of America (Fellow)
- Hawaiian Academy of Science
- International Marine Minerals Society
- Marine Technology Society (Fellow)
- New Zealand Geological Society
- Royal Society of New Zealand
- Russian Academy of Natural Sciences, Foreign Member
- Sigma Xi Society
- Society of Exploration Geophysics

9. Honors and Awards

- Fellow, Geological Society of America, 1978
- Meritorious Service Medal from the U.S. Dept. of Commerce for the development of the first U.S. multibeam, narrow beam, shipboard ocean floor mapping system on a NOAA vessel, 1981
- Distinguished Alumni, University of Hawaii, 1993
- Fellow, Marine Technology Society, 2006

10. Institutional and professional service in the last five years

- Antarctic Research Centre Advisory Board Member (ARC), since 2002
- Chair, Joint Antarctic Research Institute (JARI), since 2002
- Weltec Council Member, since 2002
- President Emeritus, International Marine Minerals Society (IMMS), since 2005
- Director (Board Member), Australian CO2 Cooperative Research Center (CO2CRC), since 2004
- AWATEA Executive Committee, since 2008
- Chair, Sustainable & Renewable Energy Advisory Board, since 2008

11. Percentage of time available for research or scholarly activities

15%

10. Percentage of time committed to the program

10%
1. **Name and Academic Rank**
   
   Stephen M. Masutani, Researcher

2. **Degrees with fields, institution, and date**
   
   Ph.D., Mechanical Engineering, Stanford University, 1985
   M.S. Mechanical Engineering, Stanford University, 1980
   B.S., Mechanical Engineering, University of Hawaii, Manoa, 1977

3. **Service on this Faculty**
   
   Years Service at UH: 15; Original appointment: May 1994 (non-tenure track R4); August 1999 (tenure track); Tenured: July 2003.

4. **Related Experience**
   
   2000-Present: Cooperating Graduate Faculty, Dept. of Molecular Biosciences and Biosystems Engineering, UH
   1991-Present: Owner, Combustion and Power, Honolulu, Hawaii
   1989-Present: Cooperating Graduate Faculty & Lecturer, Dept. of Mechanical Engineering, UH
   1997-1998: Pacific International Center for High Technology Research (PICHTR), UH, Program Manager
   1989-1994: PICHTR, Energy & Resources Division, UH, Sr Mechanical Engineer & CO2 Project Manager
   1985-1989: Visiting Scientist (Shokutaku), The Hitachi Research Laboratory, Hitachi, Ltd., Ibaraki, Japan

5. **Consulting & Patents**
   
   Engineering consultant, Combustion and Power; client list available on request
   Co-developer of several patents on low-NOx combustors held and commercialized by Hitachi, Ltd.

6. **Professional Registration**
   
   Licensed Professional Engineer (Mechanical), State of Hawaii

7. **Membership of Scientific and Professional Societies**
   
   American Society of Mechanical Engineers
   American Geophysical Union

8. **Honors and Awards**

9. **Publications of Last Five Years**

   **CHAPTERS OR SECTIONS IN BOOKS**

   **REFEREED JOURNAL ARTICLES**


**REFEREED/EDITED CONFERENCE PROCEEDINGS**


10. Institutional and professional service in the last 5 years

- HNEI Personnel Committee Chair
- SOEST Dean Search advisory committee
- UH Environmental Center reviewer
- 1st – 6th International Workshop on Methane Hydrate Research and Development organizing committee
- *Journal of Marine Science and Technology* editorial board
- Proposal reviewer: Department of Energy Office of Science, ACS Petroleum Research Fund, State of Louisiana EPScOR Program
- Advisory Committee to the Sec. of Energy for the National Methane Hydrate R&D Program

11. Percentage of Time Available for Research or Scholarly Activities

>90% (R-faculty appointment in HNEI)

12. Percentage of Time Committed to ORE

Cooperating Graduate Faculty status requires no specific time commitment; % time committed varies, depending on if ORE graduate students are engaged as GRAs.
1. Name and academic rank

Gary M. McMurtry, Associate Professor

2. Degrees with fields, institution, and date

1979, Ph.D., Geology and Geophysics, University of Hawaii, Honolulu, 1979
1975, M.S., Geology and Geophysics, University of Hawaii, Honolulu, 1975
1972, B.S., Geological Sciences, University of California, Riverside, 1972

3. Number of years of service on this faculty, including date of original appointment and advancement

1980-1986, Assistant Geochemist, HIG
1986-1988, Associate Geochemist, HIG
1988-present, Associate Professor, Oceanography

4. Other related experience, i.e., teaching, industrial, etc.

• Affiliate Scientist, In Situ Center of Excellence, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California.
• Guest Scientist, Earth and Environmental Sciences Division, Los Alamos National Laboratory, Los Alamos, New Mexico.
• Science Program Director, National Undersea Research Program at the University of Hawaii, Hawaii Undersea Research Laboratory.
• Associate Director, Electron Microscopy Laboratory, Hawaii Institute of Geophysics, University of Hawaii, Honolulu, Hawaii.
• Post-doctoral Research Geologist, Geological Research Division, Scripps Institution of Oceanography, University of California, San Diego, California.

5. Consulting, patents, etc.

• President, Pacific Environmental Technologies, LLC.
• Four (4) U.S. Utility patents awarded, two (2) pending.

6. States in which professionally licensed or certified, if applicable

N/A

7. Principal publications of the last five years


8. Scientific and professional societies of which a member

- American Association for the Advancement of Science
- American Geophysical Union
- Marine Technology Society
- Pacific Congress on Marine Science & Technology (PACON) Society
- Sigma Xi, the Scientific Research Society of North America
- The Hawaiian Academy of Science (Life member)

9. Honors and awards

- Member, California Scholarship Federation, 1968
- Honors at entrance, University of California, Riverside, 1968
- Honors at graduation, University of California, Riverside, 1972
- National Science Foundation Antarctic Service Medal, 1979
- Biographical Citations:
  - *Who's Who in the West*, 1987-
  - *Who's Who of Emerging Leaders in America*, 1988-
  - *Who's Who in American Education*, 1992-
  - *Who's Who in Science and Engineering*, 1994-
  - *Who's Who in the World*, 1994-
  - *Who's Who in Asia & the Pacific Nations*, 1999-
  - *Who's Who in America*, 2005-

10. Institutional and professional service in the last five years

- NSF, Major Research Instrumentation and Ocean Technology Panel, 2008 Program Panelist.
- Tenure and Promotion Review Committee, University of Hawaii, Manoa, 2007-present
- SOEST Engineering Support Facility Oversight Committee, 2005-present
- Graduate Faculty, Department of Ocean and Resources Engineering (ORE), 2004-Present.

11. Percentage of time available for research or scholarly activities

75%

12. Percentage of time committed to the program:

25%
1. Name and academic rank

Mark A. Merrifield, PhD, Professor

2. Degrees with fields, institution, and date

PhD, Oceanography, University of California, San Diego, 1989
AB, Physics, University of California, Berkeley, 1982

3. Service on this Faculty, including date of original appointment and dates of advancement in rank

15 years, Cooperating Graduate Faculty, 1997 – Present
Assistant Professor, 1994 – 1997.

4. Related Experience

Associate Professor, Department of Oceanography, University of Hawaii, 1999 – Present.
Director, University of Hawaii Sea Level Center, 1996 – 1997.
Assistant Professor, Department of Oceanography, University of Hawaii, 1997 – 1999.
Postdoctoral Research Fellow, Department of Mathematics, University of New South Wales, 1989 – 1991.

5. Consulting, patents, etc.

1 to 2 projects per year dealing with a description or interpretation of oceanic conditions

6. States in which professionally licensed or certified, if applicable

N/A

7. Principal publications of the last five years


8. Scientific and professional societies of which a member
   • American Geophysical Union

9. Honors and awards
   • UCAR Post-doctoral Fellowship (declined), 1991

10. Institutional and professional service in the last five years
    • Director, University of Hawaii Sea Level Center
    • Chair, Global Sea Level Observing System, Group of Experts
    • Lead, Waves & Water Level Component, Hawai’i Ocean Observing System (HiOOS)
    • Member, Jason Science Working Team
    • Member, NOAA Climate Observations Panel

11. Percentage of time available for research or scholarly activities
    50%

12. Percentage of time committed to the program
    10%
1. Name and academic rank
   H. Ronald Riggs, PhD, Professor

2. Education
   PhD, Civil Engineering, University of California, Berkeley, 1981.
   MS, Civil Engineering, University of California, Berkeley, 1976
   BS, Civil Engineering, California State University, Chico, 1975.

3. Service on this Faculty: 16 years
   Cooperating Graduate Faculty, 1993 - Present

4. Related Experience
   Assistant Professor, Associate Professor, Professor, Department of Civil and Environmental Engineering, University of Hawaii, 1987 – Present.
   Senior Research Engineer, Risers and Terminals Section, Exxon Production Research Company, Houston, TX, 1984-1987.
   Research Engineer, Division of Nuclear Power Plant Engineering, Hochtief AG, Frankfurt am Main, Germany, 1982-1984.

5. Consulting, patents, etc.
   Consulting
     • President, OffCoast, Inc., Honolulu, Hawaii, 1996 – Present.

6. States in which professionally licensed or certified, if applicable
   P.E., State of Hawaii

7. Principal publications of the last five years
8. Scientific and professional societies of which a member
   • American Society of Civil Engineers (ASCE)
   • American Society of Mechanical Engineers (ASME)
   • American Society of Engineering Education

9. Honors and awards
   • Fellow, American Society of Mechanical Engineers

10. Institutional and professional service in the last five years
    • Department Chair (2003–2008), Civil and Environmental Engineering, University of Hawaii
    • Assistant Editor, ASCE J. of Waterway, Port, Coastal and Ocean Engineering
    • Editorial Board, Ocean Engineering; Executive Committee, ASME Ocean, Offshore and Arctic Engineering Division
    • Co-organizer, ASME 28th Intl. Conf. on Ocean, Offshore, and Arctic Engineering; International Ship and Offshore Structures Congress, Very Large Floating Structures Committee member
    • Reviewed papers for conferences and journals.

11. Percentage of time available for research or scholarly activities
    50%

12. Percentage of time committed to the program
    10%
1. Name and academic rank

John R. Smith, Jr., PhD, (Full) Specialist

2. Degrees with fields, institution, and date

1996, PhD, Geological Oceanography, University of Hawaii at Manoa
1989, MS, Geological Oceanography, University of Hawaii at Manoa
1983, BS with Honor, Geological Oceanography, Florida Institute of Technology

3. Service on this Faculty

11 years, Cooperating Graduate Faculty, 1998 - Present.

4. Related Experience

Specialist, Hawaii Undersea Research Laboratory, University of Hawaii, 1995 – Present
Geophysicist, Western Geophysical Company of America, Houston, TX, 1983 – 1986

5. Consulting, patents, etc.

Fulfilled licensing requests for products from copyrighted digital database.

6. States in which professionally licensed or certified, if applicable

N/A

7. Principal publications of the last five years


8. Scientific and professional societies of which a member

- American Geophysical Union, Hawaiian Academy of Science

9. Honors and awards
10. Institutional and professional service in the last five years

Service to the University, School, Department, and HURL

- SOEST Dean’s Education and Outreach Council, Sept 2006 to present.
- SOEST Technology Working Group for Ocean Observing Initiative, June 2006 on.
- Various tours of ship and submersible and ROV facility for VIPs and possible users.

Service to the Fields of my Specialties

- Initiated the building of a database in 1992 of all the modern multibeam seafloor bathymetric data in the Main Hawaiian Islands and have satisfied the resulting data requests. Several public releases of data and poster maps have taken place through the American Geophysical Union, the U.S. Geological Survey, and NOAA. (see publications)

Service to the Public and Community Outreach Activities

- Featured scientist in documentaries *Megadisaster: East Coast Tsunami* for The History Channel and *Draining the Oceans* in production for release by National Geographic in 2009.
- Created a 3D fly-through visualization of Hawaiian Islands topographic and bathymetric data sets for the new Science Adventure Center at the Bishop Museum, Oct 2006.

Service to the National and International Scientific Community

A. Requests for Proposals

- 2008, Managed RFP process for extramural NOAA’s Coral Reef Conservation Program funds. This involved 32 pre-proposals and 12 full proposals, seeking external reviews, revising guidelines, forming a review panel, and extensive correspondence.
- 2007, managed same CRCP RFP process, this time involving 28 pre-proposals and 14 full proposals. $300K/ year are available for the program, built up over several years.

B. Editorial

- Prepared and submitted a response to the Ocean Commission Report of 2004 to outline the importance of the National Undersea Research Program in collaboration with HURL, NURP, and the State of Hawaii, and independent Principal Investigators.
- Prepared a profile of HURL’s ocean mapping activities and submitted it to the NOAA Integrated Ocean Mapping activities report of 2004.
- Edited a more in-depth summary of HURL’s deep-sea coral activities and submitted it to the NURP HQ and center directors to use for advancement of the NURP program as a whole.

C. Meetings

- Invited to present at the Pacific Geology Workshop sponsored by the U.S. Extended Continental Shelf Task Force in April 2008 at the East-West Center, Honolulu, HI.
- Invited to represent NURP and HURL at two federal grant outreach workshops in Guam and Saipan, CNMI to improve the quality of submittals. July 2006.
- Invited to represent the NOAA Office of Ocean Exploration and NURP at the Integrated Ocean and Coastal Mapping (IOCM) standards workshop at the NOAA/UNH Joint Hydrographic Center in Durham, NH. April 2006.
- Invited to be a panelist for a breakout session at the Seamount Biogeoosciences Network Workshop in La Jolla, CA entitled *SBN Database Needs, CyberInfrastructure and the Seamount Catalog*. March 2006.
- Invited participant and presenter at the annual fall NSF/UNOLS DEep Submergence Science Committee (DESSC) meetings.

D. Referee

- Provided six reviews of funding proposals (NSF) or manuscripts for journals or books.

11. Percentage of time available for research or scholarly activities: 25%

12. Percentage of time committed to the program: 5%
1. **Name and academic rank**
   Jian Yu, Associate Researcher

2. **Degrees with fields, institution, and date**
   Ph.D., Chemical Engineering, University of British Columbia, September 1991
   M.Eng., Chemical Engineering, Zhejiang University, China, September 1985
   B.Eng, Chemical Engineering, Zhejiang Institute of Technology, China, September 1982

3. **Number of years of service on this faculty, including date of original appointment and advancement**
   8 years (as of July 2009), September 2001 – present, Associate Professor/Researcher

4. **Other related experience (i.e., teaching, industrial, etc.)**
   Sept 1994 – Aug 2001 Assistant Professor, Chemical Engineering, Hong Kong University of Science & Technology, Hong Kong
   April 1993 – Aug 1994 Postdoctoral Associate, Civil & Environmental Engineering, University of Windsor, Ontario
   Aug 1985 – July 1987 Lecturer, Chemical Engineering, Zhejiang University, China

5. **Consulting, patents, etc.**
   **Consulting:**
   - Bio-On srl, Bologna, Italy, March 2008 – date
   - EGI International Inc., Keokuk, Iowa, June 2007 – date
   - I-PHA Ltd. Hong Kong, March 2003 – May 2006

   **Patents (issued):**
   - Recovery and purification of polyhydroxyalkanoates from PHA-containing cell mass (US Patent No. 7,514,525, awarded April 2009)

6. **States in which professionally licensed or certified**
   N/A

7. **Principal publications of the last five years**


8. **Scientific and professional societies of which a member**
   - American Chemical Society (ACS)
   - Bio-Environmental Polymer Society (BEPS)

9. **Honors and awards**
   Excellent Teaching, School of Engineering, Hong Kong University of Science & Technology, 1999

10. **Institutional and professional service in the last five years**
    Averaged undergraduate instructional FTE (based on % of 18 credits taught per year):
    15% in Bioengineering Program

11. **Percentage of time available for research or scholarly activities**
    80%

12. **Percentage of time committed to the program**
    5%
1. Name and academic rank
   David Rezachek, PhD, PE

2. Degrees with fields, institution, and date
   1991, PhD, Ocean Engineering, University of Hawaii at Manoa
   1980, MS, Mechanical Engineering, University of Hawaii at Manoa
   1976, BS, Environmental Technology and Urban Systems, Florida International University
   1972, BS, Chemistry (with distinction), University of Minnesota
   1972, Ensign, US Navy Officer Candidate School

3. Number of years of service on this faculty, including date of original appointment advancement
   10 years; Affiliate Graduate Faculty, 1999 – Present

4. Other related experience, i.e., teaching, industrial, etc.
   • Associate Development Director/Consultant, Honolulu Seawater Air Conditioning, LLC, 2003 - 2009.
   • Assistant Mechanical Engineer, Sugar Technology and Engineering Department, Hawaiian Sugar Planters’ Association (HSPA), 1980 – 1987.

5. Consulting, patents, etc.
   • Associate Development Director/Consultant, Honolulu Seawater Air Conditioning, LLC, 2003 - 2009.

6. States in which professionally licensed or certified, if applicable
   Professional Engineer (Mechanical), License No. 5485, State of Hawaii.

7. Principal publications of the last five years


8. Scientific and professional societies of which a member
- American Society of Mechanical Engineers (ASME)
- Hawaii Academy of Science (HAS)
- Hawaii Solar Energy Association (HSEA)
- International District Energy Association

9. Honors and awards

10. Institutional and professional service in the last five years
- Team-taught capstone design project, Department of Ocean and Resources Engineering, University of Hawaii, Spring 2005, Spring 2009.

11. Percentage of time available for research or scholarly activities
10%

12. Percentage of time committed to the program
2%
1. Name and academic rank

Joseph C. Van Ryzin, PhD

2. Degrees with fields, institution, and date

1977, PhD, Ocean Engineering, University of Rhode Island
1968, MS, Mechanical Engineering, University of Rhode Island
1966, BS, Mechanical Engineering, Carnegie Institute of Technology

3. Number of years of service on this faculty, including date of original appointment and advancement

24.5 years; Affiliate Graduate Faculty: Fall 1984 – Present

4. Other related experience, i.e., teaching, industrial, etc.

President and Senior Ocean Engineer, Makai Ocean Engineering, Inc., Waimanalo, Hawaii, 1973-Present

5. Consulting, patents, etc.

Patents:
- System for Extraction and Utilization of Oxygen from Fluids, Low-Drag Oxygen Extraction Gills
- System for heat exchange in seawater by using finned aluminum extrusions

Consulting:
- Nature of business is as consulting ocean engineer; 37 years experience

6. States in which professionally licensed or certified, if applicable

Professional Engineer (Mechanical), State of Hawaii

7. Principal publications of the last five years


Plus numerous project reports on the designs of deep water pipelines, seawater air conditioning systems, and Ocean Thermal Energy Conversion studies.

8. Scientific and professional societies of which a member

- American Society of Mechanical Engineers
- Marine Technology Society, Former Hawaii Section Chairman

9. Honors and awards

- Member of Design Team for Mini-OTEC Project, which was awarded "One of Ten Outstanding Engineering Achievements in the U.S.", 1980, by the National Society of Professional Engineers.
- Lead Engineer, HOST Park 55” Cold Water Pipeline, received an OPAL Merit Award in 2003 from the American Society of Civil Engineers as one of 6 most Outstanding Civil Engineering projects in the US.
- President of Makai Ocean Engineering: Recipient of the “Exporter of the Year” award from Governor of the State of Hawaii in 2003 for Professional Services.
- President of Makai Ocean Engineering: Annual Compass Industrial Award by the Marine Technology Society for the one company providing “Outstanding Contributions to the Advancement of the Science and engineering of Oceanography and Marine Technology” – 2005.
10. Institutional and Professional Service in Last Five Years

11. Percentage of time available for research or scholarly activities
   • Approximately 25% of my professional time is on research.

12. Percentage of time committed to the program
   • Approximately 1% of my time is devoted to UH program.
1. Name and academic rank
   Dayananda H. Vithanage, Associate Faculty

2. Degrees with fields, institution, and date
   PhD, Ocean Engineering, University of Hawaii, 1987
   BS, Civil Engineering, University of Ceylon, Sri Lanka, 1978

3. Number of years of service on this faculty, including date of original appointment and advancement
   4 years

4. Other related experience, i.e., teaching, industrial, etc.
   • 38 years in Civil, Coastal and Environmental Engineering in the Private sector
   • Technical Director and Vice President, Oceanit Laboratories, Inc., Honolulu, Hawaii, 2000-2003
   • Senior Projects Engineer and Vice President, Oceanit Laboratories, Inc., Honolulu, Hawaii, 1990 – 2000
   • Chief Engineer, Lanka Hydraulic Institute, Colombo, Sri Lanka, 1987 to 1989
   • Engineer, Coast Conservation Department, Sri Lanka, 1978 to 1983
   • Lecturer, Coastal Engineering, University of Moratuwa, Sri Lanka, 1978 – 1983

5. Consulting, patents, etc.
   Consulting
   • Oceanit Laboratories Inc.

   Patents
   • Lysimeter for Collecting Chemical Samples from the Vadose Zone - US Patent Number: 5,567,889. Inventors: Patrick K. Sullivan, PhD, PE, Dayananda Vithanage, PhD, PE, and Robert E. Bourke.
   • Flexible Pipe Diffuser - US Patent Number: 5,590,979. Inventors: Patrick K. Sullivan, PhD, PE, Dayananda Vithanage, PhD, PE, and Warren E. Bucher, PhD.

6. States in which professionally licensed or certified, if applicable
   • Professional Engineer (Civil), License No. 9348, Hawaii, 1989.
   • Licensed Surveyor and Leveler, Sri Lanka, 1980.

7. Principal publications of the last five years
   Environmental Impact Statement Honokohau Harbor Expansion
   Environmental Assessment for Tinian Wastewater treatment plant outfall

8. Scientific and professional societies of which a member
   • Member ASCE
   • Member AWWA
   • Member HWEA

9. Honors and awards

10. Institutional and professional service in the last five years

11. Percentage of time available for research or scholarly activities: 10 %

12. Percentage of time committed to the program: 10%
APPENDIX C

LABORATORY EQUIPMENT

- Vessels: 25 ft outboard motor boat
  57 ft Coastal Vessel
  225 foot Ocean Going research Vessel
- Kilo Nalu Nearshore Reef Observatory-major cabled observatory
- Environmental Fluid Dynamics Laboratory
- Wave Channel: a 10-meter long, 30 × 10 cm wave simulation apparatus
- ORE Departmental Computer Clusters
- Makai Research Pier – instrumented in ocean test facility for new Department of Energy $5 million dollar ocean renewable energy Center
- University of Hawaii Marine Center- ROV and AUV support facilities
- Hawaii Undersea Research Laboratory- staff of nine technicians, two submersibles and a machine shop and instrumentation facility
APPENDIX D

INSTITUTIONAL SUMMARY
INSTITUTIONAL SUMMARY

A. The Institution

1. University of Hawai‘i at Mānoa, Hawai‘i Hall 202, Honolulu, HI 96822

2. Chief Executive Officer: Virginia S. Hinshaw, Chancellor

B. Type of Control

The University of Hawai‘i at Mānoa is a state institution.

C. History of Institution

Founded in 1907, the University of Hawai‘i at Mānoa is the flagship campus of the University of Hawai‘i System, located in beautiful Mānoa Valley, just outside downtown Honolulu, Hawai‘i on the island of O‘ahu. A destination of choice, students and faculty come from across the nation and the world to take advantage of UH Mānoa's unique research opportunities, diverse community, nationally-ranked Division I athletics program, and beautiful landscape. Consistently ranked a "best value" among U.S. colleges and universities, our students get a strong education at an affordable price.

The campus size is 320 acres consisting of 11 Colleges and nine Schools (units). Bachelor's degrees are offered in 87 fields, master's degrees in 87 fields, doctoral degrees in 55 fields, and professional degrees in three fields.

There are approximately 1,272 full-time faculty, 88% of which have at least one doctoral degree, and a student faculty ratio of 16:1.

Research

UH Mānoa is one of only 13 institutions to hold the distinction of being a land-, sea-, and space-grant research institution. Classified by the Carnegie Foundation as having "very high research activity," UH Mānoa is known for its pioneering research in such fields as oceanography, astronomy, Pacific Islands and Asian area studies, linguistics, cancer research, and genetics. The National Science Foundation ranks UH Mānoa in the top 30 public universities in federal research funding for engineering and science and 49th overall. In 2007, the campus received over $209 million in research awards.

Financial

- In-state tuition: $5,952
- Out-of-state tuition: $16,608
- Room and board: $7,500 *2008-2009 academic year estimate.
- Some programs charge fees, such as programs within the College of Engineering, currently at $400/semester for sophomores–seniors.
Athletics
- NCAA Division I
- Member of the Western Athletics Conference, Mountain Pacific Sports Federation
- NCAA Division I sports: 19

Campus Life
- Student organizations: over 200
- Intramural sports: seven currently offered (varies by semester)

Alumni
Our 130,000 alumni reside in 50 states and more than 80 countries worldwide.

Rankings
- Named a "Best Western College" and an "America's Best Value College" by Princeton Review
- The National Science Foundation ranks UH Mānoa in the top 30 public universities for federal research funding in engineering and science (manoa.hawaii.edu/about/)

The University of Hawai‘i is a ten-campus system consisting of the University of Hawai‘i at Mānoa, the University of Hawai‘i at Hilo, the University of Hawai‘i at West Oahu, and seven community colleges. It is governed by a fifteen member Board of Regents, appointed by the Governor and confirmed by the Legislature. The administrative head of the system is the President of the University of Hawai‘i. The administrative head of the UH Mānoa is the Chancellor of the University of Hawai‘i at Mānoa.

A number of changes have occurred in the University of Hawai‘i organization since the last ABET visit in 2003. Evan Dobelle joined UH as President of the system in 2001. In 2004, Dr. Dobelle resigned and David McClain was named Acting President and subsequently permanent President in 2006. In the summer of 2002, Peter Englert assumed the position of Chancellor of UH Mānoa. He stepped down in 2005 and Denise Konan was appointed as Interim Chancellor in August 2005. In April 2007, Virginia Hinshaw was selected to become Mānoa Chancellor and took up her post on July 1, 2007.

While Chancellor, Peter Englert formed his administrative team by bringing in Neal Smatresk as the Vice Chancellor for Academic Affairs (May 2004), Gary Ostrander as the
Vice Chancellor for Research and Graduate Education (December 2004), and Kathy Cutshaw as the Vice Chancellor for Administration, Finance, and Operations (on an interim basis since January 2005; appointed permanently to the position in January 2007). The team was joined by Francisco Hernandez as the Vice Chancellor for Students in July 2006.

In May 2007, Neal Smatresk left UH Mānoa. Linda Johnsrud, Vice President for Academic Policy and Planning for the UH System, was appointed to also serve as Interim Vice Chancellor for Academic Affairs effective June 2007. She returned full-time to her Vice President responsibilities in June 2008 and Peter Quigley was named as Interim Vice Chancellor for Academic Affairs in August 2008. A permanent Vice Chancellor, Reed Dasenbrock, assumed the duties in April 2009.

The University of Hawai‘i at Mānoa consists of 28 schools, colleges, organized research units, and major support organizations. Of these, the College of Engineering, the College of Tropical Agriculture and Human Resources, and the School of Ocean and Earth Science and Technology offer engineering programs.

D. Student Body

The total student population is approximately 20,000, with 13,780 undergraduates and 6,225 graduate and professional students. Hawaii (in-state) students account for 69%, out-of state students 21%, and international students 10% of the population. All fifty states are represented along with students from 103 countries and a male/female ratio of 44:56.

Ethnic Diversity

The University of Hawaii is known as one of the most diverse institutions of higher education in the United States. The ethnic background of the students is:

- African American: 1.2 percent
- Asian: 47.8 percent
- Caucasian: 22.9 percent
- Hawaiian: 9.7 percent
- Hispanic: 2.5 percent
- Mixed: 10.3 percent
- Pacific Islander: 4.0 percent
- Other: 1.6 percent

(manoa.hawaii.edu/about/)
E. Regional or Institutional Accreditation

The University of Hawai‘i at Mānoa is accredited by the Western Association of Schools and Colleges (WASC). It was first accredited in 1952. The most recent review was March 2003. Information on the WASC accreditation may be found at: manoa.hawaii.edu/wasc/. The next review will be held in December 2009.

F. Personnel and Policies


1. The promotion and tenure system

   Tenure-track faculty serve different lengths of service in their probationary years depending on their level: assistant professor: 5 years; associate professor: 3 years; professor: 2 years. The probationary period may be lengthened, shortened, or eliminated by specific action of the University or faculty member, not to exceed seven years. If tenure is denied, the faculty member is given a one-year contract. Promotion from assistant to associate professor is automatic with tenure.

   During the probationary period, faculty are assessed for strengths and weaknesses at least every two years. The department personnel committee reviews contract renewals, promotion, and tenure applications. The department Chair makes his/her own assessment, both of which are forwarded on to the Dean. In the case of contract renewals during the probationary period, the decision stops with the Dean. The Dean forwards promotion and tenure applications to the Tenure and Promotion Review Committee (TPRC) after assessment. The TPRC reviews the dossier, makes a recommendation, and returns the dossier to the Dean for transmission to the appropriate Chancellor, who forwards the dossier to the President. The President makes a recommendation to the Board of Regents, which has the authority to grant tenure and promotions. These provisions are in the Faculty Handbook: http://www.uhpa.org/uhpa-bor-contract/article-xii-tenure-service/ and http://www.uhpa.org/uhpa-bor-contract/article-xiv-promotion/

2. The process used to determine faculty salaries

   The University of Hawai‘i Professional Assembly (www.uhpa.org) is the exclusive bargaining representative (faculty union) of the faculty members of the University System under H.R.S. Chapter 89 since November 1, 1974. Faculty members in Bargaining Unit 7 consist of lecturers, instructors, professors, librarians, specialists, extension agents, researchers, and the faculty in the Schools of Law and Medicine. As of 2008, there are 3,898 individuals in Bargaining Unit 7. UHPA’s primary duties and responsibilities are the negotiations of a faculty contract, and the enforcement of the terms and rights of faculty members under that contract.

The faculty are currently operating under the 2003-2009 UH Faculty Contract. Under this contract, salary adjustments were as follows:
1) Effective July 1, 2003, all Faculty Members shall have their base salaries increased by one percent (1%).

2) Effective July 1, 2004, all Faculty Members shall have their base salaries increased by three percent (3%).

3) Effective July 1, 2005, all Faculty Members shall have their base salaries increased by two-percent (2%).

4) Effective July 1, 2006, all Faculty Members shall have their base salaries increased by five percent (5%) of which one-fifth (1/5) of the five percent (5%) shall be paid by the University.

5) Effective July 1, 2007, all Faculty Members shall have their base salary increased by nine percent (9%) of which three-ninths (3/9) of the nine percent (9%) shall be paid by the University.

6) Effective July 1, 2008, all Faculty Members shall have their base salaries increased by eleven percent (11%) of which three-elevenths (3/11) of the eleven percent (11%) shall be paid by the University.

As a result of these increases, the negotiated salary adjustment has been 34.8% since 2003.

In addition to the negotiated across-the-board salary increases, there are procedures for special salary adjustments and bonus payments: [http://www.uhpa.org/uhpa-bor-contract/procedures-for-special-salary-adjustment-bonus-payments/](http://www.uhpa.org/uhpa-bor-contract/procedures-for-special-salary-adjustment-bonus-payments/)

3. Faculty benefits

*Leaves of Absence with Pay:* Sabbatical Leaves, Study Leaves, Vacation Leaves, Sick Leaves, Bereavement Leaves, Family Leaves, Holidays, Leave for Jury or Witness Duty

*Leaves without Pay:* Professional Improvement, Personal Reasons, Rehabilitation for Substance Dependency

*Travel:* The University Research Council ([http://wwwdev.hawaii.edu/urc/](http://wwwdev.hawaii.edu/urc/)) allocates funds for travel to professional meetings. Co-chaired by the Dean of the Graduate Division and the Assistant Vice Chancellor of Research Relations, the URC consists of 17 appointed committee members. The URC holds bimonthly meetings to select recipients for the faculty travel grants.

The engineering units provide additional support for faculty travel to conferences and funding agencies.
Exemption from Tuition: Faculty Members and their spouses or domestic partners who register for credit courses offered through any unit of the University of Hawaii are exempt from the payment of tuition, with certain restrictions indicated in the Faculty Contract.

G. Educational Unit

The engineering programs at the University of Hawai‘i at Mānoa are in three units: the College of Engineering and the College of Tropical Agriculture and Human Resources (CTAHR), which are under the Vice Chancellor for Academic Affairs and the School of Ocean and Earth Science and Technology (SOEST), which is under the Vice Chancellor for Research. The College of Engineering has three programs: Civil Engineering (in the Department of Civil and Environmental Engineering), Electrical Engineering, and Mechanical Engineering. SOEST has one program: Ocean and Resources Engineering. CTAHR has one program: Biological Engineering (in the Department of Molecular Biosciences and Bioengineering). All these are under the Chancellor, the chief administrative officer of the University of Hawai‘i at Mānoa, as shown in the organizational chart below.
H. **Credit Unit**

The University of Hawai‘i at Mānoa is on the semester system. One semester credit represents one class hour or three laboratory hours per week. One academic year represents 32 weeks of classes, exclusive of final examinations. Each program sets its own requirement for the number of semester hours for graduation, as indicated in the table below.

### Credit Hours Required for Graduation and their Four-Year Equivalents

<table>
<thead>
<tr>
<th>Program</th>
<th>Credit Hours for Graduation</th>
<th>One Year Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Engineering</td>
<td>128</td>
<td>32</td>
</tr>
<tr>
<td>Civil Engineering</td>
<td>125</td>
<td>31.25</td>
</tr>
<tr>
<td>Electrical Engineering</td>
<td>124</td>
<td>31</td>
</tr>
<tr>
<td>Mechanical Engineering</td>
<td>124</td>
<td>31</td>
</tr>
<tr>
<td>Ocean and Resources Engineering</td>
<td>30</td>
<td>15</td>
</tr>
</tbody>
</table>
I. Instructional Modes

All engineering programs offer traditional on-campus instruction.

J. Grade-Point Average

All undergraduate engineering programs require a minimum 2.0 grade-point average for graduation; the Ocean and Resources Engineering MS degree requires a 3.0 grade-point average.

K. Academic Supporting Units

Mathematics, College of Natural Sciences, Keller 401-A
Wayne Smith, Chair

The mathematics program offers preparation in the full spectrum of mathematical sciences, including algebra, geometry, differential equations, real and complex analysis, topology, logic, number theory, and probability and statistics, as well as various topics in applied mathematics. Mathematics majors begin with the study of calculus and linear algebra. After completion of these fundamental courses, students may choose to specialize. The department advises each prospective major on requirements and course options to meet his or her needs and interests. Departmental advisors are also available every day to all students.

Depending upon individual interest, students of mathematics may pursue careers in a variety of fields such as teaching, computer science, operations research, statistics, business, and economics. In addition, students who continue on to the graduate program may choose to become professors and/or research mathematicians. The faculty has the competence and resources required to provide the basic mathematical preparation required for any of these professions.

A goal of all non-survey mathematics courses is the development of precision of thought and expression. This receives special emphasis in the many writing-intensive courses the department offers.

Physics, College of Natural Sciences, Watanabe 416
Stephen Olsen, Chair

Physics is the study of matter and energy and how they interact at the most basic levels. Areas include mechanics, optics and lasers, thermodynamics, electricity, magnetism, nuclear phenomena, condensed matter, and elementary particles. Physics is widely regarded as the most basic of all the sciences. UH Mānoa offers both the Bachelor of Arts and Bachelor of Science degrees in physics. Faculty members who teach physics courses are at the forefront of research in physics both in experiment and in theory. In the field of elementary particles, faculty members currently perform experiments in Hawai‘i, in Japan and in Antarctica to study neutrinos and high-energy gamma rays coming from the stars. Others are involved in
experiments at the BES accelerator in China and at the KEK accelerator in Japan, studying particle production and decay and the violation of particle/anti-particle symmetry. In condensed-matter physics, they investigate nano-materials and use a scanning tunneling microscope to take pictures of individual atoms. Two free electron lasers are being installed in the physics department. These devices will allow faculty to carry out forefront spectroscopic research in chemistry, material science, fundamental physics and medicine. Often, undergraduate physics majors work on these projects along with graduate students and the faculty.

Chemistry, College of Natural Sciences, Bilger 239
Thomas Hemscheidt, Chair
Chemistry stands at the crossroads between physics and biology. As biological processes are examined in ever finer detail, chemistry is increasingly called upon to provide the insights, techniques, and materials needed to understand the workings of living organisms, including ourselves. Chemistry is thus a popular major for those interested in biomedical careers. In another direction, chemistry is also essential to the search for solutions to the ecological problems created by the ever-expanding range of human activities. Chemists create new substances with new properties that find application throughout our civilization.

As a major, chemistry provides a solid foundation of scientific knowledge and experimental skills that enables one to specialize in many directions toward careers in research, teaching, business, or professional practice. Also, because virtually all constructed things we see and use in our daily lives involve chemistry, there is a huge pool of jobs for chemists in the manufacturing industries.

Biology, College of Natural Sciences, Dean 2
S. D. Maynard, Director
The Biology Program is a cooperative program whose faculty members are from the Biology Program and the Departments of Botany; Cell and Molecular Biology; Microbiology, Molecular Biosciences and Biosystems; Engineering; and Zoology. It provides an academic home to students who wish to pursue a broad training in the biological sciences. It offers a BA degree for pre-professional students, a BS degree with five specializations: cell and molecular biology, ecology/evolution/conservation biology, marine/aquatic biology, organismic biology and general biology, a BS degree in marine biology, and a minor in biology.

Biology is of fundamental importance in a science or liberal arts education, as it provides students with a keener insight into and a deeper appreciation of the many facets of living systems. Most students plan to use their training as preparation for professional work, such as aquaculture, biotechnology, biological research, dentistry, marine biology, medicine, optometry, park services, pharmacy, and teaching. Our graduates have an outstanding record of acceptance in advanced degree programs at dental, medical, pharmacy, and graduate schools. Many of our graduates also become teachers after obtaining a post-baccalaureate
teaching certificate at the College of Education.

The biology curricula are designed to provide students with a strong background in the principles of biology and with rigorous upper-division instruction in a number of basic areas. This combination of breadth and in-depth instruction allows students to develop the intellectual foundations and the skills necessary to deal with the specific biological concerns of today and the flexibility to meet the needs of the various professions. From this base, our graduates can pursue future specialization with confidence.

**Microbiology**, College of Natural Sciences, Snyder 207
P. Q. Patek, Chair

Microbiology deals with microscopic forms of life and their activities. Bacteria, algae, fungi, protozoa, and viruses are included in this discipline. The field is diverse and concerns the nature of microorganisms, as well as their interactions—both advantageous and adverse—with other organisms and with the environment. Entire academic disciplines and commercial enterprises are based on what microorganisms do. For example, the very forms that may cause infectious diseases and epidemics may also support industries that produce vaccines or antimicrobial agents. Microorganisms play an essential role in the cycling of the limited supply of nutrients available on Earth’s surface by decomposing plant residues and animal remains and by being primary producers of food in the oceans. Many microorganisms or their products may be eaten, drunk, used as fuel, or carefully disposed of as undesirable. They may be used to clean up the environment or controlled only with great effort to prevent corrosive, obnoxious, or destructive activities that they may bring about. Microbiology also deals with the physiology, biochemistry, genetics, and molecular biology of microorganisms. Many of the advances in DNA technology are mediated through bacteria, yeasts, and viruses; much of what we know about metabolism in general comes from their study.

**Zoology**, College of Natural Sciences, Edmondson 152
S. Conant, Chair

The Department of Zoology at UH Mānoa offers undergraduate programs leading to bachelor of science and bachelor of arts degrees and a zoology minor, and graduate programs that offer master of science and PhD degrees. Of particular note is the department’s emphasis on tropical marine biology and evolutionary biology. There are few places in the U.S. where these emphases can be pursued more productively or in a more practical setting. Students can acquire a broad background for a career in marine biology. The BS degree is particularly suited for students preparing for graduate training in zoology and related fields and for those seeking immediate employment in zoology-related research and application markets, providing the broadest scientific background at the undergraduate level. Students preparing for pre-professional programs (premedical, pre-dental, pre-physical therapy, pre-veterinary medical) should consider the BA degree. It provides greater flexibility in pursuing the broad liberal arts education encouraged by professional schools. The courses applied toward the zoology major may then be selected with those programs in mind.
English, College of Language, Linguistics, and Literature, Kuykendall 402
Mark Heberle, Chair

The Department of English encourages students to develop their critical reading, writing, and creative skills through study of a variety of literatures in English, composition and rhetoric, and creative writing. The department recognizes the unique diversity of cultures in Hawaiʻi and employs a variety of approaches, including multicultural and Asia Pacific perspectives, to address this uniqueness. Students work directly with faculty in relatively small classes to allow personal attention. The department participates actively in UH Mānoa’s Honors Program and its Study Abroad Semester and offers professional internships for interested students in the senior year.

The goals of the undergraduate English program are (a) to offer a comprehensive range of courses which recognizes Hawaiʻi’s geographic and cultural location in the Pacific as part of a challenging program in literary and cultural studies, composition and rhetoric, and creative writing; (b) to develop students’ critical thinking and reading skills; (c) to develop students’ interests and abilities in rhetoric and writing across a variety of genres.

Speech, College of Arts and Humanities, George 326
H. Lee, Chair

The Department of Speech has as its primary objectives the development of knowledge in and instruction concerning the process of speech communication. This involves three fundamental areas of emphasis. The first area is human message processing, which involves understanding the function and structure of the various codes, verbal and nonverbal, used to form messages in speech communication as well as examining the encoding and decoding processes involved in speech communication. The second area is relational communication, which focuses on factors that influence growth, maintenance, and termination of relationships. The third area is social influence, deals with the processing of beliefs, attitudes, and behavioral modification, including gaining compliance, conflict resolution, persuasive campaigns, and propaganda.

Speech is predominantly a discipline of systematic, purposeful thinking and communicating. Students obtain a liberal education of considerable breadth and depth in regard to speech communication theory. Furthermore, they are afforded ample opportunity to develop their communicative skills by applying theory in such diverse activities as interviewing, group discussion, organizational communication, conflict management, intercultural communication, public speaking, interpersonal communication, and health communication. Indeed, the basic philosophy of this department—and it is stressed in every course and co-curricular program offered—is that there is no surer preparation for professional life and participation in society than an education that enhances the ability of the individual to maintain lifelong learning and the skills to communicate effectively.
**Economics**, College of Social Sciences, Saunders 542

Gerard Russo, Chair

Economics is the social science that deals with the allocation and use of human and material resources under conditions of scarcity and uncertainty. It examines this subject matter at the micro level (the consumer, the household, the firm, and the industry) and the macro level (the region, the labor force, the government, the nation, and the world). Courses in these topics are complemented by instruction in the statistical and mathematical tools necessary for modeling, data collection and analysis, and hypothesis testing. Students of economics will learn a body of knowledge that is essential to understanding many aspects of the modern world and contemporary public policy issues, including such vital matters as international trade, economic development, the environment, Hawai‘i’s economic challenges, regulation, business cycles, and consumer behavior. A BA in economics is an excellent background for demanding analytical and policy positions in the public and private sectors; it is also a highly regarded preparation for graduate work in law, business, and public policy, as well as economics.

Economics at UH Mānoa is consciously directed toward policy challenges in the Asia Pacific region, which comprises the nations of the Pacific rim and the Pacific Islands, as well as Hawai‘i. Geographic and subject matter interests of students and faculty contribute to a regional specialization in accord with UH’s overall mission.

L. **Non-Academic Supporting Units**

1. **Computing Facilities**, Keller 213 (http://www.hawaii.edu/infotech/)

   David Lassner, VP for Information Technology and Chief Information Officer

   Information Technology Services (ITS) provides support for academic computing, management information systems, networking, telephony, teleconferencing and distance learning technologies for the UH Manoa campus and the UH system. ITS provides and supports a wide array of hardware, software, networks and services to meet these objectives. ITS’ infrastructure includes central servers and services, local and wide area networks, a large voice communications system, and several statewide video and teleconferencing systems to provide distance education services. In addition, ITS develops, operates and maintains the UH’s institutional administrative information systems.

   Specific ITS services include: electronic mail, web hosting services, Internet access, host-based software services, software site license programs, computer labs for students, a Digital Media Center for faculty, technical documentation, telephone services, voice mail, and a number of types of teleconferencing support. ITS also offers short courses and professional development activities for faculty and staff. All UH students, faculty and staff can obtain access to the Internet and UH computing resources through ITS. The ITS Help Desk provides technical support and a single point of contact for access to ITS services.

Sara Rutter, Science and Technical References Librarian

The UHM library serves as a resource for both the Manoa campus and for other UH system campuses. The Library has a staff of 53 FTE library faculty, 97 FTE support and professional staff and 50 FTE student assistants. The collections total 3.4 million volumes, 5.9 million microfilm units, 5,120 computer files, 5,933 manuscripts and archives, 64,448 audiovisual items, 251,000 maps/aerial photographs, and 33,291 current serial/journal titles, many in web format.

Library services and collections are housed in two buildings on the Manoa campus: Hamilton and Sinclair Libraries. Hamilton Library contains a majority of the research collections, including the majority of the engineering collection. Sinclair Library holds the Student Success Center dedicated to supporting undergraduate education. In Fall 2002, Phase III, a five-floor addition to Hamilton, was completed. Four floors of this addition are dedicated to science and technology. Renovation continues in the older Phase I and II sections. The Science & Technology Reference Department is located on the first floor of the addition.

The UHM Library website at library.manoa.hawaii.edu provides electronic access to a wide variety of electronic services and collections including the Hawaii Voyager Library Catalog, Databases and Indexes, Electronic Journals, Newspapers and E-books, Reference Tools and Digital Archives. The Science and Technology department website, which serves Engineering is at www.hawaii.edu/sciref, with links to an Engineering subject guide at www.hawaii.edu/sciref/engineering.html and library guides for undergraduate and graduate students in engineering at:


http://www.hawaii.edu/sciref/instruction/survivalguide_engin_grad.pdf

3. **Faculty and Student Services**

**Office of Faculty Development and Academic Support**, Kuykendall 107

Gerald Meredith, Interim Chair ([http://www.ofdas.hawaii.edu/](http://www.ofdas.hawaii.edu/))

The Office of Faculty Development and Academic Support (OFDAS) provides general academic support and services in support of faculty and instructional development. OFDAS provides leadership development workshops, seminars, and focus groups for department chairs; TA training; supports faculty evaluation and development funds (professional development plans); supports departmental instructional and faculty development projects; coordinates faculty convocations, orientations, and honors ceremonies; maintains a faculty development resource and conference room (Kuykendall 106) available to faculty and departments; coordinates a faculty mentoring program; and provides direction and supervision for its subunit centers (Center for Teaching Excellence, Center for Instructional Support, and Faculty Mentoring Program).
**Office of Student Affairs**, Queen Lili‘uokalani Center for Student Services, Room 409
Francisco Hernandez, Vice Chancellor for Students and Dean of Students
([http://studentaffairs.manoa.hawaii.edu/](http://studentaffairs.manoa.hawaii.edu/))

The Office of Student Affairs (OSA) encompasses non-academic student support services: co-curricular activities, housing, counseling and career guidance, employment, and health, which serve all students. OSA also administers programs that provide support services to minority students, especially Hawaiians and Filipinos, other underrepresented students, students with disabilities, and senior citizens, and assists students who have special problems or concerns, such as academic grievances and student conduct issues.

The Office of Student Affairs is under the leadership and supervision of the Vice Chancellor for Students, who is responsible for the direction and coordination of student services. The Vice Chancellor for Students reports directly to the Chancellor and is a member of the University’s Mānoa Management Executive and Leadership Team.

**Center for Career Development and Student Employment**, Queen Lili‘uokalani Center for Student Services, Room 412
Myrtle Ching-Rappa, Director ([http://cdse.hawaii.edu/](http://cdse.hawaii.edu/))

The Center for Career Development and Student Employment (CDSE) partners with faculty and employers to empower UH Mānoa students to engage in career life planning. CDSE supports students and alumni in their career and personal development through awareness, exploration, experience, and reflection in University and non-university work-based learning opportunities. Some of the major programs and services include: career counseling, career planning sessions and workshops, graduate school planning, co-operative education and internships, part-time and full-time employment including Federal Work Study and campus recruitment, information sessions, and career fairs.

**Tutoring**

Advising and tutoring are generally handled within each of the departments; however, there are services offered to all University of Hawaii at Manoa students in the Office of Student Affairs, as described above.

It is the responsibility of the University of Hawai‘i at Mānoa to prepare students to enter the workforce and become tomorrow’s leaders, innovators, community members, and responsible workers. For high school students, Mānoa offers pre-college intervention outreach programs and new student orientation programs to help ease the transition to college. Academic resources such as advising and tutoring services are offered to students. For students that want to broaden their Mānoa experience, there are learning opportunities and student success programs available at: ([http://studentaffairs.manoa.hawaii.edu/studyhard/](http://studentaffairs.manoa.hawaii.edu/studyhard/)).

**M. Faculty Workload**

Full-time faculty load in the Department of Ocean and Resources Engineering is two 3-credit courses per semester. Student thesis, dissertations and directed reading courses (ORE 500, 395, 699, 700 and 800) may be equivalent to one of the instructional courses.
## Table D-1. Programs Offered by the Educational Unit

<table>
<thead>
<tr>
<th>Program Title</th>
<th>Day</th>
<th>Modes Offered</th>
<th>Nominal Years to Complete</th>
<th>Administrative Head</th>
<th>Administrative Unit or Units (e.g. Dept.)</th>
<th>Submitted for Evaluation</th>
<th>Offered, Not Submitted for Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Engineering</td>
<td>X</td>
<td>Cooperate Off Campus</td>
<td>4</td>
<td>Harry Ako</td>
<td>Molecular Biosciences and Bioengineering</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Civil Engineering</td>
<td>X</td>
<td>Cooperative Off Campus</td>
<td>4</td>
<td>Ronald Riggs</td>
<td>Civil and Environmental Engineering</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Electrical Engineering</td>
<td>X</td>
<td>Cooperative Off Campus</td>
<td>4</td>
<td>Anthony Kuh</td>
<td>Electrical Engineering</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Mechanical Engineering</td>
<td>X</td>
<td>Cooperative Off Campus</td>
<td>4</td>
<td>Ronald Knapp</td>
<td>Mechanical Engineering</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Ocean and Resources Engineering</td>
<td>X</td>
<td>Cooperative Off Campus</td>
<td>2</td>
<td>John Wiltshire</td>
<td>Ocean and Resources Engineering</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
### Table D-2. Degrees Awarded and Transcript Designations by Educational Unit

<table>
<thead>
<tr>
<th>Program Title</th>
<th>Modes Offered</th>
<th>Alternative Mode</th>
<th>Name of Degree Awarded</th>
<th>Designation on Transcript</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Engineering</td>
<td>X</td>
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<td>BS in Biological Engineering</td>
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<tr>
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<td></td>
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<td>MS in Biological Engineering</td>
</tr>
<tr>
<td>Civil Engineering</td>
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<td></td>
<td>Bachelor of Science</td>
<td>BS in Civil Engineering</td>
</tr>
<tr>
<td>Civil Engineering</td>
<td>X</td>
<td></td>
<td>Master of Science</td>
<td>MS in Civil Engineering</td>
</tr>
<tr>
<td>Civil Engineering</td>
<td>X</td>
<td></td>
<td>Doctor of Philosophy</td>
<td>PhD in Civil Engineering</td>
</tr>
<tr>
<td>Electrical Engineering</td>
<td>X</td>
<td></td>
<td>Bachelor of Science</td>
<td>BS Electrical Engineering</td>
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<tr>
<td>Electrical Engineering</td>
<td>X</td>
<td></td>
<td>Master of Science</td>
<td>MS in Electrical Engineering</td>
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<tr>
<td>Electrical Engineering</td>
<td>X</td>
<td></td>
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<td>PhD in Electrical Engineering</td>
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<td>Mechanical Engineering</td>
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<td>Bachelor of Science</td>
<td>BS in Mechanical Engineering</td>
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<td>MS in Mechanical Engineering</td>
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<td>Mechanical Engineering</td>
<td>X</td>
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<td>Doctor of Philosophy</td>
<td>PhD in Mechanical Engineering</td>
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<td>Ocean and Resources Engineering</td>
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<td>Master of Science</td>
<td>MS in Ocean and Resources Engineering</td>
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<td>PhD in Ocean and Resources Engineering</td>
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### Table D-3. Support Expenditures
OCEAN AND RESOURCES ENGINEERING

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<thead>
<tr>
<th>Expenditure Category</th>
<th>Previous FY 2007-2008</th>
<th>Current FY 2008-2009</th>
<th>Year of visit 2009</th>
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</thead>
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<tr>
<td>Operations (not including staff)</td>
<td>$37786.00</td>
<td>$78424.00</td>
<td>$78000.00</td>
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<tr>
<td>Travel</td>
<td>11280.00</td>
<td>36528.00</td>
<td>36500.00</td>
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<tr>
<td>Equipment</td>
<td>0</td>
<td>7892.00</td>
<td>8000.00</td>
</tr>
<tr>
<td>(a) Institutional Funds</td>
<td>0.00</td>
<td>7892.00</td>
<td>8000.00</td>
</tr>
<tr>
<td>(b) Grants and Gifts</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Graduate Teaching Assistants</td>
<td>33763.00</td>
<td>14670.00</td>
<td>17500.00</td>
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<tr>
<td>Part-time Assistance (other than teaching)</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Faculty Salaries</td>
<td>555291.00</td>
<td>664870.12</td>
<td>711693.00</td>
</tr>
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<td><strong>TOTALS</strong></td>
<td><strong>$638121.00</strong></td>
<td><strong>$810278.12</strong></td>
<td><strong>$859696.00</strong></td>
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### Table D-4. Personnel and Students
OCEAN AND RESOURCES ENGINEERING

Year: Fall 2008

<table>
<thead>
<tr>
<th>Head Count</th>
<th>FT</th>
<th>PT</th>
<th>FTE</th>
<th>Ratio to Faculty</th>
</tr>
</thead>
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<tr>
<td>Administrative</td>
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<td>0</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Faculty (tenure-track)</td>
<td>5</td>
<td>0</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td>Other Faculty (excluding student Assistants)</td>
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<td>0</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>Student Teaching Assistants</td>
<td>2</td>
<td>0</td>
<td>1.0</td>
<td>0.14</td>
</tr>
<tr>
<td>Student Research Assistants</td>
<td>27</td>
<td>13.5</td>
<td>1.93</td>
<td></td>
</tr>
<tr>
<td>Technicians/Specialists</td>
<td>5</td>
<td>1</td>
<td>5.25</td>
<td>0.75</td>
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<tr>
<td>Office/Clerical Employees</td>
<td>1</td>
<td>2</td>
<td>2.0</td>
<td>0.29</td>
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<tr>
<td>Others</td>
<td>6</td>
<td>0</td>
<td>6.0</td>
<td>0.86</td>
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<td>31</td>
<td>3</td>
<td>32.5</td>
<td>0.00</td>
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<tr>
<td>Graduate Student enrollment</td>
<td>31</td>
<td>3</td>
<td>32.5</td>
<td>4.64</td>
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**Table D-5. Program Enrollment and Degree Data**

**OCEAN AND RESOURCES ENGINEERING**

<table>
<thead>
<tr>
<th>Academic Year</th>
<th>Total Undergrad</th>
<th>Total Grad Students</th>
<th>Degrees Conferred</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Bachelor</td>
</tr>
<tr>
<td>CURRENT 2008 Fall</td>
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<td>0</td>
<td>0</td>
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<tr>
<td>2008 Fall</td>
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<tr>
<td>1 2007</td>
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<td>0</td>
</tr>
<tr>
<td>2 2006</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3 2005</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4 2004</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>5 2003</td>
<td>0</td>
<td>0</td>
<td>0</td>
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</table>

FT--full time  PT--part time

**Table D-6. Faculty Salary Data**

**OCEAN AND RESOURCES ENGINEERING**

Academic Year: 2008

<table>
<thead>
<tr>
<th>Professor</th>
<th>Associate Professor</th>
<th>Assistant Professor</th>
<th>Instructor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>5</td>
<td>1</td>
<td>1</td>
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<tr>
<td>High</td>
<td>185,000</td>
<td>108,281.88</td>
<td>84,000</td>
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<tr>
<td>Mean</td>
<td>131,776.72</td>
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<tr>
<td>Low</td>
<td>107,596.44</td>
<td></td>
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</tbody>
</table>
APPENDIX E

DEPARTMENTAL PUBLICATIONS

2003-2009 (by year)


2007


Ertekin, R.C. and Incecik, A. 2007, Foreword by the Incoming Editors-In-Chief, Ocean Engineering, Vol. 34, No. 3-4, March, pp. 359-360.


2006


**2005**


2004


2003


APPENDIX F

COURSE OUTCOMES BY YEAR
<table>
<thead>
<tr>
<th>Program Outcomes</th>
<th>Average Rating by Students</th>
<th>Normalized Average Rating by Credit Hours by Student</th>
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</thead>
<tbody>
<tr>
<td>General education</td>
<td>1.86</td>
<td>0.90</td>
</tr>
<tr>
<td>Basic science, math &amp; eng</td>
<td>2.13</td>
<td>1.00</td>
</tr>
<tr>
<td>Ocean engineering core</td>
<td>2.11</td>
<td>1.00</td>
</tr>
<tr>
<td>Ocean engineering specialization</td>
<td>2.14</td>
<td>1.00</td>
</tr>
<tr>
<td>Use of latest tools</td>
<td>1.59</td>
<td>0.90</td>
</tr>
<tr>
<td>Problem formulation and solution</td>
<td>2.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Design and Optimization</td>
<td>2.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Independent and team work</td>
<td>1.74</td>
<td>0.85</td>
</tr>
<tr>
<td>Professional and non-technical issues</td>
<td>1.45</td>
<td>0.85</td>
</tr>
<tr>
<td>Communication skills</td>
<td>1.81</td>
<td>0.85</td>
</tr>
<tr>
<td>Research and contemporary issues</td>
<td>1.74</td>
<td>0.85</td>
</tr>
<tr>
<td>Need for life long learning</td>
<td>1.81</td>
<td>0.85</td>
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<tr>
<td>Sum</td>
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<td>1.00</td>
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<tr>
<td>Standard Deviation</td>
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### Program achievement ratings by students

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### 2003/04 Academic Year

<table>
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<th># credits</th>
<th>Total</th>
<th>Normalized Total</th>
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<tbody>
<tr>
<td></td>
<td>CE</td>
<td>OE</td>
<td>OR</td>
</tr>
<tr>
<td>General education</td>
<td>1.86</td>
<td>0.90</td>
<td>2.00</td>
</tr>
<tr>
<td>Basic science,</td>
<td>2.13</td>
<td>2.43</td>
<td>2.18</td>
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<tr>
<td>math &amp; eng</td>
<td>2.11</td>
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<td>2.33</td>
</tr>
<tr>
<td>Ocean engineering</td>
<td>2.14</td>
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<td>2.50</td>
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<tr>
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<td>1.93</td>
<td>2.23</td>
<td>2.01</td>
</tr>
<tr>
<td>Use of latest</td>
<td>2.00</td>
<td>2.31</td>
<td>2.23</td>
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<tr>
<td>Problem formulation and solution</td>
<td>1.59</td>
<td>1.88</td>
<td>1.63</td>
</tr>
<tr>
<td>Design and</td>
<td>1.74</td>
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<td>1.83</td>
</tr>
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<td>Independent and</td>
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<tr>
<td>team work</td>
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<td>0.27</td>
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### 2003/04 Academic Year

<table>
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<th>CE</th>
<th>OE</th>
<th>OR</th>
<th>ALL</th>
<th>Normalized Total</th>
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<tbody>
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<td></td>
<td>CE</td>
<td>OE</td>
<td>OR</td>
<td>Total</td>
<td>CE</td>
</tr>
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<td>1. General education</td>
<td>0.15</td>
<td>0.07</td>
<td>0.07</td>
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<tr>
<td>2. Basic science, math &amp; eng</td>
<td>0.15</td>
<td>0.07</td>
<td>0.07</td>
<td>0.47</td>
<td>0.52</td>
</tr>
<tr>
<td>3. Ocean engineering core</td>
<td>0.23</td>
<td>0.07</td>
<td>0.07</td>
<td>0.44</td>
<td>0.79</td>
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<tr>
<td>4. Ocean engineering specialization</td>
<td>0.38</td>
<td>0.07</td>
<td>0.07</td>
<td>0.81</td>
<td>1.35</td>
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<td>5. Use of latest tools</td>
<td>0.38</td>
<td>0.07</td>
<td>0.07</td>
<td>0.81</td>
<td>1.35</td>
</tr>
<tr>
<td>6. Problem formulation and solution</td>
<td>0.35</td>
<td>0.03</td>
<td>0.03</td>
<td>0.78</td>
<td>1.23</td>
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<tr>
<td>7. Design and Optimization</td>
<td>0.35</td>
<td>0.03</td>
<td>0.03</td>
<td>0.46</td>
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<td>8. Independent and team work</td>
<td>0.32</td>
<td>0.00</td>
<td>0.00</td>
<td>0.53</td>
<td>1.11</td>
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<td>9. Professional and non-technical issues</td>
<td>0.26</td>
<td>0.10</td>
<td>0.10</td>
<td>0.58</td>
<td>0.91</td>
</tr>
<tr>
<td>10. Communication skills</td>
<td>0.29</td>
<td>0.14</td>
<td>0.14</td>
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<td>11. Research and contemporary issues</td>
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<td>12. Need for life long learning</td>
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<td>0.15</td>
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### 2004/05 Academic Year

#### Average Rating by Students

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</thead>
<tbody>
<tr>
<td>Average Rating</td>
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<td>603</td>
<td>607</td>
<td>608</td>
<td>609</td>
<td>612</td>
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<td>661</td>
<td>664</td>
<td>667</td>
<td>678</td>
<td>783</td>
<td>792</td>
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<td>Credit Hours</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normalized Average Rating by Credit Hours by Student</td>
<td>0.39</td>
<td>0.42</td>
<td>0.44</td>
<td>0.67</td>
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<td>0.56</td>
<td>0.37</td>
<td>0.44</td>
<td>0.16</td>
<td>0.84</td>
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#### # credits

<table>
<thead>
<tr>
<th>Program Outcomes</th>
<th>Total</th>
<th>Normalized Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>General education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic science, math &amp; eng</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ocean engineering core</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ocean engineering specialization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of latest tools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Problem formulation and solution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design and Optimization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Independent and team work</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professional and non-technical issues</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication skills</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research and contemporary issues</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Need for life long learning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard Deviation</td>
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</tr>
</tbody>
</table>

#### Program achievement ratings by students

<table>
<thead>
<tr>
<th>Program Outcomes</th>
<th>Total</th>
<th>Normalized Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>General education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic science, math &amp; eng</td>
<td></td>
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<td>Ocean engineering core</td>
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<td>Use of latest tools</td>
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<tr>
<td>Problem formulation and solution</td>
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<tr>
<td>Design and Optimization</td>
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<td></td>
</tr>
<tr>
<td>Independent and team work</td>
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### 2006/07 Academic Year

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Program achievement ratings by students

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### Average Rating by Instructors

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APPENDIX G

STUDENT ADVISORY COMMITTEE REPORT
STUDENT ADVISORY COMMITTEE REPORT

Introduction

This report summarizes comments, ideas, and opinions generated from the June 10, 2009 meeting of the student advisory committee of the Ocean and Resources Engineering (ORE) Department, University of Hawaii at Manoa. The contents of the report are based on student experiences up to June 10, 2009. The materials in this report are the ideas that are agreed upon by the majority of the committee members. The report covers the major issues involved in Master Program offered by the department; PhD-specific issues are not included. The committee members are current students of the department, listed alphabetically:

1. James Anderson  (MS Student)
2. Yefei Bai   (PhD Student)
3. Allan Carmichael  (MS Student)
4. In Chieh Chen  (MS Student)
5. Blue Eisen   (MS Student)
6. Masoud Hayatdavoodi(PhD Student)
7. Miguel Quintero  (MS Student)
8. Volker Roeber  (PhD Student)
9. Jacob Tyler   (MS Student)
10. David Wilkinson  (MS Student)

Each ORE student was eligible to serve as a member of the panel. Standard SWOT technique was used to analyze the performance of the department. Below, the method is briefly explained.

SWOT Analysis

The ORE department was evaluated based on Strengths, Weaknesses, Opportunities and Threats (SWOT). The current performance of the department is itemized under its strengths or weaknesses. The strengths and weaknesses are mostly influenced by factors within the department and are presented as areas which the student committee believes are accomplished well by the department and areas that the committee believes require more attention. The possible opportunities or threats are mostly influenced by external factors and the perceived areas of concern are itemized under opportunities or threats.

In all the issues addressed, consideration was given to the practicality of the issue and wherever possible, solutions and suggestions for the weaknesses or threats were provided. Below is the final itemized list of the SWOT analysis. Each item is followed by a brief explanation. The list is not prioritized.
Strengths

a) Courses
   i) Strong and wide in range: The courses offered in the department are strong overall and cover a wide range of ocean engineering topics.
   ii) Research Related: The courses are generally very much related to the student’s direct research and needs.
   iii) Students are challenged to work independently and as a member of a team in completing assignments and projects.

b) Research
   i) Broad range of research: There are different possible areas for students to conduct research and in general, can be tailored to the student’s interests.
   ii) Real projects: There are several on going research projects in the department that are state projects which provide students with the opportunity to work on a real life project and become familiar with a practical project.
   iii) Coastal and Surface wave model research projects are strong and practical. This makes it easier for the students to find job and transition into a directly related area after graduation.

c) Faculty
   i) Knowledge: The faculty members are very knowledgeable in their field.
   ii) Guiding Students: The faculty members can either answer the questions of students or guide them to the relevant references to find answers of their questions.
   iii) Teaching skills:
      (1) Professors are generally very knowledgeable and able to convey their knowledge to students.
      (2) The Hydrodynamic course (ORE 609) has very good notes as a further reference.
      (3) Water wave mechanics (ORE607, Fall 2008) home works are very practical.
      (4) Professors generally provide a good list of references for each course.
   iv) Research skills
      (1) Faculty members are conducting necessary and top notch research.
      (2) Researches are really advanced in the field. This is known by interacting with students from other schools in conferences.
   v) Mentoring: Overall, faculty members are interested in acting as mentor and providing a positive educational experience for the students. They have different approaches of mentoring but overall students are happy with their work.
   vi) Availability: They are usually available and happy to see and discuss with students.
d) **Students**

i) Diverse Background: Diverse group of students with different backgrounds are working together. This gives them the chance to exchange their broad knowledge in different courses.

ii) International students: Students from all over the world are in the department, this provides them with the cultural exchange and valuable experiences.

e) **Facilities**

i) 24 hours access to the department facilities provides students with the ability to work and plan for their time in a better and comfortable way.

ii) Computing resources are excellent. Up-to-Date machines are provided for the numerical computations.

iii) Kilo Nalu lab is very strong and excellent opportunity for students to conduct real field experiments.

iv) Maui and Alaska supercomputers are outstanding clusters for number crunching for researches and thesis works.

f) **Library:** All required books and papers are very well provided.

g) **IT:** Overall most of the needs of the students and department as well as supports of the technical needs are provided.

h) **Seminars:** There are very useful to expand students’ knowledge about direct and relative research in the field. The talks also include areas that are not covered in the courses.

i) **Webpage:** Covers most of the needs of the department, especially for prospective students to give them an idea about the department.

j) **Reputation:** Department has a good reputation among other departments in the university and states. The history of the department is also a positive point about ORE that few schools in the country can compare with.

k) **Interaction with other Schools:** There is a good interaction with OSU, however, it could be developed for more schools and provide the department with more benefits.

➢ **Weaknesses**

a) **Courses**

i) Some of the courses in the department are needed for graduation, but are not offered on a regular basis.

ii) More courses in the field of offshore engineering could be offered.
iii) Renewable Energy courses could be more in-depth and are not closely related to students’ research projects.

iv) Because of the broad background of the students, more classes related to the fundamentals of ocean engineering should be offered.

v) There are no summer courses

b) Research:
   
i) The Renewable energy research is not as strong as other fields in the department, even though some students chose the department only because of the Renewable energy studies.

   ii) The ongoing research activities are not very well communicated. There is no available reference to know about all research and opportunities in the department.

c) Faculty
   
i) Teaching skills:

      (1) Faculty members could be more active in teaching the required courses of the three major fields (Coastal, Offshore and Ocean resources engineering).

      (2) Sediment Transport course (ORE 664) could be better organized.

      (3) Ocean Engineering Lab course (ORE 601) needs to be more structured and be taught at the end of the program rather than the first semester!

      (4) Water wave mechanics course (ORE 607) could be taught better if it had lecture notes.

   ii) Relation between Faculty members

      (1) Students feel that some of the faculty members are disconnected from each other. This makes it difficult to have a friendly environment in the department.

      (2) Research in the department could be more efficient if there was a closer relationship between faculty members.

d) Students: Not everybody has the required background. Department needs to either not accept students with inadequate backgrounds or offer some basic courses for them.

e) Facilities
   
i) Very weak experimental facilities. More valuable results could be achieved by having the experimental labs in parallel to the numerical works.

   ii) There are no machine shops.

f) Staff
   
i) Out of date methods for administration, very slow working process.

   ii) Understaffed in the department.

   iii) Bureaucracy in working. This, however, is a common problem at UH.
iv) Not very professional manner is expressed by the department staff.
v) They should be more aware of student problems and issues, especially when faced with a diverse and international student population.

g) Seminars
i) While attending seminars are helpful, requiring notes for seminars is counter-productive to the spirit of discussion and participation during seminars.

h) Out of the school activities: Few social gatherings occur in the department. The social activities could improve the overall environment of the department to be friendlier.

i) Physical Space of the department
i) Even though in the recent years there has been an improvement, more room is still needed.
ii) Better technical infrastructure for the Holmes offices is necessary.
iii) A room for student gatherings is needed.

j) Travel and conference expenses: There is no source of money for student’s conferences and traveling expenses, at least until they get reimbursed from different resources.

k) Prospective students: No available program for prospective students to come to the department and know it better before making their decision.

l) Specialties: Students feel that the major fields in the departments are not really covered as they are advertised before getting to school. This is very obvious for the Ocean Resources Engineering and also partially for the Offshore Engineering field.

➢ Opportunities

a) The Geographical Location of the Department: The department is placed at an excellent geographical location for ocean engineering research and study. It is possible to take more advantages of the field works and studies.

b) Alumni
i) Having the oldest department of Ocean Engineering in the country has provided a valuable network of the department’s alumni all around the world. The network, however, needs to be maintained and re-connected.
ii) Closer relationship with alumni of the department could give financial, scientific and practical benefits to the department.
iii) Developing an alumni association would be a systematic approach.
iv) One person could be responsible for contacting alumni to ask for their support.
c) Internships
   i) Internship programs provide an excellent opportunity for the students to experience real work. It is useful for the companies as well.
   ii) The program could be modified to take the internship period into consideration during the MS studies.

d) Exchange Students
   i) Exchange program with other schools could be developed in a better and systematic way. This would bring money and knowledge to the department and department has the potential for that. The department reputation would also be improved by this way.
   ii) ORE students should be able to go to other schools as well.

e) SOEST benefits
   i) ORE could use the SOEST facilities in a better way, such as computer labs, field work facilities etc.
   ii) Closer relation with other SOEST departments to exchange knowledge and science are perceived as important and beneficial.

f) Departmental meetings: Yearly (or so) student seminars to know more about each other’s research and exchange ideas.

g) Conferences: Encouraging students to participate in National and International conferences and present papers by providing more financial and mentor support.

➢ Threats

a) Financial Crisis: Almost all research in the department has out-of-school sources. The financial crisis is a serious threat for department research and the ORE program as a whole.

b) Low number of prospective Students: Having consistent number of students in each year could modify the course offering system. The undergraduate students in the university are not well informed about ORE.

c) Up-to-dated technologies and Sciences: Not really up-to-date on modern techniques in the courses, some research, and computer software. There are new computer software in the field that students are not studying any of them and are not familiar with.

d) Low RA and TA salary: Even though ORE is a part of SOEST, it is paid less than the oceanography department. This can be a problem in accepting new students for the department especially considering the financial crisis.

e) Competition: It seems that more schools are offering Ocean Engineering program. More work needs to be done to maintain the good reputation of the department.
Conclusion

The major concerns about the Ocean and Resources Engineering department were summarized in four main categories; Strengths, Weaknesses, Opportunities and Threats. In addition to the above points, it is necessary to mention that in the past few years, there has been a significant progress in the department toward switching the weaknesses to strengths and the threats to opportunities, which need some time to show its effects. Hiring new faculty members (especially in the Ocean Renewable Energy field), improving the physical space problem by adding more rooms to the department, offering new courses and research and also increasing the quantity and quality of the facilities in the department (computers, printers, software etc.) are among those changes that has contributed strongly to the departments’ improvement.

In conclusion, the department has been very successful in fulfilling its mission in educating engineers and graduate students in the field of Ocean Engineering. This is accomplished by providing a high quality education system for students. The fact that almost all ORE graduated students were able to find an opportunity in the relevant area and some outstanding positions, is a strong and satisfactory parameter indicating the success of the department toward achieving its goal. In fact, studying in ORE is recommended to significant number of current students by its alumni, this shows the satisfaction level of the quality of the program among its graduated students. The current students of the department are overall very satisfied and pleased with the program and the opportunities that this program has introduced in to their professional life. This, however, does not mean that there are no weaknesses, which are mentioned above and the student committee believes that the overall performance of the department could be improved even more by paying attention and working on the current weaknesses and threats.

The student committee members tried to only express those issues that are of similar concern for all ORE students. These comments, however, are the students’ perspectives and there are not necessarily facts about the department. Any idea that did not have the majority’s support is not expressed here.
APPENDIX H

LOCAL PROFESSIONAL ADVISORY PANEL REPORT
This report summarizes the opinions and ideas generated by the ABET Professional Advisory Panel of the Ocean and Resources Engineering (ORE) Department of the University of Hawaii. The panel met on June 18, 2009. Since the Panel consists primarily of professionals who are not experts in education but are employers of the ORE graduate, we have not reviewed in depth the educational process but rather focused on the quality of the graduate. The following summarizes our discussion:

Overall:

- We strongly support and appreciate the University of Hawaii ORE Department. It serves a vital role in the Hawaii community and in the US. There is a shortage of Ocean Engineers in the US and UH is among a handful of universities serving students interested in this field. Being an ocean dominated State, ORE is particularly important for protecting and developing our ocean resources.

Quality:

- ORE graduates generally have had an adequate exposure to Ocean courses; there were no adverse comments on course content.

- ORE graduates, however, often lack basic engineering skills. If graduates are not hired, it is most often due to weak engineering basics. This lack of key engineering skills is most likely a problem of insufficient qualifications of incoming students; basic skills are not taught in graduate school.

- We strongly encourage that ORE Increase dramatically the quality of ORE incoming students by:
  
  o **Increase the pool of ORE applicants:** We note that there are relatively few applicants to the school; in broad numbers 30 apply, 20 are accepted, and 10 finally enroll. There is little promotion of ORE at UH because the capacity of the department is easily filled each year. If the pool of applicants were larger, more qualified incoming students could be selected.

  o **Promote the School:** A formal process should be created to reach out to the most talented graduating engineers in traditional engineering fields and to introduce them to Ocean Engineering and the University of Hawaii. The goal should be to greatly increase the number and quality of ORE applicants.

  o **Emphasize quality:** Setting high standards for incoming students and focusing only on highly qualified applicants will improve the school.
Support highly qualified incoming students: Often talented applicants are lost to other schools due to a shortage of first year funding. For top-level applicants, extraordinary efforts should be made to provide funding including internships at local engineering firms. Making connections with these firms during the application process may encourage more qualified incoming students.

Hawaii emphasis:

- Emphasize Hawaii engineers: Graduates from ORE with an existing tie to Hawaii are particularly valuable for Hawaii employers. These graduates are more likely to seek Hawaii employment and more likely to remain in Hawaii. It is therefore recommended that ORE particularly emphasize contacts and recruitment of the better qualified BS graduates from UH Engineering.

Plan B Papers:

- Some Plan B papers have been broad topics with little engineering focus. We recommend:
  
  - Stronger definition of acceptable Plan B paper: ORE should adopt stronger criteria for acceptable Plan B topics with a major emphasis on engineering.
  
  - Maintain a list of pre-approved challenging Plan B topics: Students are often guided into topics by their advisors. The faculty should brainstorm regularly and maintain a list of pre-approved Plan B paper topics. The student can then select a topic with adequate engineering challenge or create his own with similar engineering content.

Intern Program:

- We give very high marks for the new ORE intern program. This is a win-win situation for the student and the employer. The student is exposed to real-world engineering problems and can assess a future Hawaii employer. Similarly, the employer can get to know a potential employee well, can be exposed to fresh new ideas and talent from the University, and can do so at a relatively low cost.

Panel Members:

- Roger Babcock, UH Civil Engineering
- Warren Bucher, Oceanit
- Liz Corbin, DBED&T
- Joe Van Ryzin, Makai Ocean Engineering
- Jose Andres
Exit Survey
Department of Ocean and Resources Engineering
School of Ocean and Earth Science and Technology
University of Hawaii at Manoa

Year of Graduation: ____________ Semester: ____________ Degree: MS ☐ PhD ☐

Please rate the following skills, abilities, and attributes generally expected of an ocean engineering graduate by using a 5-point scale indicating low to high and marking (×) at the space provided. Rate each topic or skill in terms of the importance you expect it will have in your post-graduate career. Next, please rate the effectiveness of the preparation you received from our program.

Please feel free to use the space after the list to briefly explain any of your responses, especially if you feel your preparation was less than adequate.

Importance: 0 - Not Important, 1 - Somewhat Important, 2 – Important, 3 - Very Important, 4 - Extremely Important

Preparation: 0 - Not Prepared, 1 - Somewhat Prepared, 2 – Prepared, 3 - Well Prepared, 4 - Very Well Prepared

<table>
<thead>
<tr>
<th>Importance</th>
<th>Preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

An understanding and ability to:

1. apply advanced mathematics
   | × |
2. apply knowledge of: engineering science and mechanics
   | × |
3. apply knowledge of an ocean engineering subdiscipline (coastal, offshore or ocean resources)
   | × |
4. conduct lab and field experiments and/or analyze and interpret data
   | × |
5. design and optimize engineering systems to meet the needs of the marine community
   | × |
6. identify, formulate, and solve ocean engineering problems
   | × |
7. function on multi-disciplinary or cross-functional teams
   | × |
8. synthesize and integrate knowledge across disciplines
   | × |
9. function in culturally and ethnically diverse environments
   | × |
10. communicate orally, informally, and in prepared talks
    | × |
11. communicate in writing, in business letters, and technical reports
    | × |
12. use computing technology in communications
    | × |
13. use computing technology in engineering analysis and design
    | × |
14. use the techniques, skills, and engineering tools for ocean engineering practice
    | × |
15. engage in life long learning and professional development
    | × |

An understanding of:

16. professional and ethical responsibility in engineering practice
    | × |
17. product development or design from a business
    | × |
perspective
research and contemporary issues in and beyond the marine community
the environmental aspects of engineering practice
the practice of ocean engineering on a global scale
the relation of ocean engineering practice to societal or cultural issues

Becoming a Licensed Professional Engineer

Additional Comments:

Please answer the following questions:

Do you have job offers in a field related to Ocean and Resources Engineering? (if not leave blank) (1 not related at all, 5 very related)

Overall, how satisfied are you with the education you received in ORE at UH? (1 not satisfied at all, 5 very satisfied)

Will you participate in continuing education activities - (do not include graduate degrees)
Will you attend a professional/technical society conference(s)

In your opinion, what job options are available today for graduates in Ocean and Resources Engineering?

Please list what you consider the strengths of the Ocean and Resources Engineering program to be in preparation for your career?

What do you consider the weaknesses of the Ocean and Resources Engineering program to be in preparation for your career?
This questionnaire is NOT a course evaluation. It determines the learning outcomes as perceived by the students or the instructor. Please rate the program outcomes using a five-point scale in terms of the students’ achievement in this course.

Scale: (0) None or Not Applicable, (1) Low, (2) Reasonable, (3) High, (4) Very high

The following outcomes are inclusive of the ORE program and pre-program. Each ORE course only covers a sub-set and therefore low ratings in specific outcomes do not reflect negatively on this course. Indicate a level of “0”, if a program outcome is not applicable.

<table>
<thead>
<tr>
<th>This course has increased or improved the students’</th>
<th>Level of Achievement</th>
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<tbody>
<tr>
<td></td>
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</tr>
<tr>
<td>1. General education necessary to understand the impact of engineering solutions in a global and societal context</td>
<td></td>
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<tr>
<td>2. Ability to apply knowledge of mathematics, science, and basic engineering topics</td>
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<tr>
<td>3. Proficiency in the core disciplines necessary for ocean and resources engineering practice</td>
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<tr>
<td>4. Knowledge of at least one of the three option areas that include coastal, offshore, and ocean resources engineering</td>
<td></td>
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<tr>
<td>5. Ability to use techniques, skills, &amp; latest engineering tools necessary for ocean and resources engineering practice</td>
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<tr>
<td>6. Ability to identify, formulate, and solve ocean and resources engineering problems</td>
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<td>7. Ability to design and optimize engineering systems for given design requirements and constraints</td>
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<td>8. Ability to work independently and function on multi-disciplinary teams</td>
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<tr>
<td>9. Appreciation of professional and ethical responsibilities in engineering practice</td>
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<td>10. Ability to communicate effectively to technical and non-technical audiences</td>
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<tr>
<td>11. Awareness of latest research and contemporary issues in and beyond the ocean and resources engineering disciplines</td>
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<tr>
<td>12. Recognition of the need for, and ability to engage in lifelong learning and continuing professional development</td>
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► This questionnaire is completed by Student ○ Instructor ○
Student Progress Form
Department of Ocean and Resources Engineering
University of Hawaii at Manoa

Background Information
Name: ____________________________ SN: ____________________________
Birthplace: ____________________________ Citizenship: ____________________________ Visa Status: ______
Prior Degree: ____________________________
Experience: ____________________________
Degree Sought: ____________________________ Option Area: ____________________________ Admitted: ______

Pre-Program Requirements
Prior Degree: ABET: Y / N Credits: _____ Years: _____ Credits per year: ______
UH courses: 32 credits per year
General Education:

Prior General Education Credits: ________ Number of Years: ______
Math and Science:

Prior Math and Science Credits: ________ Number of Years: ______
Basic Engineering:
CAD
Statics
Dynamics
Fluid Mech
Solid Mech
Prob & Stat
other:

3rd/4th Year Level:

Prior Engineering Credits: ________ Number of Years: ______
UH Engineering Credits: ________ Number of Years: ______
Total Engineering Credits: ________ Number of Years: ______
General Exam: ____________________________
Program Requirements

Advisor: ____________________________________________________________

Core Program: _______________________________________________________

Hydrostatics
Lab & Field
Oceanography
Acoustics
Water waves
Hydrodynamics

Option Area: _________________________________________________________

Capstone Design: _____________________________________________________

Seminar:
Electives:

Thesis/Project: _______________________________________________________

Total Credits: _______________________________________________________

Research Work

Advisor/Chair: _______________________________________________________

Committee:
Title:
Final Exam: _________________________________________________________

Graduation: _________________________________________________________

Exit Interview

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<th>Program Outcomes</th>
<th>Comments by Graduate</th>
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<td>A general education necessary to understand the impact of engineering solutions in a global and societal context</td>
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<tr>
<td>An ability to apply knowledge of mathematics, science, and basic engineering topics that include calculus, algebra, differential equations, probability and statistics, physics, chemistry, statics, dynamics, and fluid and solid mechanics</td>
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<tr>
<td>Proficiency in the core program that comprises hydrostatics, oceanography, water waves, underwater acoustics, and laboratory and field experiments</td>
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<td>Working knowledge of at least one of the three option areas that include coastal, ocean resources, and offshore engineering</td>
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<tr>
<td>an ability to use the techniques, skills, and latest engineering tools necessary for ocean &amp; resources engineering practice</td>
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<td>an ability to identify, formulate, and solve ocean and resources engineering problems</td>
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<td>an ability to design and optimize engineering systems to meet the needs of the marine community</td>
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### Post Graduation

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