Program Self-Study Report

For Review of

Degree Program

Master of Science in Mechanical Engineering

Submitted by

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To

Engineering Accreditation Commission
Accreditation Board for Engineering and Technology
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TABLE OF CONTENTS
Self-Study Report
Mechanical Engineering

A. Background Information ................................................................. 4
   1. Degree Titles ............................................................................ 4
   2. Program Modes .................................................................. 4
   3. Actions to Correct Previous Shortcomings ......................... 4
   4. Draft Statement from the Most Recent Accreditation for Mechanical Engineering Program ............................................. 5
   5. Contact Information .............................................................. 7
B. Accreditation Summary ................................................................. 8
   1. Students ............................................................................... 8
   2. Program Educational Objectives ........................................... 10
      2.1 Summary
      2.2 Description of Program Educational Objectives
      2.3 Process for Identifying and Revising Program Educational Objectives
      2.4 Process of Assessing and Evaluating Program Educational Objectives
      2.5 Ongoing Improvement of the Effectiveness of the Program
   3. Program Outcomes and Assessment ........................................ 16
      3.1 Summary
      3.2 Description of Program Outcomes and their Relation with Program Educational Objectives
      3.3 Process of Identifying and Revising Program Outcomes
      3.4 Process of Assessing and Evaluating Program Outcomes
      3.5 Continuous Improvement Process for Program Outcomes
      3.6 Relation of Courses to Program Outcomes
   4. Professional Component ......................................................... 33
   5. Faculty ................................................................................. 34
   6. Facilities .............................................................................. 37
   7. Institutional Support and Financial Resources .................... 44
   8. Program Criteria .................................................................. 46
   9. General Advanced-Level Program ....................................... 47

Appendix I - Additional Program Information ........................................ 48

A. Tabular Data for Program ............................................................ 49
   Table I-1. Basic-Level Curriculum ............................................. 49
   Table I-1A. Advanced-Level Curriculum ................................... 51
   Table I-2. Course and Section Size Summary ............................ 54
   Table I-3. Faculty Workload Summary ....................................... 59
   Table I-4. Faculty Analysis ....................................................... 61
   Table I-5. Support Expenditures .............................................. 63
B. Course Syllabi ........................................................................ 64
C. Faculty Resumes .................................................................... 172
D. Evaluation Forms .................................................................... 228
   1. Supervisor Survey ............................................................ 230
2. Checklist for BSME Degree Equivalency.................................232
3. Checklist for MSME Degree ..................................................240
4. Thesis Evaluation and Rating Form ......................................246
5. Graduating Student Exit Survey ..........................................248
A. Background Information

1. **Degree Title:** Master of Science in Mechanical Engineering

2. **Program Mode:** Residence program

3. **Actions to Correct Previous Shortcomings**

   The last initial ABET visit was performed on fall of 2001 and the Draft Statement on dated March 4, 2002 pointed out three deficiencies and two weaknesses as below:

   1. **Criterion 1: Students**
      Students with BS/BA degrees from non ABET accredited programs do not meet all program requirements (Deficiency)
   2. **Criterion 3: Program Outcomes and Assessment**
      a) No documented assessment process, b) have not provided evidence that demonstrates graduates have met program outcomes, c) the faculty have not established metrics for each of program outcomes, and d) have no documented feedback process in place to improve the program (Deficiency)
   3. **Criterion 2: Program Educational Objectives**
      Objectives need to be published. (Weakness)
   4. **Criterion 4: Professional Components**
      a) Weakness in providing a major design experience for students with BS/BA from a non-ABET accredited program (weakness), b) Students with BS/BA from a non-ABET accredited program may not satisfy one and one-half years of engineering topics and courses (Deficiency)
   5. **Criterion 8: Program Criteria**
      Students from non-ABET accredited engineering programs may not have a sufficient background in statistics (weakness)

   Corrective Actions were taken at the request of the Engineering Accreditation Commission, and the report for response the Draft Statements was sent to the Engineering Accreditation Commission. Then, the Engineering Accreditation Commission sent Summary of Accreditation Actions stating accreditation of the Master of Science in Mechanical Engineering Program to September 30, 2004 with a requirement of a reaccreditation evaluation visit during fall of 2003. The Summary of Accreditation Actions dated August 15, 2002 stated that previous deficiencies and weaknesses were reduced to weaknesses and concerns, respectively, as below:

   **Criterion 1: Students** (weakness)
   1. **Criterion 1: Students** (Reduced to Weakness)
   2. **Criterion 3: Program Outcomes and Assessment** (Reduced to Weakness)
   3. **Criterion 2: Program Educational Objectives** (Reduced to Concern)
4. Criterion 4: Professional Components  (Reduced to Concern)
5. Criterion 8: Program Criteria  (Reduced to Concern)

Furthermore, the evaluation visit during fall of 2003 would be a focused visit to evaluate the corrected actions. As a result, the Self-Study Report for Focused Visit was submitted to the Engineering Accreditation Commission on June of 2003, and there was another focused ABET visit on fall of 2003 to address and correct those deficiencies and weaknesses. After the second visit, all weakness and concerns were completed resolved as shown in the Draft Statement dated February 24, 2004. The Draft Statement is provided below.

4. Draft Statement from the Most Recent Accreditation for Mechanical Engineering Program

Introduction
The mechanical engineering program is in the Department of Mechanical and Astronautical Engineering. There are 14 mechanical engineering faculty members and 70 declared MSME majors in Fall 2003. There were about 30 graduates in the last year. The program has a new chair as of the summer of 2003.

Program Strengths
1. The students appear to be well-qualified and highly-motivated, mid-career professionals.
2. Communications with the chair before the visit were efficient and friendly.
3. The current students are very supportive of the mechanical engineering program and the faculty.

Program Weaknesses
1. Criterion 1. Students The previous review noted that students entering the program with BA/BS from non-ABET accredited programs did not meet all program requirements. This was due to some students from non-ABET accredited programs (about 1/3 of the students were in the non-ABET category) not meeting all BSME equivalency program requirements.

The faculty made changes to try to ensure this BSME equivalency. New checklists were created and are being used effectively. Greater flexibility is provided in the MSME program by allowing more courses to be used to meet the EAC BSME equivalency. In addition, a new capstone design course ME 3172 (discussed below) has been created. An examination of transcripts and supporting checklists by the reviewer showed that this issue had been addressed satisfactorily.

• The weakness is resolved.

2. Criterion 3. Program Outcomes and Assessment In the previous review it was noted that outcomes had been defined, a set of assessment tools had been defined, and metrics had been identified. An assessment committee had been established and
performance was to be reviewed quarterly. However a weakness remained pending
demonstration that the process and tools work effectively.

A constituency group has been identified. An examination of questionnaire results
and minutes of faculty meetings demonstrated that an improvement process is in
place and working. Program outcomes have been defined and mapped against the
program objectives. A set of tools to evaluate the outcomes has been developed.
Assessment data has been gathered and utilized to improve the program.

- This weakness is resolved.

Program Concerns

1. **Criterion 2: Program Educational Objectives** During the last visit, there was a
concern that the educational objectives were not published in the catalog or in other
publicly available media.
The objectives are now published in the latest catalog shown on the website and on
the department’s website.

- This concern is resolved.

2. **Criterion 4. Professional Component** In the previous review there was a
concern about demonstration of the mechanical engineering program criteria. The
General Criteria requires that the program must have a major design experience.
The mechanical engineering program criteria require that all graduates demonstrate
“the ability to work professionally in both thermal and mechanical systems areas
including the design and realization of such systems.” For students from EAC-
accredited mechanical engineering programs, this requirement is satisfied in their
BSME programs. A significant number of these students have undergraduate degrees
from non-EAC accredited BSME programs. For these students, additional course
work is required to bring them up to an EAC equivalency. The ability to work in both
stems is usually demonstrated in a capstone design experience. At the last General
Review, major design experience was being met by the ME 3711 (Machine Design)
and MS 3202 (Failure Analysis) classes.

A new capstone design class ME3712, Capstone Design Project, was established. It is
taken at about the sixth quarter of the eight-quarter program. Examination of the ME
3712 course outline and a number of recent senior design reports did not indicate that
students demonstrated the ability to work in the thermal systems courses such as
ME3240, Marine Power and Propulsion. The Department is urged to be mindful of
this two-stem requirement as the implement curricular improvements.

- This concern is resolved.

3. **Criterion 8. Program Criteria** Criterion 8 of the mechanical engineering program
criteria requires that each graduate demonstrate a familiarity with linear algebra
and statistics. In the last visit, the EAC noted that the program relied on ME 3410
(Instrumentation and Measurement) to provide this background for the non-EAC accredited students; the EAC team cited this as marginal.

After July 2002, a statistics course became mandatory for those who do not have an EAC-accredited BSME degree. The Reviewer examined the statistics course materials, and found the course to be satisfactory. In addition, the faculty strengthened the linear algebra competence of the students by requiring MA 2043, Introduction to Matrix and Linear Algebra, for those students who had not taken a similar course as an undergraduate.

- This concern is resolved.

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B. Accreditation Summary

In this report, the following definitions are used, which are consistent with the standard definitions as used by ABET

Objectives: Statements that describe the expected accomplishments of our graduates during first several years following their graduations.

Outcomes: Knowledge, skills, and abilities that are derived from the objectives and measurable at the time of graduation.

Assessment: Processes that identify, collect, and analyze data for the purpose of determining achievements of objectives and outcomes.

Evaluation: Process of reviewing the results of data collection and analysis, and making determination of the value of findings and action to be taken.

Action: Implementation of new or revised objectives, outcomes, assessment and evaluation procedures, degree requirements, policies, etc. to improve the program.

Constituents: Group of people that affect or are affected by the program, including students, faculty, administrators, program sponsor, alumni, their supervisors, etc.

The complete loop to meet the ABET requirement to improve our degree program is sketched in Figure 1.1. The detailed explanations will be provided in later sections as necessary.

1. Students

Students generally enter the Mechanical and Astronautical Engineering Department through the Navy military channels and are selected based on outstanding professional performance, promotion potential, and academic background. Academic thresholds are based on a three point code called an APC – Academic Profile Code. The ME degree program requires an APC of at least 3-2-3, meaning a Quality Point Rating (QPR) at least 2.2-2.59 in undergraduate work at a recognized institution, the calculus sequence completed with at least an average between C+ and B, and completion of a calculus based Physics sequence with at least an average between C+ and B.

Entering students are initially advised by a Program Officer (currently LCDR James Melvin) and given a matrix of courses that would be required both to fulfill the degree requirements and their military educational skill requirements. During the course of study the students meet with both their program officer and a faculty member designated as a curriculum academic associate. The Academic Associate, currently Professor Josh Gordis, assists the student in the selection of electives, and coursework sequences designed, and sometimes tailored, to meet the requirements of ABET when it is established that the student does not
come from an ABET accredited undergraduate program and significant additional preparation is needed.

Students’ progress is closely monitored by the program officer to ensure that the student does not fall behind in class work. Research progress is monitored closely by the supervising professor. In the event that a student fails to maintain a 3.0 QPR after any quarter, he is put on academic probation and given a program plan designed to lead to recovery, monitored closely by the Program Officer.

In the ME degree program, we rarely encounter a need for transfer of credits. In cases where it is needed, we allow the transfer of up to 12 hours of graduate level credit from another institution towards the MSME degree. In special cases permission to transfer a particular course for credit towards a degree requirement may be granted by the Department Chairman.

Validation of required degree courses is allowed where necessary and approved by the Academic Associate and the Department Chairman after a thorough review of the students prior background, prior courses, texts studied, syllabi covered, and sometimes an oral examination.
Figure 1.1. Closed-Loop Process for Improvement of MSME Program
2. Program Educational Objectives

2.1 Summary
This section describes the Program Educational Objectives of the MSME degree program at Naval Postgraduate School. Furthermore, it is discussed how the Program Educational Objectives are set, assessed, and evaluated by proper stakeholders of the program. Finally, ongoing process for improvement is also presented.

2.2 Description of Program Educational Objectives
Based on the Naval Postgraduate School (NPS) mission and ABET criteria, the Program Educational Objectives were determined by the ME faculty with input from GSEAS Dean and Provost. The Program Educational Objectives were reviewed by multiple constituents of the program and revised as necessary.

The NPS Mission Statement, as well as the Program Educational Objectives, are provided below:

NPS Mission

Provide relevant and unique advanced education and research programs in order to increase the combat effectiveness of U.S. and Allied armed forces and enhance the security of the United States.

Program Educational Objectives

The overall educational objective of the Mechanical Engineering program is to support the NPS mission by producing graduates who have knowledge and technical competence, at the advanced level in Mechanical Engineering, to support national security.

In order to achieve this goal, the specific objectives are to produce graduates who have:

1. The ability to identify, formulate, and solve technical and engineering problems in Mechanical Engineering and related disciplines using the techniques, skills and tools of modern practice, including modeling and simulation. These problems may include issues of research, design, development, procurement, operation, maintenance or disposal of engineering components and systems for military applications.

2. The ability to provide leadership in the specification of military requirements, in the organization and performance of research, design, testing, procurement and operation of technically advanced militarily effective systems. The graduate must be able to interact with personnel from other services, industry, laboratories and academic institutions, and be able to understand the role that engineering and technology have in military operations, and in the broader national and global environment.

3. The ability to communicate advanced technical information effectively in both oral and written form.
These objectives were published in the school Catalog and the MAE departmental website (http://www.nps.navy.mil/mae/objectives.htm).

2.3 Process for Identifying and Revising Program Educational Objectives

The Program Educational Objectives have been reviewed by the stakeholders to revise them as necessary in order to improve the program. The stakeholders for identifying and revising the Program Educational Objectives are

- Faculty
- Curriculum sponsor
- Supervisors of our alumni
- Alumni
- Students

Surveys and personal interviews have been conducted to assess and evaluate the appropriateness as well as achievement of our Program Educational Objectives. Each survey and interview results were summarized by a responsible faculty member, and the results were presented at a faculty meeting for discussion. If there was any change needed from the discussion, the Educational Program Objectives were revised to reflect the concerns from the data. The revised Objectives were assessed and evaluated in the following cycles as sketched in Figure 1.1.

2.4 Process of Assessing and Evaluating Program Educational Objectives

Surveys were conducted for various constituents including alumni, supervisors of our alumni, Engineering Duty Officer (EDO) school survey, curriculum sponsor, and students. In addition, personal interviews were performed with alumni and supervisors of our alumni.

Most of our students in the program are engineering duty officers in the US Navy. The engineering duty officers should attend the EDO School twice. They attend the school just after graduation from our program for the junior officers program, and several years later for the senior officers program. As a result, we visited the EDO school regularly to survey and interview our alumni there. Sometimes, we had teleconferences with our alumni in cases we could not visit the school or a direct visit was not deemed necessary. On the average, we contacted direct visits or teleconferences at least once a year and very often twice. We also surveyed and interviewed supervisors of our alumni. In many cases, our senior alumni were the supervisors of our junior alumni. In such cases, they were surveyed and interviewed in two different capacities.

For the supervisors of our alumni, we asked a question whether the Program Educational Objectives served their need. The blank survey form is attached for your review in Appendix I-D-1. During the interviews, more elaborate input was provided regarding the appropriateness of the Objectives. For the survey of our alumni, the same question as stated in Appendix I-D-1 was asked, and personal interviews were followed. In general, during these interviews we realized that it is rather difficult to efficiently target a large number of alumni and alumni supervisors. This is evident by the limited responses that we were able to collect to-date. Specific steps taken to remedy this problem are outlined in Section 2.5.
For the graduating students, we also asked whether the Program Educational Objectives seemed to be appropriate. The primary reason we decided to ask the students these questions is that, typically, they already work in the Navy or Department of Defense communities for some time before they enroll to our degree program. Therefore, they have enough work experience to respond to the question.

Every graduating student indicated that the Program Educational Objectives serve well for their jobs. Out of three specific Objectives, almost everyone stated the Objective #1 was well met from our degree program. In other words, our graduates were well prepared for technical knowledge and skills from our degree program.

As far as Objective #2 is concerned, the surveys and interviews showed overall satisfaction. However, some suggestions proposed by our alumni were to introduce a couple of courses like Product Lifetime Maintenance, Risk/Benefit Cost Analysis, etc. So far, these requests were rather sporadic and consistent. Therefore, it was decided in the faculty meeting to analyze more input from the future before we took any action for revising our curriculum because our curriculum does not have a room to add a course without sacrificing an existing course with a very tight work schedule of our students. As one possible solution, we decided to add an elective course on Risk and Cost Benefit Analysis, which is discussed later in this report. In addition, we made sure that such concepts are reinforced in our design-related courses.

There were also some concerns regarding Objective #3. Our alumni stated that their thesis experiences were very useful in terms of both written and oral technical communication skills but they would like to have more opportunities to practice them during the degree program. Such opportunities exist but there is some variation with regards to student exposure. Many of our 4000 level courses require that students turn in term projects that are accompanied by oral presentations at the end of the quarter. However, other courses do not require them. Since 4000 level courses are elective, student experience with regards to communication skills would vary depending on their choices of elective courses. Considering this, the faculty passed a resolution to provide a seminar to all students for them to learn how to communicate technical information verbally or in writing.

The initial part of the form asks that students rate the program on a scale of 0 – 5 with respect to each the three stated program objectives. A high numerical rating implies strong agreement that the program meets the objective. The ratings did not appear to vary significantly with time from 2002 – 2006. For this reason, the data are summarized in Figure 2.1 as average student response for each of the objectives.

Overall, the highest numerical response, 4.39, is for Objective 1 (The ability to identify, formulate and solve technical and engineering problems …); the next highest, 4.31, is for Objective 3 (The ability to communicate …). The lowest response, 4.08, is for Objective 2 (The ability to provide leadership in the specification of military requirements …).
The form also solicits written comments regarding the appropriateness of the program objectives; however, few of the students offered any comments and those who did tended to be individuals having non-ME undergraduate backgrounds. Two comments in this respect are given below.

![Graduating Student Exit Surveys (2002 - 6): Objectives](image)

**Figure 2.1. Average student responses in respect of the program objectives.**

- The challenge to accomplish a BSME undergraduate and complete the MSME, the 2.5 years was a rapid pace and it is hard to say that I reached a proficient level of engineering technical understanding. Although my previous experience of practical application and work in an engineering environment the education at NPS has more than complemented my previous engineering exposure and will be beneficial in my future professional career with the Navy.

- Too many ‘check the box’ requirements and not enough 4000 level classes to say advanced level for the objectives.

### 2.5 Ongoing Improvement of the Effectiveness of the Program

Based on the feedback from our alumni and supervisors of our alumni, we identified several issues that called for corrective actions. These are outlined as follows:

- The need for a seminar on technical presentation was identified in our department. This was discussed in several departmental meetings and as a result several courses were either added and/or revised. We also explored the option of inviting outside speakers to give talks to our students on technical presentation skills. More detailed actions are provided in the next section of Program Outcomes because the Outcomes were derived in order to meet the Objectives.

- The difficult which we experienced in efficiently identifying and targeting sufficient numbers of our alumni supervisors was brought up during a teleconference with our curriculum sponsor at NAVSEA (Naval Sea Systems Command) in January 2007. We solicited the sponsor’s help in solving this problem. It was decided that the sponsor would grant us access to a scheduled nationwide conference of our alumni supervisors and we would circulate our questionnaires. The first such occurrence will take place during the summer of 2007.
• An elective Risk and Cost Benefit Analysis course was introduced and was offered first during 2006. The course is also taught this year. So far, student responses have been very positive. In addition, relevant lecture notes from the course have been made available to students during their design projects.
3. Program Outcomes and Assessment

3.1 Summary
This section describes Program Outcomes established to achieve Program Educational Objectives stated in the previous section. The relationship between Program Outcomes and Program Educational Objectives is also discussed. Then, the process to identify as well as to revise Program Outcomes is presented.

Furthermore, the process is also described for assessing and evaluating Program Outcomes in detail. In particular, the developed Assessment Criteria are discussed, and the evaluation of the criteria is presented for each criterion. This section also describes the continuous improvement process for Program Outcomes emphasizing action items for improvement. Finally, a description of relation of Courses to Program Outcomes is presented.

3.2 Description of Program Outcomes and their Relation with Program Educational Objectives
The Program Outcomes are stated below:

1. Graduating students will have knowledge and skills equivalent to an ABET-accredited BSME.
2. Graduating students will have advanced knowledge in Mechanical Engineering and competence in one of the available specialized disciplines of Mechanical Engineering.
3. Graduating students will have high level of communication skills including technical writing and oral presentation.
4. Graduating students will have the ability to independently identify, formulate and solve technical and engineering problems in Mechanical Engineering.
5. Graduating students will have the ability to apply technical knowledge in a leadership role related to national security.

The Program Outcomes are published in the university catalog as well as the current departmental website.

Those Program Outcomes were established from the Program Educational Objectives as shown in Table 3.1. For example, Program Outcomes #1, #2 and #4 were derived from Objective #1 while Outcomes #2 and #5 were established from Objective #2. Finally, Outcome #3 is related to Objective #3.

3.3 Process of Identifying and Revising Program Outcomes
The Program Objectives have been reviewed by the various constituency groups to revise them as necessary in order to improve the program. The stakeholders for identifying and revising the Program Objectives are

- Faculty
- Curriculum sponsor
- Supervisors of our alumni
Surveys and personal interviews have been conducted to assess and evaluate the appropriateness of the Program Outcomes. For example, the survey form for the supervisor, as attached in Appendix I-D-1, contains the question asking for the appropriateness of the Program Outcomes.

Each survey and interview results were summarized by a responsible faculty member, and the results were presented at a faculty meeting for discussion. If there was any change needed from the discussion, the Educational Program Objectives were revised to reflect the concerns from the data.

Table 3.1. Relationship between Program Objectives and Outcomes

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<th>Outcome #2</th>
<th>Outcome #3</th>
<th>Outcome #4</th>
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<tr>
<td>Objective #1</td>
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X indicates the Outcome is derived from the Objective.

3.4 Process of Assessing and Evaluating Program Outcomes

In order to assess the Program Outcomes, several Assessment Criteria (AC) were established by the faculty, and the relationship between the Assessment Criteria and the Program Outcomes are shown in Table 3.2. There are eight Assessment Criteria as listed below, and each one is to measure the related Program Outcome(s).

Assessment Criteria (AC)

1. Graduating students will meet ABET-accredited BSME equivalence. All students will complete the BSME equivalency checklist form that must be approved.
2. Graduating students will complete one year of study beyond the basic level and follow a specialization track in one of the available disciplines of Mechanical Engineering. All students will complete the MSME degree checklist that must be approved.
3. All MSME degree recipients will complete and present a thesis. Thesis evaluation consists of the thesis signature page, the thesis distribution statement, and the thesis evaluation and rating form.
4. PE exams and success rates.
5. Survey results from the Engineering Duty School.
6. Survey results from the graduating student exit survey.
7. Survey results from recent graduates and their supervisors.
8. Sponsor evaluation.
Table 3.2. Assessment Criteria (AC) to Measure Outcomes

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| Outcome #2: Advanced Study        |                        |                      |                         |                |                                        |                  |                                 |                                   |
|-----------------------------------|                        |                      |                         |                |                                        |                  |                                 |                                   |
| X                                 |                        |                      |                         |                |                                        |                  |                                 |                                   |

| Outcomes #3: Communication Skill  |                        |                      | X                       | X              | X                                      |                  | X                               | X                                 |
|-----------------------------------|                        |                      |                         |                |                                        |                  |                                 |                                   |

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<th>Outcomes #4: Identify, Formulate, and Solve Technical &amp; Engineering Problems</th>
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<th>Outcomes #5: Apply technical Knowledge in Leadership &amp; National Security</th>
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3.4.1. Assessment Criterion #1 - BSME Equivalency Checklist

Assessment Criterion #1 was established to assess Program Outcome #1 as shown in Table 3.2. In order to assess the Outcome, a form called BSME Equivalency Checklist was devised and has been used to guide each student’s educational progress. (The blank form is attached in Appendix I-D-2.) The form is prepared by student with a guidance by the student advisor (called Academic Associate) and reviewed and approved by Program Officer (an active Navy officer who oversees students in military affair), Academic Associate (a faculty member, who guides students to meet the degree requirements), and the Department Chair Person.

The form first checked whether a new student has an ABET accredited BSME degree or not from his or her undergraduate study. If the student has the BSME degree from an ABET accredited institution, the person checks the corresponding check box and the form is complete. On the other hand, unless the student received an ABET accredited BSME degree, he or she needs to check the remaining sections of the form.

The BSME Equivalency form contains four sections. The first section is to check the Mathematics requirements. This section requires a minimum of 24 quarter credit hours (or 16 semester credit hours) of college level mathematics. In addition to check the total mathematics credit hours, the form also checks individual topic courses like Multivariable Calculus, Differential Equations, Linear Algebra, and Statistics as stated in the ABET Curriculum Description.

The second section of the BSME Equivalency form checks the requirements for Basic Sciences like chemistry and calculus-based physics. The minimum 24 quarter credit hours (or 16 semester credit hours) of college-level basic science is required.

The third section checks General Education. A minimum of 24-quarter credit hours (or 16 semester credit hours) is required in subjects other than mathematics, basic science, computer science, and engineering. These general education courses should complement the technical content of the curriculum.

The last section checks Engineering courses including Engineering Design. A minimum of 72 quarter credit hours (or 48 semester credit hours) of engineering science and design are required. Of those 54 quarter credit hours or 36 of the semester hours must be specifically in Mechanical Engineering and include both Thermal and Mechanical Systems. The checklist separates all Mechanical Engineering courses from other engineering courses. In addition, the form includes the check for a major design experience at the advanced undergraduate level.

The approved BSME Equivalency forms for the past graduates have been stored in the department.
3.4.2. **Assessment Criterion # 2 - MSME Equivalency Checklist**

Assessment Criterion #2 was established to assess Program Outcome #2 as shown in Table 3.2. In order to assess the Outcome, a form called *MSME Checklist* was devised and has been used to guide each student’s educational progress. (The blank form is attached in Appendix I-D-3.) The form is prepared by student with a guidance by the student Thesis Advisor and Academic Associate, and reviewed and approved by Program Officer, Academic Associate, and the Department Chair.

The form checks the overall credit requirements for the MSME degree which was established at NPS. The requirement is at least 32-quarter hours of graduate level credits. At least 12-quarter hours must be at the 4000 level and at least 24 quarter hours must be in courses offered by the Mechanical Engineering Department. When the credits were counted for the MSME degree, it was made sure that there was no dual count of any 3000 or 4000 level course between the MSME requirement and the BSME equivalency requirement.

In addition, the *MSME Checklist* requires students to check their competency in the advanced level by checking required courses in each specialization track offered by the department. This requirement states two 4000 level courses in the specialty track. Furthermore, the form also records the thesis title and thesis advisor name because the thesis is one of the requirements for the MSME degree.

The complete forms for the past graduates are kept in file.

3.4.3. **Assessment Criterion # 3- Thesis Evaluation**

Assessment Criterion #3 is also a direct assessment technique and it was established to assess Program Outcomes #3 and #4 as shown in Table 3.2. In order to assess the Outcome, the *Thesis Evaluation and Rating Form* has been used. (The blank form is attached in Appendix I-D-4.) Each student selects his or her thesis topic after discussion with various faculty members. Once the thesis topic is selected, a thesis proposal form is filled out by the student, and the form is approved by Thesis Advisor, Academic Associate, Program Officer, and Department Chair.

After completion of the thesis work, the student writes a written thesis and presents his findings in the department in front of students, faculty, and other guests. The written thesis is approved by Thesis Advisor and Department Chair.

Finally, the Thesis Advisor evaluates the student thesis in terms of (1) Academic level competence, (2) Scientific or technical merit of the thesis, (3) Defense relevance, (4) Written communication, and (5) Oral communication. This evaluation is confidential to students.

At the end of each quarter, this form is collected from all thesis advisors. In order to make sure no one will miss the form, the faculty approved that the department Chair would not sign off each student thesis unless the form is filled out and submitted with the thesis.
The collected assessment forms have been summarized by one responsible faculty member, and presented at the faculty meetings for evaluation and improvement. The summarized results of the collected data are shown in Table 3.3.

The assessment results show that there are variations of the ratings from quarter to quarter. The weighted sum average is shown in the last row of Table 3.3. As the data indicate, communication skills have the lowest rating. In order to improve the communication skills, the faculty decided to invite an expert to present a seminar to our students on better communication skills, on a regular basis so that every student has an opportunity to improve their skills.

### Table 3.3 Complied Data from Thesis Evaluation Assessment

<table>
<thead>
<tr>
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<tr>
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<td>3.94</td>
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<td>3.68</td>
<td>3.79</td>
<td>7.27</td>
</tr>
</tbody>
</table>

#### 3.4.4. Assessment Criterion #4 - PE Exam Success Rate

Assessment Criterion #4 was established to assess Program Outcome #4 as shown in Table 3.2. Taking the PE Exam is not a requirement of the degree program. However, having the license is beneficial to the students. Therefore, many students took the exams voluntarily. It was thought that the PE passing rate would provide an objective indication for assessing Program Outcome #4 (Identify, Formulate, and Solve Technical & Engineering Problems).

The MAE Department offers a course, ME1000, Preparation for the Professional Engineers Exam as a means to encourage and facilitate our students in obtaining Registration as a
Professional Engineer. ME1000 is offered on a regular basis as student demand has warranted. Prof. Matt Kelleher, a registered PE, conducts seminars on the process and helps students apply and prepare for the exam. The last time it was taught was Summer 2006 to eight students.

Historically the success rate on the ME PE Exam for NPS Students has been on the order of 80% or better. Since Fall 2002, 8 of the 11 students that took the PE Exam passed it, a rate of 81%. This compares to the national passing rate on the ME test of 70%. This is an indication that our students are successful in knowing the disciplines on Mechanical Engineering.

In an effort to accumulate data on our student’s PE success rate in the future, a procedure has been initiated whereby the students taking ME1000 who will also be taking the PE Exam have agreed to inform the Curricular Officer or the Instructor of ME1000 as to their success on the PE Exam. Although it is not required, the students have provided their personal email addresses so that they can be queried at the appropriate time after the PE Exam as to the outcome.

The Department also encourages students who have not taken the FE (or EIT) to take the FE Exam so that they can subsequently pursue PE Registration. The detailed results on the component subjects from our student’s FEs are evaluated by Department faculty for indications of potential problems. As an example, last year only one (1) student took the FE and he did not do well on statistics. While this was a limited sample, our professor in charge of overseeing the statistics content of our program, Prof. Morris Driels, reviewed the statistics course content and textbook. This course is taught by the Operations Research (OR) Department. Prof. Driels worked collaboratively with the faculty member in OR in charge of this course and has made some recommendations on how they can improve the engineering applicability of that course. We will evaluate the results of this action with the next set of FE results.

3.4.5. Assessment Criterion # 5 – ED (Engineering Duty Officers) School Report and Presentation

The Engineering Duty Officers School (“ED School”) is a significant source of information and feedback for the MSME graduates enrolled in the 570 Curriculum. The 570 Curriculum is called Naval/Mechanical Engineering. The 570 Curriculum is related to the MSME degree program but the two are not the same. Any incoming student to NPS is assigned to a Curriculum, and the 570 Curriculum is one of them. Then, the student takes courses toward a degree program which is allowed for the Curriculum. Nearly 100% students in the 570 Curriculum pursue the MSME degree. However, there are students who enrolled in the MSME degree from other Curriculum, even though the number of students from outside of the 570 Curriculum is much less than that from the 570 Curriculum.

Engineering Duty Officers (ED’s) constitute about 30% to 50% of the total graduates of the 570 Curriculum. (see Figure 3.1.) Almost all of the ED officers receive the MSME degree. Upon graduation, all ED’s have to attend a short course (6 week duration) at the ED School
in order to prepare them for the practical aspects of their job. As part of that preparation they have to prepare and deliver to their peers an oral presentation. In addition, they have to prepare a technical paper related to their job. Successful completion of both is necessary in order to qualify as Engineering Duty Officers. Therefore, visiting the ED School, attending presentations delivered by our graduates and reading their technical reports, would provide us with input on Outcome #3 (“Graduating students will have a high level of communication skills including technical writing and oral presentation”) and Outcome #5 (“Graduating students will have the ability to apply technical knowledge in a leadership role related to national security”).

In January 2003, an initial familiarization visit to the ED School took place. Profs. Millsaps and Papoulias and Program Officer CDR Cunningham participated and several items were reviewed. We were able to listen to presentations given by recent graduates of the program and also review several technical papers written also by recent graduates. Both the presentations and the technical papers were satisfactory. We did not see the need for major program changes. It was also felt that continuing visits to the ED School are very helpful but they are also difficult to coordinate. The best time to visit is June and it takes an average of two days per visit. Therefore, we asked the ED School if we could get a copy of the graduates’ technical reports and review them. Although the ED School leadership was very supportive of this need, they pointed out some potential distribution limitations since the graduates prepare the reports under the assumption that they would be reviewed only by the ED Qualifying Board and not by third parties such as NPS. They promised that they would look into that.

Following this initial visit we have had several phone conversations and interviews with the ED School. Although we did not listen to graduates’ presentations, we did talk to their
instructors and received positive feedback. Some technical papers were also transmitted to us. We kept up our inquiries with regards to perpetual access to the graduates’ technical reports, and we were assured that the request is under review.

In September 2004, Prof. Millsaps conducted a follow-up visit to the ED School, the trip report is included as Attachment B. The overall feedback was positive; the only potential issue was inadequate preparation with regards to oral presentation skills and writing.

During the Spring of 2006, the ED School was able to post the technical papers of our graduates in a secure web site and provide us access to it. Profs. Papoulias and Millsaps reviewed a sample of the papers and found them satisfactory.

A third visit to the ED School took place during June 2006. Profs. Millsaps, Kwon, Gordis, and Program Officer CDR Plott attended. The nature of the visit and its findings were consistent with the original visit.

From each visit or phone conversations, a trip report has been generated and presented to the faculty. During the discussion it was noted that larger faculty participation was required for adequate review of the technical papers produced by our graduates. The following steps were recommended:

- Collect the technical papers and post them in a secure site under Departmental control. That way, it will be easier for faculty members to access.
- Assign specific papers to be reviewed by faculty members that are in the right area of expertise. Provide a standard form for review and evaluation.
- Keep track of the statistics of the reviews and take corrective actions as necessary.

In addition, there seems to be an issue with regards to oral presentation skills. This is consistent with findings from other Assessment Criteria. Proper actions were taken for improvement. The summary of actions taken to improve the Program is provided in the next section.

3.4.6. Assessment Criterion # 6 – Graduating Student Exit Survey

This Assessment Criterion was established to assess all program Outcomes in terms of graduating students’ perspective because students are one of the most important constituencies.

The Department maintained a Graduating Student Exit Survey for many years prior to the merger of the Mechanical and Aero into Mechanical and Astronautical Engineering Departments. As a result of the ABET visit in 2001 the Exit Survey was modified to align it better with the Program Educational Objectives and Outcomes. The Exit Survey was modified again following the merger of the Astronautical Engineering program and faculty to form the Department of Mechanical and Astronautical Engineering in 2004. This second modification did not involve substantive changes. Rather, the Exit Survey form was redesigned so that it could be distributed, completed and returned electronically; furthermore, this Exit Survey is still designed to elicit comments only from students in the program leading to the MSME. The current form is attached as Appendix I-D-5.
The form then states the intended Program Outcomes and asks the students to rate the program on the same 0 – 5 scale with respect to each of the Outcomes. The first three Outcomes are broken down further into more specific questions. Again, the responses did not appear to vary with time and so the response data are summarized in Figures 3.2 through 3.6 as average student response. The data for Outcome #1 (Graduating students will have knowledge and skills equivalent to an ABET-accredited BSME) are given in Figure 3.2.

![Figure 3.2. Average student responses for Outcome #1.](image)

The lowest numerical response was 4.02 for Outcome #1.1 (Have a solid grasp on statistics) and the highest, 4.59, was for Outcome 1.4 (Apply knowledge of mathematics science and engineering). This latter response was the highest among all of the ratings for the program objectives and outcomes.

The data for Outcome #2 (Graduating students will have advanced knowledge in Mechanical Engineering and competence in one of the available specialized disciplines of Mechanical Engineering) are provided in Fig. 3.3. The numerical values for Outcomes 2.1 (Advanced Competence …) and 2.2 (Advanced knowledge of analytical/numerical tools …) were 4.37 and 4.22, respectively. In contrast, the response value for Outcome 2.3 (Achieve advanced knowledge of modern laboratory techniques) was 3.73, the lowest among all of the responses to this survey. From the written comments (summarize at the end of this section) this low value reflects the poor state of many of the course-specific laboratories, or, in many cases, the absence of laboratories in areas where laboratory work should be included.

The responses for Outcome #3 (Graduating students will have a high level of communication skills including technical writing and oral presentation) are summarized in Figure 3.4. The lowest value, 4.04, was for Outcome 3.1 (Make a contribution to the scientific or technical literature) while the remaining responses were from 4.29 – 4.47. Of particular note is that the students rated the program highly on Outcome 3.3 (Do an effective and clear technical presentation), at 4.47, although numerous faculty comments suggest that this is an area in which improvement in student performance is needed.
Finally, the data for Outcomes #4 (Graduating students will have the ability to independently identify …) and #5 (Graduating students will have the ability to apply technical knowledge in a leadership role related to national security) are given in Figs. 3.5 and 3.6. The Survey called for only a single response for each outcome. Student responses were 4.35 and 4.24, respectively.

![Figure 3.1. Average student responses for Outcome #2](image1)

![Figure 3.4. Average student responses for Outcome #3](image2)
Students generally did not comment on the Outcomes per se; this likely reflects the layout of the form. Instead, pertinent comments were often found in the section on ‘Additional questions’. These questions are often related to the Program Outcomes. In addition, a meeting was arranged between graduating students and program Officer and Academic Associates to discuss for any improvement of the educational program. Selected responses are summarized below.

- The controls track needs more classes on intermediate topics to aid in the transition from 3000 to 4000 level.
- More math focused on engineering topics.
- We need more 4000 level courses and specialization.
- Course labs are run down and dirty
- Some of the labs seemed to be lacking in basic supplies and equipment. Maybe due to a lack of funds.
- Computer lab always seems crowded. Systems are outdated.
- Update lab equipment to put the graduate level student on the same level as industry. This is the course-specific labs, not the computer lab.
- Statics and dynamics together is too much for non-ME undergraduates.
- Recommend a MATLAB introduction specialized for engineers
- A better introduction to MATLAB. The six week course that is currently offered is poorly organized and makes use of some advanced examples that student with limited engineering background cannot grasp.
- The laboratories in most classes that you would assume would have labs are pretty much none existent, which really takes away from the learning experience.
Focus the calculus courses more on the tools that ME students need for the advanced courses.

Split up Statics and Dynamics courses. The break neck speed of the combined class leaves no time to reflect and absorb. This is a problem in some of the follow on courses like vibrations and controls.

Improve the bridge between what Math teaches and ME expects.

The laboratories especially the materials laboratories need work.

Laboratories were not used in most classes. As a result there is little hands on experience in labs which to me is an important aspect of engineering education.

The library and computing facilities were great. The laboratories were not well integrated into the courses. A lot of educational benefit could be gained from incorporating them.

More laboratory experiences. I think that a course in experimental methods would advance student’s understanding of the physics of the phenomena that we study. Computational methods are nice, but I think something is lost when only the computational methods are studied or similarly if only experimental methods are studied.

Restructure course scheduling to make similar subject areas more grouped and not so disjointed, especially when several quarters pass between opportunities to take related classes. A lot of refreshing is needed to get back into that subject.

Some of the labs seem dated or in need of repair to equipment, but they generally accomplished their purpose. Computing facilities are more than ample.

There are very few labs since the classes have been reduced and combined in order to get students through the program faster.

Based on the above, and many more similar responses, we can identify several areas that come up consistently:

- Better labs, both physical and computational.
- Split-up ME2503 (combined Statics and Dynamics course).
- Better introduction to MATLAB.

These concerns were prioritized. Specific actions taken to address the ones that appeared to be more critical to the program and also were under our control are outlined in Section 3.5.

3.4.7. Assessment Criterion # 7 – Alumni & Supervisor Survey

Alumni and supervisor surveys are required in order to assess Program Outcomes #2 (“Graduating students will have advanced knowledge in Mechanical Engineering and competence in one of the available specialized disciplines of Mechanical Engineering”), #3 (“Graduating students will have high level of communication skills including technical writing and oral presentation”), #4 (Graduating students will have the ability to independently identify, formulate and solve technical and engineering problems in Mechanical Engineering), and #5 (Graduating students will have the ability to apply technical knowledge in a leadership role related to national security). A number of past alumni and supervisors attend the Senior ED Course at the ED School. Therefore, interviews
with these will provide us direct measures of the corresponding program outcomes. Such interviews may be combined with planned visits to the ED School for Assessment Criterion 3.

Profs. Millsaps and Papoulias along with Program Officer CDR Plott conducted a phone interview with four supervisors (CDR Gunze - PSNSY, CDR Christensen – SW Regional Maintenance Center, San Diego, CDR Reck – Strategic Systems Program, and LCDR Sexton – EDO Senior Course coordinator) of our graduates on September 2005. All four supervisors were at the ED School at the time of the interview. They communicated to us not only their opinions but also the opinions of their peers who were not present during the interview.

The general feeling was that the program objectives and outcomes serve them well. This was particularly true for Program Outcomes #2, #4, and #5. There were three issues that were identified during the interview as needing further study:

- Program may not prepare its graduates with adequate oral presentation skills.
- Program may not prepare its graduates adequately so they can conduct cost, benefit, and risk analysis of technology decisions that they often face.
- Program should provide knowledge on JCIDS, FORCEnet, and global information grid processes.

A second interview with supervisors was conducted in March 2006. Three supervisors were directly interviewed, CDR’s Anderson, Smith, and Maldonado. In addition to the phone interview, they were also asked to provide us with their written evaluation. On a scale from 0 to 5, they rated the Program Objectives as 4.67, and the four program outcomes as 4.33.

There were two possible issues that were identified during the interview as needing further study:

- There is room for improvement with regards to oral presentation skills.
- It is not clear how the program addresses Objective #2 especially with regards to specification of military requirements.

There seems to be an issue with regards to oral presentation skills. Some suggestions for remedy are:

1. One option would be to make the faculty members aware of the issue and see if they can ask the students to give short presentations as part of their course assignments. In a way, this is already happening since all of the non-BSME students are required to take either ME3712 or TSSE and both programs require oral presentations as part of standard course requirements.

2. Another possible solution would be to invite external speakers to give to the students presentations on oral presentation skills. For example, Senior Lecturer George Lober from the Defense Analysis Dept. at NPS has extensive expertise on oral presentation skills.
3.4.8. Assessment Criterion # 8 – Program Sponsor Evaluation

NAVSEA (Naval Sea Systems Command) 08 is the Program Sponsor of our Curriculum called Naval/Mechanical Engineering. (The subtle difference between the Curriculum and the MSME degree program was described in AC #5 previously.) They provide us with their input regarding the education of Engineering Duty Officers. In order words, NAVSEA 08 specifies what technical knowledge and skills are needed for those officers to perform their jobs. Based on the input, the department sets course works for ED officers. Those educational requirements for ED officers are beyond the requirements for the MSME degree. The ED officers need more breadth of knowledge than the degree requirement.

In order to better educate the ED officers, there have been biannual meetings between NAVSEA 08 and the department. At the meetings, the educational requirements for ED officers were reviewed and updated. Then, the department either created or revised course work depending on the new requirement.

Even though the Program Sponsor does not dictate the MSME degree program itself, the degree requirement is a subset of the ED officer educational requirement. Therefore, an input was solicited from the Program Sponsor for the MSME degree Program Educational Objectives and Outcomes whether they are appropriate. The Program Sponsor indicated general satisfaction with the Objectives and Outcomes.

3.5 Continuous Improvement Process for Program Outcomes

Based on the assessment of the program Outcomes as discussed above, some actions have been taken to improve the program. Those actions are summarized below.

Actions Taken To Improve the Degree Program

- Some courses have implemented a written term report even at 2000 or 3000 levels to provide opportunities to students to practice their written communication skills in technical contents. Along similar lines, in many of our courses we require that the students give short presentations.
- Previously, Engineering Statics and Dynamics were combined into a single course to meet the requirement of the reduced residency of the program. However, based on the graduating students exit survey as well as the course instructors’ assessment, it was determined that the combined course did not serve the purpose well. Students learning was not satisfactory. As a result, a course committee was formed, which included Profs. Shin, Kwon and Gordis, to review the situation. The committee proposed in the faculty meeting to split the course into two separate courses as Statics and Dynamics. The proposal was approved by the faculty, and the new split courses were introduced to students from the Spring Quarter of 2007.
- Some of alumni expressed that they wanted to be prepared during the educational Program so that they can conduct cost, benefit, and risk analysis of technology decisions that they often face even with not enough data available. In order to meet those requests, an elective course ME4702 – Engineering Systems Risk Benefit Analysis has been offered to the students.
• It was decided that the Thesis Evaluation form must be filed before the Chairman can sign-off on a thesis. This policy has been implemented for about a year. As a result, availability of data has greatly improved.

• A very aggressive lab recapitalization plan is in progress. A department committee solicited input from all faculty members with regards to their priorities and justification. These were further prioritized by the Department Chair and forwarded to the Dean for funding.

There were other concerns and inputs for potential improvement of the educational program as noted previously. However, in order to maintain stability of the educational program, the faculty decided to watch out for a longer period before any further action could be taken.

3.6 Relation of Courses to Program Outcomes

The course contents were reviewed to meet the program Outcomes. In general, 2000 and 3000 level courses offered in the department are used to meet the BSME equivalency. As a result, those courses were reviewed and checked against the ABET BSME requirements (a) to as stated below. Table 3.4 gives the relationship between the courses and the BSME requirements.

(a) Apply knowledge of mathematics, science and engineering.
(b) Design and conduct experiments as well as analyze and interpret data.
(c) Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
(d) Function on multidisciplinary teams.
(e) Identify, formulate, and solve engineering problems.
(f) Understand professional and ethical responsibilities.
(g) Communicate effectively.
(h) Understand the impact of engineering solutions in a global, economic, environmental, and social context.
(i) Recognize the need for and be able to engage in life long learning.
(j) Understand contemporary issues.
(k) Use the techniques, skills, and modern engineering tools necessary for engineering practice.

For the MSME degree requirements, students take 3000 and 4000 levels courses on top of the BSME equivalency requirement, depending on their selected specialty areas. The course syllabi are provided in Appendix I-B, and the course journals including exemplary student works will be provided when there is the onsite visit.
### ABET REPORT

#### Mechanical Engineering Program

#### Table 3.4 Course Matrix to Support ABET Requirement of BSME

<table>
<thead>
<tr>
<th></th>
<th>Courses in the Generic ME curriculum</th>
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<tbody>
<tr>
<td></td>
<td>ME0952</td>
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<tr>
<td>1</td>
<td>Chemistry and calc-based phys. (depth in 1)</td>
</tr>
<tr>
<td>2</td>
<td>Apply advanced math thru multivariate calculus and differential equations</td>
</tr>
<tr>
<td>3</td>
<td>Familiarity with statistics…..</td>
</tr>
<tr>
<td>4</td>
<td>Ability in thermal AND mech systems.incl design and realization</td>
</tr>
<tr>
<td>a</td>
<td>Ability to apply knowledge of math, science and engineering</td>
</tr>
<tr>
<td>b</td>
<td>Ability design &amp; conduct experiments, and analyze and interpret data</td>
</tr>
<tr>
<td>c</td>
<td>Ability to design a system, component or process to meet desired ends</td>
</tr>
<tr>
<td>d</td>
<td>Ability to function on multi-disciplinary teams</td>
</tr>
<tr>
<td>e</td>
<td>Ability to identify, formulate and solve engineering problems</td>
</tr>
<tr>
<td>f</td>
<td>Understand prof'l &amp; ethical responsibility</td>
</tr>
<tr>
<td>g</td>
<td>Ability to communicate effectively</td>
</tr>
<tr>
<td>h</td>
<td>Broad understanding impact of eng'g solutions in global &amp; societal context</td>
</tr>
<tr>
<td>i</td>
<td>Recognition of the need for, and an ability to engage in lifelong learning</td>
</tr>
<tr>
<td>j</td>
<td>Knowledge of contemporary issues</td>
</tr>
<tr>
<td>k</td>
<td>Ability use techniques, skills and modern eng'g tools for eng'g practice</td>
</tr>
</tbody>
</table>

Note 1: Achieved through courses in Physics Dept or at MPC, as arranged by Curriculum Officer

Note 2: Achieved via seminars; encouragement to participated in PE exams and post-graduation contacts
4 Professional Component

At the basic level the professional component is satisfied by assuring that the incoming students either have an ABET-accredited undergraduate engineering degree or that they will meet the equivalent of such a degree through a combination of their undergraduate experience and their course matrix at NPS. The advanced-level part of the program includes graduate-level mathematics; additional engineering science and design; and one general course, NS3230, Strategy and Policy: the American Experience.

Our students are unique in respect of the requirements for an adequate design experience. From their Naval experience, they often have had experience in oral and written communication of technical ideas, and in the detailed specifications of equipment that is in need of maintenance, repair or replacement. In addition, our program includes design experience in the several courses. In ME3150 students explore the conceptual design of some form of heat exchanger device. In ME3711, students are asked to design a component such as a helical reduction gear system to a minimum weight criterion for a naval vessel. For those students who have not graduated from an ABET accredited undergraduate program, we especially provide a capstone design experience in the course ME 3712. This course covers system design principles, requirements, concept evaluation, standards and constraints, and though project work, the students are involved in a system design to the conceptual level. The ME3801 control systems course includes a design requirement. Students have been asked to design a compensation system for stabilizing the roll response of a marine vehicle such as a roll stabilizer fin system in which constraints are articulated and evaluated through simulation. The MS3202 course considers failure analysis as the feedback in the iterative process of design. Students are required to identify a failed component and conduct a failure analysis of it. A recommendation regarding how to prevent future failures is part of the required report.

The optional TSSE program covers the organization of a design project as well as the trade-offs necessary in performing the design of a major engineering system such as a warship. The TSSE program includes TS3002, Principles of Ship Design and Case Studies. This course is a systems-oriented course that focuses on needs identification, setting of requirements, feasibility determination, risk reduction, contracts and detail design. The TSSE program concludes with a two-course sequence (TS4002 and 4003) that focuses on the design of a warship as a single engineering system. A major component of this sequence is the integration of the combat system with the hull and propulsion systems.

Mathematical considerations including coverage of probability and statistics are covered through specific focused courses given in the Mathematics and Operations Research Department, such as MAXXXX and OSXXXX.

Basic Science work, if needed, may be provided by taking selected courses at nearby community colleges such as Monterey Peninsula College (MPC).
5 Faculty

The Mechanical Engineering Department prior to September 2003, housed 13 tenure track faculty members. In that month, the Aeronautics program at NPS was closed by a deal between the Air Force and Navy Service Secretaries, and it was decided to combine the Faculty in the Astronautical Engineering part of the AA Engineering Department with the ME Faculty into the new MAE Department. At this time, the Department now houses 16 tenure track faculty and services both the students from the 570 Curriculum (Naval and Mechanical Engineering) and the 591 (Space Systems Engineering) curriculum.

The Mechanical and Astronautical Engineering Department currently is divided into 6 specialization tracks as shown in the Table 5-1 below. Associate Professor Ashok Gopinath is on leave in India working for General Motors, Professors Kaminer and Agrawal have recently completed a Sabbatical year. Recent hires have included Assistant Professor Marcello Romano (Space Craft Dynamics and Control) who is completing his third year and will be recommended for continuation. Additionally the Department houses 17 Non Tenure Track and Visiting Faculty who variously support both the Teaching program as needed and the overall Research program.

The decrease in the number of tenure track faculty from much earlier levels of 17 is consistent with the general decline in student enrollment in the 570 curriculum and the current ratio of resident students (570 and 591) to tenure-track faculty members is about 4.5. With several retirements from both the old Aeronautics and Astronautics Department, and the ME Department, we have both gained and lost Faculty. Table I-4 in the Appendix I lists current Tenure Track faculty covering the 6 major subdivisions of the Department, while the table 5-1 below shows how the faculty align with the specialization areas.

<table>
<thead>
<tr>
<th>Area</th>
<th>Faculty Members</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal/Fluid Sciences</td>
<td>Prof. K. Millsaps; Assoc. Prof. A. Gopinath</td>
</tr>
<tr>
<td></td>
<td>Prof. G. Hobson, Assoc. Prof. C. Brophy</td>
</tr>
<tr>
<td>Solid Mechanics, Shock and Vibration</td>
<td>Distinguished Prof. Y. Shin; Prof. Y. Kwon;</td>
</tr>
<tr>
<td></td>
<td>Assoc. Prof. J. Gordis</td>
</tr>
<tr>
<td>Dynamics, Control and Autonomous Systems</td>
<td>Distinguished Prof. A. Healey; Prof. I.</td>
</tr>
<tr>
<td></td>
<td>Kaminer, Prof. M. Driels;</td>
</tr>
<tr>
<td>Materials Science and Engineering</td>
<td>Distinguished Prof. T. McNeilley; Prof. I. Dutta</td>
</tr>
<tr>
<td>Total Ship Systems Engineering</td>
<td>Assoc. Prof. F. Papoulias</td>
</tr>
<tr>
<td>Space Systems Engineering</td>
<td>Distinguished Prof. B. Agrawal, Prof. I M.</td>
</tr>
<tr>
<td></td>
<td>Ross, Assist. Prof. M. Romano</td>
</tr>
</tbody>
</table>

The backgrounds of the current faculty are well balanced across these discipline areas and the faculty size is sufficient to cover the Mechanical Engineering ESRs as specified for the
program. Any future departures will be met with recruitment to stabilize the total number of Tenure track faculty. However, the current enrollment places the Department well below the School’s average resident-student to tenure-track faculty ratio (currently about 5.9) and this will be a factor in gaining approval to go forward with a tenure-track recruiting action. Also, the projected reductions in student enrollment will limit our ability to hire. Our strategic plan calls for faculty size to be maintained, but not to grow.

As is noted in Table I-3, Faculty Workload, the Tenure Track Faculty cannot teach the total number of required courses in the program, and we rely on adjunct faculty with specialty area expertise to cover the remainder of classes. For example, we expect to teach 79 total sections in the 2007 year, 45 of which will be taught by Tenure Track faculty and 34 of which will be taught by contract specialists and adjunct faculty. While there is a downside to this from the student perspective, and our own sense of professionalism, the use of contract teaching faculty provides a cushion in the event of reductions in student enrollment which we do not control. We also use this to provide special expertise from outside where it is not with the resident tenure track faculty. This year 43% of our classes will be taught by adjunct, contract, and visiting faculty.

Detailed information pertaining to faculty competency is provided in Table I-4 of Appendix I and the Curriculum Vitae in Part C of Appendix I. All of the faculty have been involved in a wide range of reimbursably funded Navy, DoD, NSF and other research projects. These projects cover a wide range of Navy-relevant topics across the fields of Mechanical, Materials and Naval Engineering.

The annual reimbursable research funding expenditures were $2,899,520 in FY04; $4,681,894 in FY05; $3,309,991 in FY06; and $4,624,251 is planned for expenditure in FY07. There is a difference between planned and expended as some projects carry over across fiscal years. These projects have enabled students to interact directly with research sponsors from the Navy and other agencies in order to see major trends and issues that will emerge in the future. On average, the planned expenditure is $289,015 per faculty member for FY 07.

Altogether, Mechanical Engineering faculty members have published 109 papers in journals and more than 245 papers in conference proceedings over the last five years averaging 1.36 /3.06 per faculty member per year.

In addition, three Mechanical Engineering faculty members are authors or co-authors or contributors to textbooks in the field.


M. R. Driels “Weaponering”,


The following faculty members have received professional society recognition by being named fellows of their professional societies.

A.J. Healey, Fellow of ASME  
Y. W. Kwon, Fellow of ASME  
T. R. McNelley, Fellow of ASMI  
Y. S. Shin, Fellow of ASME

Recently, three of our faculty members have been recognized recently with the award of Distinguished Professor, Distinguished Professors Healey (2003), McNelley (2006) and Shin (2006), in addition to Distinguished Professor Brig Agrawal.

The Department has also been fortunate to have a large number of distinguished visiting and adjunct faculty members from all over the world. These individuals are named below and have participated in both teaching and research activities, and they have contributed a rich diversity to the academic experiences of the students. Several of these individuals have contributed in both a teaching and research capacity as tenure-track faculty members have reduced their teaching load through use of reimbursable funds. A number of National Research Council (NRC) postdoctoral associates have also been affiliated with the Department as well and they have helped maintain a strong, high-level research effort in the program. This has been especially true in the materials area, wherein the NRC postdocs have interacted strongly with the students during the course of their thesis research activities as well as with the faculty.

Current Non Tenure Track faculty members are as follows:

Distinguished Visiting Professor J Lloyd  
Dr. J. Sinibaldi, Associate Research Professor  
Mr. D. P. Horner, Assistant Research Professor  
Dr. K. Jones, Associate Research Professor  
Dr. V. Dobrokhodov, Research Assistant Professor  
Mr. S. P Kragelund, Research Associate  
Dr. Chanrashekhara, Research Professor  
Dr. Terry Alfriend, Research Professor  
Mr. J. Didoszak, Research Assistant Professor
Most faculty interactions outside of the institution are with various Navy and Government agencies and laboratories. In many instances, however, faculty members have developed contacts and collaborations with faculty members from other universities as well as with industrial partners through vehicles such as Cooperative Research and Development Agreements (CRADAs). Professor A. J. Healey has developed an international collaboration with IST-Lisbon through a memorandum of understanding between IST and NPS. The Office of Naval Research and NATO has assisted in arrangements; Professor Antonio Pascoal of the Electrical Engineering Department at IST has represented that institution. Sabbatical leave has been another vehicle. For example, Professor A. Gopinath has been on sabbatical leave in Germany and now, India. Professor Kaminer and Agrawal have been on leave at Berkeley and Industry respectively, during FY 2006. Professor Dutta’s earlier leave at Motorola has provide renewed insights for his research program in micro soldering materials issues.

6. Facilities

The Department moved into a new building just prior to the last ABET Accreditation visit in 1995. The project budget included $4M to support the acquisition of extensive new laboratory equipment. The Department had been spread out in three different buildings prior to 1995 and the consolidation of facilities largely under one roof has greatly improved interactions and collaborations among the faculty and between faculty and students.

Instructional facilities in the new building included four large, new classrooms, a fully equipped computer laboratory and dedicated laboratories for both instruction and research. The classrooms are due for upgrading and installation of computers and projectors to use existing network connections and bring them fully online. It is anticipated that this will be accomplished with institutional funds rather than Departmental funds.

The original computer laboratory included 24 Silicon Graphics workstations and peripherals. Institutional funds have been used on subsequent occasions to upgrade this laboratory with new servers, Windows NT workstations and selected peripherals have most recently been instituted. This computer laboratory is available at all times to the students and is consistently the most heavily used facility in the building.

Other new facilities acquired with the original building project allowed extensive upgrading of both the instructional and research laboratories in the Department and the Department participates in both a Laboratory Recapitalization Program at NPS as well as special program plus up funds coming from requests to the Navy claimant, NETC through the POM process. For example, we have participated in additional funds through POM 06 for laboratory equipment in “Plus UP” areas defined by the GSEAS Dean for the Unmanned Systems Laboratory and the installation of a “clean room” for the “Nano Mems” activities at NPS in which our Materials faculty will share.

In addition to POM 06 funds, the Center for AUV Research has benefited from the annual DURIP (Defense University Research Instrumentation Program) for the purchase of a
REMUS Autonomous Underwater Vehicle ($304K), and two Scan Eagle Unmanned Aerial Vehicles ($350K) as well as a Sea Fox Autonomous RHIB boat from other Navy funds.

In view of diminishing funds for the hiring and use of supporting staff, the degree program as a whole has recently a lessened reliance on formal physical laboratory work. In response to our Navy sponsor, we have included specifically a course in finite element analysis of structures and fluids. Also, computer simulation is widely used in our Dynamics and Control classes with Matlab, and Simulink projects being given. However, especially in the Propulsion and Materials groups, the following courses have associated physical laboratories wherein students conduct experiments and submit reports: ME2201, Fluid Mechanics; ME2601, Solids I; MS2201, Introduction to Materials; ME3240, Power and Propulsion; ME3521, Vibrations; MS3202, Failure Analysis.

Funds for the ongoing maintenance and upgrading of the Department’s laboratory facilities have been provided through both laboratory and research recapitalization budgets (Table II-5). Also, substantial support for maintaining and improving these laboratories has come from reimbursable research funding raised by the faculty. The ongoing maintenance and further upgrading of these has been hindered more by lack of support staff and absence of institutional support for faculty labor for these purposes than by lack of funds for the equipment itself.

The Department’s laboratory facilities are organized into seventeen major areas for the purpose of oversight by the faculty. These facilities and the responsible faculty members are listed below.

Autonomous Underwater Vehicles (AUV) Laboratory and Unmanned Systems Center
(Distinguished Prof. Healey / Horner / Kaminer)
The centerpiece of this laboratory are the unmanned vehicles, ARIES, and REMUS(2) AUVs, the two Scan Eagle UAVs, several RAVEN UAVs, and a Sea Fox 5 meter RHIB USV. The Unmanned Vehicles program focuses on Command and Control of Autonomous Systems for Mine Hunting and Intelligence gathering and is funded by the Office of Naval Research. The Center has contributed to the evolution of the AUV concept from theory to employment with operational Navy elements in Fleet Battle Exercises (FBXs) and Navy Demonstrations.

CAD/CAE Laboratory; the laboratory currently houses 35 Dell windows XP workstations and has over 50 major software applications and licenses installed. Included, for example, are Matlab, SolidWorks, Ideas, GeoVRML, STK, Nastran, Dytran, Patran, AutoCad, Ansys, among many others. NPS also has access to mainframe computers and a developing cluster for large-scale processing is available.

Fluid Mechanics and Hydrodynamics Laboratories:
The fluid mechanics laboratory supports instruction in basic courses in fluid mechanics. It is equipped with a small wind tunnel for specific instructional purposes. The hydrodynamics
laboratory includes a unique U-shaped oscillating water tunnel for the study of a wide range of phenomena, such as flow about stationary and oscillating bodies, vortex-induced vibrations, stability of submarines and boundary layers, and vortex-free-surface interactions. The hydrodynamics laboratory also houses a re-circulating water tunnel for numerous flow-separation and vibration phenomena and a vortex-breakdown facility for the investigation of the stability of swirling flows. These facilities are supported by a 3-beam Laser-Doppler-Velocimeter, numerous other lasers, high-speed motion analyzers, data-acquisition systems, and dedicated computers for numerical simulations.

Marine Propulsion Laboratory:
This laboratory has gas turbine (Allison C-250) and diesel (Detroit 3-53) engines connected to water brake dynamometers, located in separate, isolated engine test cells. These engines are instrumented to obtain steady-state performance and high-frequency, time-resolved measurements. Aerothermodynamic, acoustic, and vibration phenomena in turbo-machinery and reciprocating engines are being investigated, particularly relating to non-uniform flow and condition-based maintenance (CBM) in naval machinery. These engines are used for both instructional and applied research programs in the area of marine power and propulsion. In addition, this lab has bench-top rotordynamics experiments for demonstrating high-speed machinery balancing and investigating rotordynamic instabilities. The lab has sub-scale flow facilities for developing and testing low observable (stealth) technologies for engine inlets and exhausts.

Rocket Propulsion Laboratory:
This lab conducts research on advanced concepts in solid, liquid, and combined mode propellants. Experimental and computational research is conducted in the areas of propellant mixing, combustion, pulse detonation, thrust control, and plume mixing. A full range of mechanical and optical diagnostic techniques are used on small and subscale experiments.

Turbo-Propulsion Laboratory:
The Turbo Propulsion Laboratory houses a unique collection of experimental facilities for research and development related to compressors, turbines, and advanced air-breathing propulsion engine concepts. In a complex of specially designed concrete structures, one building, powered by a 750 HP compressor, contains 10 by 60 inch rectilinear and 4 to 8-foot diameter radial cascade wind tunnels, and a large 3-stage axial research compressor for low speed studies. A two-component, automated traverse, LDV system is available for CFD code verification experiments. A second building, powered by a 1250 HP compressed air plant, contains fully instrumented transonic turbine and compressor rigs in explosion-proof test cells. A spin-pit for structural testing of rotors to 50,000 RPM and 1,800 degrees Fahrenheit is provided. Model experiments and equipment for instrumentation development are located in a separate laboratory. Data acquisition from 400 channels of steady state and 32 channels of non-steady measurements, at up to 200 kHz, is controlled by the laboratory's Pentium workstations. A third building houses a 600 HP radial and 150 HP boost compressor capable of delivering 2000 scfm of air at 10 and 20 atmospheres respectively. These charge four tanks for blow-down to a supersonic wind tunnel (4 x 4 inches), a transonic cascade wind tunnel (2 x 3 inches), and two free jets (one 6-inch and one 1-inch in diameter). The large free jet is equipped with an instrumented thrust stand for the testing of small gas turbine
engines. The building also houses a 3-inch diameter shock tube. Pressure measurements are made with a 96-channel Scani-valve ZOC system and pressure sensitive paint, and Schlieren and shadowgraph techniques are used routinely.

**Thermal Engineering Labs:**
These labs are used mainly for instruction in heat transfer to investigate convection phenomena of single and multi-phase flows and include facilities for measurement of temperature change and fluid motion in a range of systems. The lab also includes equipment/instrumentation for measurements in microelectronics and micro-heat exchanger systems.

**Machine Shop and Electronics Support:** the Department maintains a machining facility and electronics shop for support of both instruction and research.

**Materials Characterization Laboratory:** (McNelley); major facilities include a Topcon 002B 200KV transmission electron microscope; Topcon S510 scanning electron microscope; Perkin ElmerAuger spectrometer; Philips X-ray diffractometer; and additional optical microscopy and physical characterization equipment. There is a plan in the POM 08 cycle for an $850K purchase of a new SEM to replace the existing machine.

**Materials Processing Laboratory:** (McNelley); facilities include heat treatment, deformation processing and deposition facilities.

**Mechanical Testing Laboratory:** (Dutta); this laboratory is equipped with a selection of electro-mechanical and servo-hydraulic testing machines and other equipment for tension, compression, fatigue and creep testing of metals, composites and microelectronic components.

**Solid/Structures and Vibrations Laboratory;** This laboratory is equipped with an isolation pad, anechoic tank and SGI and HP workstations for data acquisition and analysis.

**Ship Shock Simulation Laboratory (Distinguished Professor Shin);** this is equipped to conduct shock and vibration analysis, modeling and simulations for hardware and software. We have conducted naval ship shock simulations including DDG53, DDG81, LPD19, and the current work is for LCS-1 & LCS-2. This computational laboratory has been functional to develop and validate modeling and simulation capabilities to improve the survivability of ships subjected to realistic underwater explosions.

**TSSE Design and Computer Laboratory** (Papoulias); this is a dedicated facility for the Total Ship Systems Engineering program and is set up to facilitate interaction among large groups of students working on various ship design projects.

**Space Craft Design and Engineering Center**
( Distinguished Prof. Brij Agrawal)

**Optical Relay Mirror Laboratory**
A new joint NPS and AFRL laboratory, the NPS-AFRL Optical Relay Spacecraft Laboratory, was dedicated on June 5, 2002. This laboratory is used for both instruction and research on acquisition, tracking and pointing of flexible military spacecraft. Three-axis simulator 1 can simulate spacecraft three-axis motion as well as the optical system of a space telescope. The spacecraft simulator has three reaction wheels and thrusters as actuators; rate gyros and sun sensors as sensors; an on-board processor and batteries; and is supported on a spherical air bearing. The optical system consists of a laser source, a fast steering mirror, jitter sensor, and a video camera as a tracking sensor.

Three-Axis Simulator 2
The three-axis simulator 2 can be divided into three modules: spherical air bearing, spacecraft bus module and optical payload module. The spacecraft bus has three variable speed control moment gyros (CMGs), a Northrop Grumman - Litton LN-200 IMU consisting of three fiber optics rate gyroscopes, sun sensors, magnetometers, inclinometer, a fine sensor, batteries, power switching and control electronics, and an automatic balancing system. The optical payload consists of a receive telescope and associated optical equipment on the upper platform and a transmit telescope and associated optical equipment on the lower platform.

Laser Jitter Control Testbed
The purpose of the testbed is to investigate control methods to reduce optical jitter and mitigate disturbances to optical beams and structures. Emphasis is placed on Adaptive Control methods due to the expected changing environment.

Adaptive Optics Test Bed
The purpose of this test bed is to develop improve control techniques for adaptive optics. The current application is controlling surface of large flexible mirrors in space. The test bed has two adaptive optics systems (two deformable mirrors and two wave front sensors). One system corrects the surface of flexible mirror and the other system correct the aberration in imaging object beam. The test bed also has fast steering mirror for correcting jitter. The test bed has two beams: reference beam and object beam. The reference beam is used by the sensors and actuators to correct flexible mirror surface and beam jitter introduced in the spacecraft.

Smart Structure Laboratory

NPS Space Truss
The overall dimension of the NPS space truss is 3.76 m long, 0.35 m wide and 0.7 m tall. Two piezo-ceramic struts are installed as actuators near the base of the truss. The output force for the actuator is 0-100 N and the displacement range is 0-90m. A linear Proof Mass Actuator, located at the left end of the truss, generates the disturbance.

Precision Pointing Hexapod
The Positioning Hexapod is used for testing control algorithms for both vibration isolation of an imaging payload and fine steering. It is based on an arrangement of six self-supporting
electromagnetic voice coil actuators with in-line accelerometers that could enable control of high vibration. Lower frequency steering and vibration isolation is provided by the use of a laser-photo-diode based on a 2-axis position detecting system and eddy current position sensors. The system can deliver over 5.7 mm of axial/position travel, 20 mm of lateral motion, 2.5 deg. of tilt motion and 10 deg. of twist.

**Flexible Spacecraft Simulator (FSS)**

The FSS, as shown in the figure, simulates attitude motion in the pitch axis of a flexible spacecraft. It consists of a central rigid body representing the spacecraft central body and a flexible appendage representing a reflector with a flexible support structure. This system is floated on air pads over a granite table to simulate a micro-gravity environment. The actuators are thrusters with air supplied by a compressed air bottle and a momentum wheel.

**FLTSATCOM Laboratory**

This laboratory, as shown in the figure, consists of a qualification model of the Navy FLTSATCOM communications satellite, the associated ground support equipment for testing the satellite, and the FLTSATCOM Attitude Control Simulator, which provides a graphical display of the spacecraft’s attitude and rotational motion in response to commands similar to the commands required for flight model FLTSATCOM spacecraft.

**Spacecraft Design Laboratory**

This laboratory houses computer-aided design tools for spacecraft design and a spacecraft design library. It has GENSAT, a general-purpose software application for satellite design, and Conceptual Design Center (CDC) software from Aerospace. In addition, it has several subsystem design software packages, such as STK, NASTRAN, IDEAS and Matlab/Simulink. Using these unique design tools, students can perform collaborative spacecraft design.

**Spacecraft Robotics Laboratory** 
(Prof. Marcello Romano)

The Autonomous Docking & Spacecraft Servicing (AUDASS) test-bed at the NPS Spacecraft Robotics Lab consists of two spacecraft simulators floating via air-pads on a flat floor in order to recreate in 2D the weightlessness and frictionless conditions of orbital space flight. The test-bed is used to validate Guidance, Navigation and Control Algorithms for spacecraft proximity operations. This test-bed has been developed under AFRL and NPS sponsorship.

**Nonlinear Control Systems Laboratory**

The laboratory contains two nonlinear control stations. At one station is a flexible robotic link manipulator system that is used for exploring and demonstrating new nonlinear feedback control laws for fast dynamical systems. The second station is a magnetically actuated spacecraft bus floating on an airbearing assembly that is used to demonstrate nonlinear control laws based on traditional and pseudospectral (PS) techniques. Both stations employ
an unscented Kalman filter (UKF) for nonlinear estimation. The PS-UKF framework forms the basis of exploring autonomous operations for generic nonlinear systems.
7. Institutional Support

The Department receives budget allocations from the GSEAS Dean in two main categories: labor and operating target (OPTAR). For a given year, the labor allocation is determined by two factors. These are the numbers of courses taught in the preceding year and the number of thesis students advised. The algorithm for this process resides in the Office of Academic Planning. There is no longer any allocation reflecting the number of faculty in a department, nor are any funds identified directly in the Department allocation as in support of faculty or program development. This situation reflects, as noted earlier, the difficult budget climate in the Department of Defense in general and at the School in particular. It is up to individual Chairs to determine the allocation of labor budget to individual faculty members. In Mechanical and Astronautical Engineering, essentially the entire budget is being consumed in support of faculty labor to teach the program for which it is systematically insufficient. The following tabular summary shows how the current situation has evolved in recent years. The budget is expressed in direct support dollars at the accelerated rate. The H funds are for workload relief and were provided to relieve the burden on faculty raising reimbursable funds which were becoming excessive. The number of course sections taught in each year are also shown for comparison.

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>TT Faculty</th>
<th>Faculty Labor Budget*</th>
<th>Workload Relief, H funds**</th>
<th>Course Sections Taught</th>
</tr>
</thead>
<tbody>
<tr>
<td>'05</td>
<td>17</td>
<td>$1,905,139</td>
<td>$415,144</td>
<td>88</td>
</tr>
<tr>
<td>'06</td>
<td>16</td>
<td>$1,959,474</td>
<td>$308,213</td>
<td>83</td>
</tr>
<tr>
<td>'07</td>
<td>16</td>
<td>$1,731,065</td>
<td>$213,460</td>
<td>79</td>
</tr>
</tbody>
</table>

* Does not include budget for Distance Learning Programs which are separate
** Additional to Labor Budget

Clearly the institutional budget allocation in support of the program has decreased significantly in recent years. The budget has been balanced each year by use of reimbursable research funds, by use of reimbursable funds for teaching new programs (e.g., the 571 Curriculum a DL program for Naval Reactors), and by other means. These other means include relying on funds held back by the administration to cover short falls in the labor budget.

Funds to support faculty development are not generally available and with the exception of sabbatical funds, the institution relies more and more on the reimbursable research program to support the immediate needs of faculty.

The Department OPTAR account is mainly used to support ongoing operations and routine office and laboratory supply items. The OPTAR account may also be used for limited travel. Mostly, travel is supported by reimbursable funds and the Chair is very limited in available support for faculty travel to conferences where no reimbursable money is available.

The OPTAR for Mechanical Engineering has varied around $40K in recent years and is $46K for Fiscal Year 2007. Additional money is provided as reimbursable indirect funds, which may be used to support both faculty and staff labor (related to research) and faculty
travel for various purposes including fund raising. The amount of these funds has also varied from $36K to $45K each year. It has not been possible to support all faculty requests for travel to see prospective research sponsors and to attend and participate in research conferences, workshops and symposia even in the absence of a funded research program in the area. The research indirect accounts are managed by individual faculty according to their own generation.

In recent years, NPS has allocated funds for recapitalization of both instructional laboratories and for the research infrastructure. The recent funding levels are provided in Table I-5. Since many facilities were new in 1995, these funds have been adequate to maintain the facilities but have not been sufficient to fund significant new initiatives in either the instructional laboratories or research. Faculty members have been able to arrange transfer of equipment from other Navy facilities or been able, in one instance, to secure donations of equipment from industry. In addition, In 2006, the Dean was able to institute Laboratory Support for New Initiatives. There were 5 areas named, Unmanned Systems and the Nano Mem initiative which resulted in the availability of funds to furbish a clean room for the materials group, and reequip the unmanned vehicles center with instrumentation for the Autonomous Underwater vehicle program. The AUV center has been successful in winning awards through the DURIP (Defense University Research Instrumentation Program) for $300K and $350K in the 04 and 06 years.

The division of Institutional recapitalization funds between laboratories supporting the MSME and the MSAstroE degree programs is roughly 178K and 83K respectively for 2007. Items are requested by the faculty annually and are prioritized by the Chair. These requests are justified at an NPS wide committee meeting, following which, cuts are made according to the estimated funds available. Purchase requests are then made and forwarded to the Dean’s office, and depending on the availability of funds at the end of the year, some of the requested items are purchased. Unfortunately, this process leads to late purchasing and sometimes items are not even purchased.

The budget allocation from the institution for technical support staff labor has been reduced even more than the faculty labor budget. In 1995, the Department had funding in support of six engineering technicians and three model maker machinists. Several of these individuals have left or retired in the intervening years and most of them have not been replaced. In 2001, there were only two engineering technicians and a recruiting action in place to hire a third, while there were two model maker machinists in support of Mechanical Engineering in a consolidated machine shop. The reductions in faculty labor support and the decline in number of engineering technicians remain the most serious impediments to maintenance and improvement of the instructional laboratories in this Department.

Recently with the help of shared funds with reimbursable funds we have been able to hire more staff in duties that cut across the Department and relate mostly to shared efforts between research programs and teaching support.

Mardo Blanco, 50% Time Mechanic
Tom Christian, Electronics Engineer 100% Time
Michael Doherty, 100% Time
John Gibson, Technician 100% Time
George Hegman, Technician 50% Time
Don Meeks Technician, 75% Time
Ben Wring, 20% Time
Aurelio Monarez, 100% Time
Matt Goldman Engineer, 50% Time

8. Program Criteria

Additional program criteria applicable to the program for the 570 Curriculum include the following:

The graduate must have knowledge of chemistry and calculus-based physics; the ability to apply advanced mathematics through multivariable calculus and differential equations; familiarity with statistics and linear algebra; and the ability to work professionally in both thermal and mechanical systems areas, including design and the realization of such systems.

All of these requirements are factored into the certification procedure that has been established to ensure that individuals accepted into the 570 Curriculum will meet both the basic and advanced level ABET criteria by completion of the program.

Briefly, the Curriculum Officer and the Academic Associate review the transcript of each incoming student to determine whether or not the student has an ABET accredited undergraduate degree. For those who do not have such a degree, the pertinent mathematics, science and humanities courses are entered into a database and coupled with a prospective matrix of courses to be taken at NPS. An iterative process then ensues, involving modification of the matrix of courses, until all of these program requirements are met. In the event that the student has not had chemistry (a rare circumstance), the requirement can be met using local colleges. The program requires students to study mathematics to the level of partial differential equations and numerical analysis. Statistics appears specifically through a course in Operations Research and the design content of the program is met through ME courses.

Table 4 in Appendix I provides a faculty analysis, and current curriculum vitae for the Mechanical Engineering faculty appear in Appendix I, Part C. All faculty members in Mechanical Engineering have earned doctorates. All are from highly regarded doctoral programs. The faculty brings a variety of professional experiences to the program, including purely academic, mixtures of industry and academic, and government or national laboratory experience. All faculty members are active in professional organizations, including ASME, ASNE, TMS and ASMI, and AIAA. Levels of involvement vary, but range from attendance at national meetings to leadership in various society activities. Several faculty members maintain well-funded research programs and a high level of research output in the form of reports, papers and presentations in conference proceedings, and publications in archival journals.
9. General Advanced-Level Program

The certification procedure that has been established to ensure that individuals accepted into the 570 Curriculum will meet the basic level ABET criteria by completion of the program has been long established in this program. Briefly, the Curriculum Officer and the Academic Associate review the transcript of each incoming student to determine whether or not the student has an ABET accredited undergraduate degree. For those who do not have such a degree, the pertinent mathematics, science and humanities courses are entered into a database and coupled with a prospective matrix of courses to be taken at NPS. A matrix of coursework is then established for each such student taking into account qualifying coursework from the Bachelor’s Degree program and adding to it such additional classes as may be needed to meet ABET basic level accreditation requirements. The Department chair certifies on a form, prior to the student graduation, that the student’s individual program meets the ABET requirements.

The certification procedure is designed to assure that the basic and advanced level program requirements are separately and completely satisfied. The advanced level criteria may be satisfied by completion of the core graduate course sequence, plus a sequence of at least three advanced graduate (4XXX) level courses as approved by the Curricular Officer, Academic Associate and Department Chairman, and a thesis. The thesis must represent an original investigation on a topic that must be approved by the Curricular Officer, Academic Associate and Department Chairman prior to commencement. Finally, the results of the thesis investigation must be presented in written form, presented in oral form to the Department, and finally approved by the thesis advisor and Department Chairman. The Department keeps a record of selected presentation on VHS video tape.
APPENDIX I A
Table 1. Basic-Level Curriculum
(Master of Science in Mechanical Engineering)

<table>
<thead>
<tr>
<th>Year; Semester or Quarter</th>
<th>Course (Department, Number, Title)</th>
<th>Category (Credit Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Math &amp; Basic Sciences</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Engineering Topics</td>
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<td>General Education.</td>
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<td>(✓)</td>
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</table>

ABET B.S.M.E. Equivalency

All students who enter the ABET-accredited M.S.M.E. degree program must satisfy the requirements of an ABET-accredited B.S.M.E. degree (ABET B.S.M.E. Equivalency). This can be accomplished in one of two ways:

1. Student has earned an B.S. degree from an ABET-accredited Mechanical Engineering undergraduate program; or,
2. Student takes sufficient additional preparatory courses at NPS to meet the ABET B.S.M.E. Equivalency requirements.

This ABET equivalency is documented for every student in the B.S.M.E. equivalence Checklist (See Section D.2.) This checklist is signed by the Program Officer, the Associate Chair for Academics, and the Chair.

(continued on next page)
### Table 1. Basic-Level Curriculum (continued)
(Master of Science of Mechanical Engineering)

<table>
<thead>
<tr>
<th>Year; Semester or Quarter</th>
<th>Course (Department, Number, Title)</th>
<th>Category (Credit Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Math &amp; Basic Science</td>
</tr>
<tr>
<td></td>
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<td>Engineering Topics</td>
</tr>
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<td></td>
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<td>General Education</td>
</tr>
<tr>
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<td>Other</td>
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</table>

Check if Contains Design

<p>| | |</p>
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>TOTALS-ABET BASIC-LEVEL REQUIREMENTS</td>
<td></td>
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</tbody>
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OVERALL TOTAL FOR DEGREE

<table>
<thead>
<tr>
<th>PERCENT OF TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum semester credit hours</td>
</tr>
<tr>
<td>Minimum percentage</td>
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</tbody>
</table>

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 1A. Advanced-Level Curriculum

*(Master of Science of Mechanical Engineering)*

<table>
<thead>
<tr>
<th>Year; Semester or Quarter</th>
<th>Course (Department, Number, Title)</th>
<th>Category (Credit Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Math &amp; Basic Sciences</td>
</tr>
<tr>
<td></td>
<td>Check if Contains Design</td>
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</tr>
<tr>
<td>Q1</td>
<td>NW3230 Strategy and Policy: The American Experience</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
<td>Q3</td>
<td>MA3132 Partial Diff. Eqns. and Integral Transforms</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>* ME 3611 Mechanics of Solids II</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
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<td></td>
</tr>
<tr>
<td>Q4</td>
<td>MA 3232 Numerical Analysis</td>
<td>4.5</td>
</tr>
<tr>
<td></td>
<td>* ME 3521 Mechanical Vibration</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>* ME 3201 Applied Fluid Mechanics</td>
<td>4.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>* ME 3150 Heat Transfer</td>
<td>4.5</td>
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<tr>
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<tr>
<td>Q5</td>
<td>ME3711 Design Of Machine Elements</td>
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<tr>
<td></td>
<td>* ME3450 Computational Methods in Mechanical Engineering</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>* MS3202 Properties, Performance &amp; Failure of Engineering Materials</td>
<td>4.0</td>
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<td>** ME 4xxx Elective</td>
<td>4.0</td>
</tr>
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</tr>
<tr>
<td>Q6</td>
<td>* ME3801 Autonomous Systems</td>
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<td>Course Code</td>
<td>Course Title</td>
<td>Credits</td>
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<tr>
<td>ME3240</td>
<td>Marine Power and Propulsion</td>
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<td>ME3712</td>
<td>Capstone Design Project</td>
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<tr>
<td>** ME 4xxx Elective</td>
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<td>4.0</td>
</tr>
<tr>
<td>Q7 TS3001</td>
<td>Fundamental Principles of Naval Architecture</td>
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</tr>
<tr>
<td>MS3304</td>
<td>Corrosion and Marine Environmental Deterioration OR</td>
<td>4.0</td>
</tr>
<tr>
<td>MS3606</td>
<td>Introduction to Welding and Joining Metallurgy</td>
<td></td>
</tr>
<tr>
<td>ME 0810</td>
<td>Thesis</td>
<td>4.0</td>
</tr>
<tr>
<td>ME 0810</td>
<td>Thesis</td>
<td>4.0</td>
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(continued on next page)
Table 1A. Advanced-Level Curriculum (continued)
(Master of Science in Mechanical Engineering)

<table>
<thead>
<tr>
<th>Year; Semester or Quarter</th>
<th>Course (Department, Number, Title)</th>
<th>Category (Credit Hours)</th>
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<tbody>
<tr>
<td></td>
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<tr>
<td>Q8</td>
<td>TS 3001 Naval Architecture</td>
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<tr>
<td></td>
<td></td>
<td>(✓)</td>
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<tr>
<td></td>
<td>ME 4xxx Elective</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(✓)</td>
</tr>
<tr>
<td></td>
<td>ME 0810 Thesis</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(✓)</td>
</tr>
<tr>
<td></td>
<td>ME 0810 Thesis</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(✓)</td>
</tr>
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TOTALS-ABET BASIC-LEVEL REQUIREMENTS

OVERALL TOTAL FOR DEGREE

<table>
<thead>
<tr>
<th>Totals must satisfy one set</th>
<th>Minimum semester credit hours</th>
<th>32 hrs</th>
<th>48 hrs</th>
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<tbody>
<tr>
<td>Minimum percentage</td>
<td>25%</td>
<td>37.5%</td>
<td></td>
</tr>
</tbody>
</table>

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 2. Course and Section Size Summary

(Master of Science in Mechanical Engineering)

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Title</th>
<th>No. of Sections offered in Current Year</th>
<th>Avg. Section Enrollment</th>
<th>Type of Class (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 1000</td>
<td>Preparation for PE</td>
<td>1</td>
<td>7</td>
<td>100%</td>
</tr>
<tr>
<td>ME 2101</td>
<td>Engng. Thermodynamics</td>
<td>2</td>
<td>13</td>
<td>80% 20%</td>
</tr>
<tr>
<td>ME 2201</td>
<td>Intro. Fluid Mechanics</td>
<td>2</td>
<td>14</td>
<td>75% 25%</td>
</tr>
<tr>
<td>ME 2503</td>
<td>Statics and Dynamics</td>
<td>2</td>
<td>16</td>
<td>100%</td>
</tr>
<tr>
<td>ME 2601</td>
<td>Mech. Of Solids I</td>
<td>2</td>
<td>16</td>
<td>75% 25%</td>
</tr>
<tr>
<td>ME 2801</td>
<td>Inrto. Engng. System Dynamics</td>
<td>2</td>
<td>13</td>
<td>75% 25%</td>
</tr>
<tr>
<td>ME 3150</td>
<td>Heat Transfer</td>
<td>2</td>
<td>11</td>
<td>89% 11%</td>
</tr>
<tr>
<td>ME 3201</td>
<td>Appl. Fluid Mechanics</td>
<td>2</td>
<td>14</td>
<td>89% 11%</td>
</tr>
<tr>
<td>ME 3240</td>
<td>Marine Power &amp; Propulsion</td>
<td>2</td>
<td>14</td>
<td>80% 20%</td>
</tr>
<tr>
<td>ME 3410</td>
<td>Instrumentation &amp; Measurement</td>
<td>2</td>
<td>11</td>
<td>50% 50%</td>
</tr>
<tr>
<td>ME 3450</td>
<td>Comput. Meth. in Mech. Engng.</td>
<td>2</td>
<td>11</td>
<td>75% 25%</td>
</tr>
<tr>
<td>ME 3521</td>
<td>Mechanical Vibration</td>
<td>2</td>
<td>10</td>
<td>75% 25%</td>
</tr>
<tr>
<td>ME 3611</td>
<td>Mechanics of Solids II</td>
<td>2</td>
<td>15</td>
<td>100%</td>
</tr>
</tbody>
</table>

1. Enter the appropriate percent for each type of class for each course (e.g., 75% lecture, 25% recitation). This percentage is based on credit hours.
### Table 2. Course and Section Size Summary (cont.)
(Master of Science in Mechanical Engineering)

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Title</th>
<th>No. of Sections offered in Current Year</th>
<th>Avg. Section Enrollment</th>
<th>Type of Class (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 3711</td>
<td>Design of Machine Elements</td>
<td>2</td>
<td>16</td>
<td>Lecture 89%</td>
</tr>
<tr>
<td>ME 3801</td>
<td>Control of Naval Engng. System</td>
<td>2</td>
<td>14</td>
<td>Laboratory 11%</td>
</tr>
<tr>
<td>ME 4160</td>
<td>Application of Heat Transfer</td>
<td>1</td>
<td>4</td>
<td>Recitation 75%</td>
</tr>
<tr>
<td>ME 4161</td>
<td>Conduction Heat Transfer</td>
<td>1</td>
<td>24*</td>
<td>Recitation 25%</td>
</tr>
<tr>
<td>ME 4162</td>
<td>Convection Heat Transfer</td>
<td>1</td>
<td>20*</td>
<td>Recitation 100%</td>
</tr>
<tr>
<td>ME 4163</td>
<td>Radiation Heat Transfer</td>
<td>1</td>
<td>6</td>
<td>Other 100%</td>
</tr>
<tr>
<td>ME 4202</td>
<td>Compressible Flow</td>
<td>0</td>
<td>0</td>
<td>Lecture 100%</td>
</tr>
<tr>
<td>ME 4211</td>
<td>Appl. Hydrodynamics</td>
<td>0</td>
<td>0</td>
<td>Laboratory 100%</td>
</tr>
<tr>
<td>ME 4220</td>
<td>Viscous Flow</td>
<td>0</td>
<td>0</td>
<td>Recitation 100%</td>
</tr>
<tr>
<td>ME 4240</td>
<td>Adv. Topics in Fluid Dynamics</td>
<td>0</td>
<td>0</td>
<td>Lecture 100%</td>
</tr>
<tr>
<td>ME 4300</td>
<td>Weaponeering</td>
<td>1</td>
<td>10</td>
<td>Recitation 75%</td>
</tr>
<tr>
<td>ME 4420</td>
<td>Marine Gas Turbine</td>
<td>1</td>
<td>7</td>
<td>Lecture 25%</td>
</tr>
<tr>
<td>ME 4522</td>
<td>FEM in Structural Dynamics</td>
<td>1</td>
<td>17*</td>
<td>Laboratory 100%</td>
</tr>
</tbody>
</table>

1. Enter the appropriate percent for each type of class for each course (e.g., 75% lecture, 25% recitation). This percentage is based on credit hours.
* Includes distance learning students
Table 2. Course and Section Size Summary (cont.)
(Master of Science in Mechanical Engineering)

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Title</th>
<th>No. of Sections offered in Current Year</th>
<th>Avg. Section Enrollment</th>
<th>Type of Class (1)</th>
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</thead>
<tbody>
<tr>
<td>ME 4525</td>
<td>Naval Ship Shock</td>
<td>1</td>
<td>6*</td>
<td>100%</td>
</tr>
<tr>
<td>ME 4550</td>
<td>Random Vib. &amp; Spectral Analy.</td>
<td>0</td>
<td>0</td>
<td>100%</td>
</tr>
<tr>
<td>ME 4612</td>
<td>Adv. Mechanics of Solids</td>
<td>1</td>
<td>15*</td>
<td>100%</td>
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<tr>
<td>ME 4613</td>
<td>Finite Element Methods</td>
<td>1</td>
<td>24*</td>
<td>100%</td>
</tr>
<tr>
<td>ME 4620</td>
<td>Theory of Continuous Media</td>
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<td>0</td>
<td>100%</td>
</tr>
<tr>
<td>ME 4731</td>
<td>Engng. Design Optimization</td>
<td>1</td>
<td>24*</td>
<td>100%</td>
</tr>
<tr>
<td>ME 4811</td>
<td>Multivariable Contr. Ship System</td>
<td>1</td>
<td>9</td>
<td>75% 25%</td>
</tr>
<tr>
<td>ME 4812</td>
<td>Fluid Power Control</td>
<td>0</td>
<td>0</td>
<td>75% 25%</td>
</tr>
<tr>
<td>ME 4821</td>
<td>Advanced Dynamics</td>
<td>1</td>
<td>5</td>
<td>75% 25%</td>
</tr>
<tr>
<td>ME 4823</td>
<td>Dynamics of Marine Vehicles</td>
<td>1</td>
<td>11</td>
<td>100%</td>
</tr>
<tr>
<td>ME 4825</td>
<td>Marine Propulsion Control</td>
<td>0</td>
<td>0</td>
<td>75% 25%</td>
</tr>
<tr>
<td>ME 4902</td>
<td>Adv. Study in Mech. Engng</td>
<td>5</td>
<td>1</td>
<td>100%</td>
</tr>
<tr>
<td>MS 2201</td>
<td>Intro. Mater. Science &amp; Engng</td>
<td>2</td>
<td>13</td>
<td>75% 25%</td>
</tr>
</tbody>
</table>

1. Enter the appropriate percent for each type of class for each course (e.g., 75% lecture, 25% recitation). This percentage is based on credit hours.

* Includes distance learning students
### Table 2. Course and Section Size Summary (cont.)
(Master of Science in Mechanical Engineering)

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Title</th>
<th>No. of Sections offered in Current Year</th>
<th>Avg. Section Enrollment</th>
<th>Type of Class (1)</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lecture</td>
</tr>
<tr>
<td>MS 3202</td>
<td>Failure of Engng Materials</td>
<td>2</td>
<td>7</td>
<td>75%</td>
</tr>
<tr>
<td>MS 3214</td>
<td>Intermediate Mat. Sci. &amp; Engng</td>
<td>0</td>
<td>0</td>
<td>100%</td>
</tr>
<tr>
<td>MS 3304</td>
<td>Corrosion</td>
<td>1</td>
<td>8</td>
<td>75%</td>
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<tr>
<td>MS 3606</td>
<td>Welding and Joining Metallurgy</td>
<td>1</td>
<td>10</td>
<td>75%</td>
</tr>
<tr>
<td>MS 4215</td>
<td>Phase Transformation</td>
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<td>75%</td>
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<tr>
<td>MS 4312</td>
<td>Characterization of Adv. Mater.</td>
<td>1</td>
<td>0</td>
<td>75%</td>
</tr>
<tr>
<td>MS 4811</td>
<td>Mech. Behavior Engng Material</td>
<td>1</td>
<td>8</td>
<td>100%</td>
</tr>
<tr>
<td>MS 4822</td>
<td>Composite Materials</td>
<td>1</td>
<td>6</td>
<td>100%</td>
</tr>
<tr>
<td>MS 4902</td>
<td>Special Topics in Mater. Science</td>
<td>0</td>
<td>0</td>
<td>100%</td>
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<tr>
<td>TS 3000</td>
<td>Electrical Power Engineering</td>
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<td>11</td>
<td>75%</td>
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<tr>
<td>TS 3001</td>
<td>Naval Architecture</td>
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<td>21</td>
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<tr>
<td>TS 3002</td>
<td>Adv. Study in Mech. Engng</td>
<td>1</td>
<td>8</td>
<td>75%</td>
</tr>
<tr>
<td>TS 3003</td>
<td>Naval Combat System Elements</td>
<td>2</td>
<td>11</td>
<td>75%</td>
</tr>
</tbody>
</table>

1. Enter the appropriate percent for each type of class for each course (e.g., 75% lecture, 25% recitation). This percentage is based on credit hours.
Table 2. Course and Section Size Summary (cont.)
(Master of Science in Mechanical Engineering)

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Title</th>
<th>No. of Sections offered in Current Year</th>
<th>Avg. Section Enrollment</th>
<th>Type of Class (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td>Lecture</td>
</tr>
<tr>
<td>TS 4000</td>
<td>Naval Combat System Engng</td>
<td>2</td>
<td>11</td>
<td>75%</td>
</tr>
<tr>
<td>TS 4001</td>
<td>Integration Naval Engng. System</td>
<td>1</td>
<td>9</td>
<td>75%</td>
</tr>
<tr>
<td>TS 4002</td>
<td>Ship Design Integration</td>
<td>1</td>
<td>8</td>
<td>50%</td>
</tr>
<tr>
<td>TS 4003</td>
<td>Total Ship Systems Engineering</td>
<td>1</td>
<td>5</td>
<td>50%</td>
</tr>
</tbody>
</table>

1. Enter the appropriate percent for each type of class for each course (e.g., 75% lecture, 25% recitation). This percentage is based on credit hours.
## Table 3. Faculty Workload Summary for Fiscal Year 2007
(Mechanical Engineering)

<table>
<thead>
<tr>
<th>Faculty Member (Name)</th>
<th>Classes Taught (Course No./Credit Hrs.) Quarter in the 07 year</th>
<th>Total Activity Distribution$^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Teaching</td>
</tr>
<tr>
<td>Brig Agrawal</td>
<td>Win :AE 3870(3-2); Sp: AE3811(3-2);AE 4816 (4-1) Sum: AE4871(3-2)</td>
<td>45%</td>
</tr>
<tr>
<td>Chris Brophy</td>
<td>Fall:ME4704(3-2);Sp: ME4902(4-0);Sum:AE4459(4-1)</td>
<td>30%</td>
</tr>
<tr>
<td>M.R. Driels</td>
<td>Fall: ME2801(3-2); Sp: ME4700(4-0)</td>
<td>25%</td>
</tr>
<tr>
<td>I. Dutta</td>
<td>Fall: MS4811(4-0), MS3202(3-2); Win: MS2201 Sp: MS3304(3-2)</td>
<td>50%</td>
</tr>
<tr>
<td>A. Gopinath</td>
<td>Leave of Absence</td>
<td>0%</td>
</tr>
<tr>
<td>J. Gordis</td>
<td>Win: ME3521(3-2); Sp: ME4731/DL (4-0); Su: ME4522(4-0)</td>
<td>45%</td>
</tr>
<tr>
<td>A. Healey</td>
<td>Win: ME4823(4-0)</td>
<td>10%</td>
</tr>
<tr>
<td>Garth Hobson</td>
<td>Fall:ME3450(3-2)Win:ME3240(4-2) Sum:ME3240(4-2)</td>
<td>30%</td>
</tr>
<tr>
<td>Isaac Kaminer</td>
<td>Fall:ME4811(3-2);Sp:ME4821(3-2) ME4002(4-0)</td>
<td>30%</td>
</tr>
<tr>
<td>Y. Kwon</td>
<td>Fall:ME4613(4-0)/DL;Win:ME2601(4-1) Sum:ME3611(4-0)</td>
<td>30%</td>
</tr>
<tr>
<td>T. McNelley</td>
<td>Fall:MS3606(3-2);Sp:MS3202(3-2), Sum:MS4215(3-2), MS2201(3-2)</td>
<td>50%</td>
</tr>
<tr>
<td>K. Millsaps</td>
<td>Sum: ME4161(4-0)/DL</td>
<td>20%</td>
</tr>
<tr>
<td>F. Papoulias</td>
<td>Fall: TS4003(2-4) Win: TS3001(3-2) Sp:TS4001(3-2) Sum:TS4002(2-4)</td>
<td>50%</td>
</tr>
<tr>
<td>Marcello Romano</td>
<td>Fall: AE3818(3-2) AE3820(3-2) Sp: AE3815(3-2)</td>
<td>30%</td>
</tr>
<tr>
<td>Student</td>
<td>FT</td>
<td>Fall Courses</td>
</tr>
<tr>
<td>------------</td>
<td>----</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>Isaac M. Ross</td>
<td>FT</td>
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### Table I-4. Faculty Analysis

Master of Science in Mechanical Engineering

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<tr>
<th>Name</th>
<th>Rank</th>
<th>FT or PT</th>
<th>Highest Degree</th>
<th>Institution from which Highest Degree Earned &amp; Year</th>
<th>Years of Experience</th>
<th>Total Faculty</th>
<th>This Institution</th>
<th>State in which Registered</th>
<th>Level of Activity</th>
<th>Professional Society (Indicate Society)</th>
<th>Research</th>
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<td>Brig Agrawal</td>
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<td>Christopher M. Brophy</td>
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Instructions: Complete table for each member of the faculty of the program. Use additional sheets if necessary. Updated information is to be provided at the time of the visit. The level of activity should reflect an average over the current year (year prior to visit) plus the two previous years.
### Table I-5. Support Expenditures

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Appendix I-B

Course Syllabi

This Appendix contains abbreviated course syllabi. The following two tables summarize the results of this Appendix with regards to course mapping to the professional component and program outcomes.
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**Total:** 30 37 25 38 13
AE2440    INTRODUCTION TO DIGITAL COMPUTATION
( 3 - 2 )

Required or Elective Required (Astronautical Program)

Course (Catalog) Description
Introduction to system operations and program development on the department UNIX workstations and the NPS computer facilities. High-level programming languages, including C, MATLAB, and FORTRAN. Development of computer programs, subroutine organization, input and output. Applications of programming techniques to the solution of selected problems in engineering.

Prerequisites and Co-requisites
MA 1115.

Textbook(s) and/or other Required Material

Course Objectives
The course teaches students how to: use the MATLAB and Simulink development environment effectively for writing professional-level scripts, solving applied engineering problems, developing and running models of Naval engineering systems; choose wisely and apply correctly different numerical methods; analyze limitations, advantages, and disadvantages of the chosen numerical method; and use interactive and graphical capabilities of MATLAB and Simulink to make user-developed models universal and easy-to-understand (analyze).

Topics Covered
1. Introduction to MATLAB/Simulink - Technical Computing Language
2. MATLAB's Development Environment and Basic Operations
3. Arrays and Array Operations
4. Data Structures, Types of Files, Managing Input/Output Data
5. Programming with MATLAB and Debugging Tools
6. Two- and Three-Dimensional Plotting and Animation
7. Accuracy of Digital Computations
8. Matrix Algebra and Eigenvalue Problems
9. Root Finding and Optimization
10. Curve Fitting to Measured Data
11. Numerical Differentiation
12. Numerical Integration
13. MATLAB's Symbolic Math Toolbox
14. Initial-Value Problem
15. Simulink Basics
16. Introduction to Mathematical Modeling of System's Dynamics

Class/Laboratory Schedule
This course meets 3 times per week for lectures of 50 minutes with additional 2 times per week for laboratory. The course is also available on-line (students usually use its ‘blackboard’ version to work on numerous interactive media elements).

**Contribution of Course to Meeting the Professional Component**

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* Midterm and final projects are assigned to students to find a real world engineering problem in the military application (spacecraft, satellites, aircraft, UAVs, armored vehicles) related to the course contents, and to present the simplified solution and discussion of the solution in a written report.

**Prepared by**

Oleg A. Yakimenko
AE3804 Thermal Control of Spacecraft  
( 3-0 )

**Required or Elective:** Required (Astronautical Program)

**Course (Catalog) Description:**
Conduction, radiation, thermal analysis, isothermal space radiator, lumped parameter analytical modeling, Spacecraft passive and active thermal control design, heat pipes, and louvers.

**Prerequisites and Co-requisites:** None

**Textbook(s) and/or other Required Material:**
2. Instructors Handouts/notes

**Course Objectives:**
To introduce the students to the fundamental concepts and basic principles of heat transfer relevant to the spacecraft environment and thermal control. To provide “building blocks” for thermal analysis/design of spacecraft.

**Topics Covered:**
1. Conduction and radiation heat transfer modes.
2. Thermal analysis of spacecraft devices and processes including isothermal space radiators.
3. The use of lumped parameter analytic models.
4. Spacecraft passive and active thermal control.
5. Heat pipes and louvers.
6. Thermal design and testing.

**Class/Laboratory Schedule:**
This course meets 3 times per week for lectures of 50 minutes.
**Contribution of Course to Meeting the Professional Component**

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**Prepared by**

John R. Lloyd
February 23, 2007
ME0952 SPECIAL TOPICS IN MECHANICAL ENGINEERING (1-0)

Required or Elective Required

Course (Catalog) Description
This course provides students with essential computer knowledge and topics of current research interest in mechanical engineering and materials science. PREREQUISITES: None. This is a Pass/Fail course required to all students in the curriculum.

Prerequisites and Co-requisites
None

Textbook(s) and/or other Required Material
None

Course Objectives
This is a seminar course where students are exposed to current topics of interests in both military and mechanical engineering subjects.

Topics Covered
N/A

Class/Laboratory Schedule
This course meets once per week for lectures and seminars, typically of 50 minutes, but some events can be up to 2 hours.
Contribution of Course to Meeting the Professional Component

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* In this course students listen and interact with speakers.
** Most of the topics treated are both technical and related to national security.

Prepared by
Knox Millsaps
ME 1000 Preparation for Professional Engineers Registration (3-0)

**Required or Elective**  Elective

**Course (Catalog) Description**
The course will cover the topics from the 8-hour Professional Examination given by the State of California for Professional Engineer. Discussion will involve applicable engineering techniques, including design and analysis of mechanical systems and components. Graded on Pass/Fail basis. Course may be taken as an overload only.

**Prerequisites and Co-requisites**
Consent of instructor.

**Textbook(s) and/or other Required Material**


**Course Objectives**
(1) The student will understand the Professional Engineer (PE) licensing process (in particular the application process), the use of a PE license, transferability of the PE from California to other states, and its application to a military career.
(2) Within the guidelines of required experience to pursue a PE license, the student will understand the content of the Engineer In Training / Fundamental Engineering exam and its application process.
(3) The student will become familiar with the types of questions that will appear on the PE exam, the reference materials allowed to take the exam, and the conduct of the PE exam itself. The student will work multiple examples of each category of exam question in preparation to take the PE exam.

**Topics Covered**
(1) Fundamental mathematics required for answering Mechanical Engineering questions of the caliber found on the PE exam.
(2) Fluid Mechanics
(3) Thermodynamics
(4) Power Cycles
(5) Heat Transfer
(6) HVAC
(7) Machine Design
(8) Dynamics & Vibrations
(9) Control Systems
(10) Plant Engineering
(11) Engineering Economics
(12) Law & Ethics
Class/Laboratory Schedule
This course meets 3 times per week for lectures of 50 minutes. Majority of the classes will be student led, focusing on problem solving.

Contribution of Course to Meeting the Professional Component

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Prepared by
Matthew D. Kelleher
ME2101 Engineering Thermodynamics  
(4-2)

Required or Elective  Required

Course (Catalog) Description

Prerequisites and Co-requisites: MA1118

Textbook(s) and/or other Required Material

Course Objectives
For the student to obtain a fundamental understanding of the concepts, definitions and laws of thermodynamics. To apply this knowledge to be capable of analyzing and designing practical energy conversion devices, such as power plants and refrigeration systems.

Topics Covered

Class/Laboratory Schedule
This course generally meets 4 times per week for lectures of 50 minutes and once a week for 1 hour and 50 minutes. This longer, double period is typically used for problem working sessions, a power plant tour or a quiz.
## Contribution of Course to Meeting the Professional Component

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**Prepared by**

John R. Lloyd
February 23, 2007
ME2201  INTRODUCTION TO FLUID MECHANICS  
( 3 - 2 )

Required or Elective  Required

Course (Catalog) Description

Prerequisites and Co-requisites
ME2503

Textbook(s) and/or other Required Material

Course Objectives
Obtain a deep understanding of fundamental fluid mechanics principles. This will be achieved through a physical and insightful study of fluid properties, fluid flow concepts, and their governing equations and solutions. The course will prepare the students for the follow-on courses such as ME 3201, ME 3150, ME 4220 and such in the Fluid and Thermal Propulsion track. Students completing the course will acquire sufficient basic fluid mechanics knowledge to solve many simple, but practical engineering fluid mechanics problems.

Topics Covered
1. Review of basic concepts and fluid properties.
2. Fluid statics, concept of pressure, hydrostatic pressure distribution, application to manometry and forces on submerged surfaces.
4. The control volume, system, Reynolds transport theorem, conservation of mass, momentum and energy in integral form.
5. Frictionless flow, Bernoulli theorem and equation.
6. Dimensional analysis, principle of dimensional homogeneity, Buckingham π-theorem, principle of similarity.
7. Reynolds number, regimes of flow, internal and external flows, flow in a circular pipe and the Moody diagram.
8. Pipe flow problems, non-circular ducts, hydraulic diameter, losses in piping systems.
9. The boundary layer, momentum integral solutions.
10. Types of drag, drag of immersed bodies, flow past a specific shapes and drag on ships.

Class/Laboratory Schedule
This course meets 5 times per week for lectures of 50 minutes.
Contribution of Course to Meeting the Professional Component

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Prepared by
Muguru S. Chandrasekhara
ME2501: STATICS (3 – 0)

**Required or Elective** Required

**Course (Catalog) Description**
Forces and moments, particles and rigid bodies in equilibrium. Simple structures, friction, first moments and centroids.

**Prerequisites and Co-requisites**
MA1116 (may be taken concurrently)

**Textbook(s) and/or other Required Material**
Text: STATICS by J. L. Meriam, Wiley

**Course Objectives**
Students are expected building a foundation of analytical capability for the solution of a variety of engineering problems. The primary purpose is to develop capacity to predict the effects of force and motion in the course of carrying out the creative design function of engineering. In the process, certain concepts and definitions should be understood at the outset; space, time, mass, force, particle and rigid body. Students completing this course will have understanding how to apply forces/moment to simple structures in equilibrium.

**Topics Covered**
1. Introduction to basic concepts, scalars and vectors, Newton’s laws, and units (mass, length & time).
2. Force System: 2-D/3-D force system, rectangular components, moment/couple, resultants
3. Equilibrium: equilibrium in 2-D/3-D, and equilibrium conditions
4. Structures: plane trusses, method of joints, method of sections, space trusses, frames and machines
5. Distributed Forces: center of mass, centroids, composite bodies, beams, flexible cables, fluid statics.
6. Frictional Phenomena: types of friction, and dry friction
7. Application of Friction in Machines: wedges, screws, journal bearings, thrust bearings, flexible belts, rolling resistance

**Class/Laboratory Schedule**
No lab required.
**Contribution of Course to Meeting the Professional Component**

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*Prepared by*

Young S. Shin
ME2502: DYNAMICS (4 – 1)

Required or Elective Required

Course (Catalog) Description
Kinematics and kinetics of particles and rigid bodies. Rectilinear, plane curvilinear and space curvilinear motion. Newton’s laws, work and energy, impulse and momentum and impact. Plane motion of rigid bodies and introduction to gyroscopic motion.

Prerequisites and Co-requisites
ME2501

Textbook(s) and/or other Required Material
Text: DYNAMICS by J. L. Meriam, Wiley

Course Objectives
Students are expected building a foundation of analytical capability for the solution of a variety of engineering problems. The primary purpose is to develop capacity to predict the effects of force and motion in the course of carrying out the creative design function of engineering. In the process, kinematics of particles and kinetics of particles, and kinetics of systems of particles are expected to understand. In addition, students will be fully exposed to plane kinematics and plane kinetics of rigid bodies, and 3-D dynamics of rigid bodies.

Topics Covered
1. Kinematics of Particles: rectilinear motion, plane curvilinear motion, rectangular/cylindrical/polar coordinates, space curvilinear motion, relative motion
2. Kinetics of Particles: Newton’s 2nd law, equation of motion, rectilinear/curvilinear motion, work and kinetic energy, potential energy, impulse and momentum, conservation of momentum
3. Kinetics of Systems of Particles: steady mass flow and variable mass flow
4. Plane Kinematics of Rigid Bodies: rotation, absolute motion, relative velocity, relative acceleration, motion relative to rotating axes
5. Plane Kinetics of Rigid Bodies: general equations of motion, translation, fixed-axis rotation, general plane motion, work-energy relation, virtual work, impulse-momentum equation
6. 3-D dynamics of Rigid Bodies: Translation, fixed-axis rotation, parallel-plane motion, rotation about a fixed point, angular momentum, kinetic energy, momentum and energy equations of motion, parallel-plane motion, gyroscopic motion

Class/Laboratory Schedule
One hour per week problem solving session.
## Contribution of Course to Meeting the Professional Component

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Prepared by
Young S. Shin
ME2601 MECHANICS OF SOLIDS I
(3 - 2)

Required or Elective Required

Course (Catalog) Description
Stress-strain. Plane stress and plane strain, principal stresses, maximum shear stress, thermal stress, Mohr’s circle, axial loading, indeterminate members, pressure vessels, elastic torsion, indeterminate torsion, shear moment diagram, elastic bending, beam deflection, combined loading, theory of failure. Supporting laboratory work.

Prerequisites and Co-requisites
MA 1118 and ME2501 or ME2503

Textbook(s) and/or other Required Material

Course Objectives
Students are expected to understand the basic action-displacement relationships, and the basic stress distribution relationships for linear mechanical elements (bars, shafts, beams) subjected to various actions (forces and moments). Inherent in this understanding is an understanding of basic stress-strain relationships for linear elastic materials. Students completing this course will have the rudiments of how to apply this understanding to the design of those elements.

Topics Covered
1. Introduction to and definition of stress and strain, elasticity and plasticity, and Hooke’s law. Allowable stresses and factors of safety are introduced for purposes of design
2. Axially load members. Displacements of axially loaded members. Analysis of statically indeterminate members including temperature effects and pre-strain.

Class/Laboratory Schedule
This course meets 5 times per week for lectures of 50 minutes.
Contribution of Course to Meeting the Professional Component

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Prepared by
Young W. Kwon
ME3150 Heat Transfer
(4-1)

Required or Elective: Required (may be waived based on individual circumstances)

Course (Catalog) Description:

Prerequisites and Co-requisites: ME 2101, ME 2201, MA 3132 (may be taken concurrently).

Textbook(s) and/or other Required Material:

Course Objectives:
To introduce the fundamental modes of heat transfer: conduction, convection and radiation. To provide analytical and numerical tools to analyze the basic mechanisms of heat transfer. To apply the basic knowledge of the fundamentals to the design of heat transfer equipment and processes.

Topics Covered:
1. Introduction to definitions of fundamental modes of heat transfer
2. Equation of conservation of energy
3. One dimensional steady conduction heat transfer
4. Two dimensional steady conduction heat transfer
5. Transient conduction heat transfer
6. Introduction to convection heat transfer
7. Conservation laws of mass, momentum, and energy
8. External flow convection heat transfer
9. Internal flow convection heat transfer
10. Natural convection heat transfer
11. Boiling and convection heat transfer
12. Fundamentals of thermal radiation heat transfer
13. Thermal radiation heat transfer between surfaces
14. Heat exchanger analysis

Class/Laboratory Schedule:
This course meets 4 times per week for lectures of 50 minutes and once a week for 1 hour for problem working, or a quiz.
Contribution of Course to Meeting the Professional Component

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Prepared by
John R. Lloyd
February 23, 2007
ME3201       APPLIED FLUID MECHANICS
             (4 - 1)

Required or Elective  Required (may be waived based on individual circumstances)

Course (Catalog) Description

Prerequisites and Co-requisites
ME2101, ME2201, MA3132 (may be taken concurrently)

Textbook(s) and/or other Required Material

Course Objectives
This is a graduate level fluids course. With its ability to quantitatively describe such diverse engineering applications, the primary goals of this course are 1) to provide the students with a fundamental understanding of the concepts and 2) to enable them to solve practical problems from first principles. It is also a prerequisite for ME 3150, ME 4220 and such in the Fluid and Thermal Propulsion track. Upon successful completion of the course, the students will be able to simplify the basic governing equations to solve specific problems by identifying and applying appropriate boundary conditions to solve the resulting differential equations. separate the viscous and inviscid regions of the flow to apply suitable solution methods, use the boundary layer solutions for a practical problem to derive a reasonable estimate of the viscous drag and solve one-dimensional gas dynamics problems.

Topics Covered
1. Derivation of the differential equations of motion (mass, momentum (Navier-Stokes) and energy), example problems.
2. Ideal fluid (inviscid) flow, singularities, rotational and irrotational flows, Principle of superposition, potential flow past closed bodies, example problems
4. Laminar and turbulent boundary layers, Reynolds averaging, external flows, example problems
5. Speed of sound, one-dimensional compressible fluid flow, isentropic flow relations, shock waves, Prandtl-Meyer flow, Flows with friction-Fanno flow, Frictionless flow with heat transfer-Rayleigh flow, choking, example problems.

Class/Laboratory Schedule
This course meets 5 times per week for lectures of 50 minutes.
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Prepared by
Muguru S. Chandrasekhar
ME3410  MISSILE AERODYNAMICS  (2-4)

Required or Elective  Elective (Not currently offered)

Course (Catalog) Description

Prerequisites and Co-requisites
ME3601, ME2801, ME3150, ME3521

Textbook(s) and/or other Required Material

Course Objectives
Students are expected to gain a fundamental understanding of the principles of measurements, and the process for specifying requirements, designing, and utilizing basic and advanced measurements techniques. Students completing this course are expected to be able to understand how to create and use experimental data, and understand the value and limitations of measurements, and be able to quantify uncertainty, and present data in written laboratory reports.

Topics Covered
1. Review of statistics, including central measures and variability.
2. Use of statistics to determine confidence intervals, and measurement uncertainty.
3. Standards
4. Physical principles of measurements and transducer theory.
5. Amplifiers, filters, and digitizers.
7. Thermal and fluid measurements.
8. Solids and structure measurement applications.
9. Optical measurements.
10. GPS and navigation theory.

Class/Laboratory Schedule
This course meets 2 times per week for lectures of 50 minutes and once a week for 2 hours for laboratory work.
Contribution of Course to Meeting the Professional Component

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* Students are required to create a preliminary design of a measurement system.  
** Students are required to write laboratory reports.

Prepared by  
Knox Millsaps
ME3450  Computational Methods in Mechanical Engineering  
(3 - 2)

**Required or Elective**  Required (may be waived based on individual circumstances)

**Course (Catalog) Description**
The course introduces students to the basic methods of numerical modeling for typical physical problems encountered in solid mechanics and the thermal/fluid sciences. Problems that can be solved analytically will be chosen initially and solutions will be obtained by appropriate discrete methods. Basic concepts in numerical methods, such as convergence, stability and accuracy, will be introduced. Various computational tools will then be applied to more complex problems, with emphasis on finite element and finite difference methods, finite volume techniques, boundary element methods and gridless Lagrangian methods. Methods of modeling convective non-linearities, such as upwind differencing and the Simpler method, will be introduced. Discussion and structural mechanics, internal and external fluid flows, and conduction and convection heat transfer. Steady state, transient and eigenvalue problems will be addressed.

**Prerequisites and Co-requisites**
ME3150, ME3201, ME3601.

**Textbook(s) and/or other Required Material**

**Course Objectives**
The course will progress along roughly two parallel paths. On the one hand, students will first briefly go over the underlying governing equations of structural analysis and fluid flow, followed by a detailed development of the finite element and finite volume methods and their application to these equations. And on the other hand, they will also simultaneously get hands-on experience in the computer lab by working with a typical commercially available FEM and CFD package. One of the goals of the course is to synthesize these two approaches.

**Topics Covered**
2. Finite Element/Variational Methods. Lab on the MATLAB Finite Element Toolbox
3. Truss Analysis. Patran and Nastran Laboratory 1
4. FEM of BVM Problems. Patran and Nastran Laboratory 2
5. FEM of Elliptic Partial Differential Equations. First Quiz
7. Finite Volume Methods for Convection-Diffusion Problems. CFD-ACE Laboratory 1
8. Numerical Diffusion & Higher Order Schemes Second Quiz
9. Source Term Linearization. CFD-ACE Laboratory 2
Class/Laboratory Schedule
This course meets 3 times per week for lectures of 50 minutes and once for a 2-hour lab.

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Prepared by
Garth V. Hobson
ME3521  MECHANICAL VIBRATIONS
(3 - 2)

Required or Elective  Required (may be waived based on individual circumstances)

Course (Catalog) Description

Prerequisites and Co-requisites
ME2503, ME3601; MA2121 or equivalent (may be taken concurrently)

Textbook(s) and/or other Required Material

Course Objectives
(1) Modeling of simple mechanical and structural systems: The class emphasizes the modeling of mechanical and structural systems as simple single and multi-degree of freedom systems. Discussed are real world examples where complex systems exhibiting undesirable vibration characteristics are modeled and analyzed as low dimensional systems. Students are presented with techniques for modeling simple single and multi-degree of freedom systems. Newtonian and analytic (Lagrangian) methods for deriving the governing differential equations of motion are covered. Linear and nonlinear systems and equations are contrasted.
(2) Solution of governing differential equations: General methods for obtaining the solution to the various governing differential equations are presented. The physics of vibration is discussed with respect to these solutions. The relationship of vibration theory to linear system theory and control theory is discussed.
(3) Applications: Various real world applications of the theory are examined, including the critical speed of rotating shafts, vibration isolation, measurement of vibration (transducer theory), frequency response analysis. Various examples from civil, structural, mechanical, naval, and aerospace engineering are discussed.

Topics Covered
1. Undamped free vibration, basic definitions, Differential equation description and solution
2. Single degree-of-freedom systems - simple harmonic oscillator/motion
3. Distributed systems - Rayleigh’s method for frequency estimation
4. Vector analysis of motion- velocity, acceleration in moving reference frame, linear vs. nonlinear systems/equations, stable vs. unstable systems
5. Damped free vibration - viscous damping, basic definitions, Single degree-of-freedom systems
6. Damped Forced Vibration, General periodic excitation, Solution to differential equation, Rotating shafts, critical speeds, Frequency response
7. Applications, Absolute vs. relative generalized coordinates, vibration isolation, transducer theory, velocimeter, accelerometer, load cells
8. Energy methods, kinetic and potential energies, Lagrange’s equation.
9. Multi-degree-of-freedom systems, matrix differential equations - basic linear algebra, eigenvalue problems, mode shapes, Orthogonality, modal decomposition

Class/Laboratory Schedule
This course meets 4 times per week for four lectures of 50 minutes, with several two-hour labs.

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Prepared by
Joshua H. Gordis
ME3611 MECHANICS OF SOLIDS II (4-0)

**Required or Elective**  Required (may be waived based on individual circumstances)

**Course (Catalog) Description**

**Prerequisites and Co-requisites**
ME2601

**Textbook(s) and/or other Required Material**

**Course Objectives**
It is the objective of this course to complete the introduction (with Mechanics of Solids I) to solid mechanics for all elementary structural elements. It is also the goal of the course to introduce students to advanced theories and methods of analysis in solid mechanics.

**Topics Covered**
1. Topics in beams: beam deflection, curved beam behavior, composite beam, non-symmetric beam, shear stress and shear center, statically indeterminate beam, energy method
2. Torsion of thin-walled members: open section, closed section, multiple sections
3. Axially load members: thick walled cylinders with internal and external pressure, compound cylinders
4. Beams on elastic foundation, infinite beams, semi-infinite beams, beams supported by equally spaced elastic elements, and application problems
5. Energy method: Catigliano’s theorem, statically indeterminate systems
   Elastic stability: critical load, Euler buckling, effects of boundary condition, eigenvalue problem

**Class/Laboratory Schedule**
This course meets 4 times per week for lectures of 50 minutes.
Contribution of Course to Meeting the Professional Component

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* A project was assigned to students to find a real world engineering problem in the military application related to the course contents, and to present the simplified solution and discussion of the solution in a written report.

Prepared by
Young W. Kwon
ME3711: DESIGN OF MACHINE ELEMENTS (4-1)

**Required or Elective**  Required (may be waived based on individual circumstances)

**Course (Catalog) Description**
Design of representative machine elements with consideration given to materials selection, tolerances, stress concentrations, fatigue, factor of safety, reliability, and maintainability. Typical elements to be designed include fasteners, columns, shafts, journal bearings, spur and helical gears, and clutches and brakes. In addition to traditional design using factor of safety against failure, particular emphasis is placed on design for specified reliability using probabilistic design methods.

**Prerequisites and Co-requisites**
ME2601

**Textbook(s) and/or other Required Material**

**Course Objectives**
The course objective Is to Introduce the students to the design process by sizing various ma components to meet specified design criteria. Students apply previously learned analysis techniques to the design of machine elements.

**Topics Covered**
1. Screws, fasteners and connections
2. Design for static strength-steady loading
3. Design for fatigue strength-variable loading
4. Design of shafts, axles, and spindles
5. Spur and helical gear design
6. Design of rolling-contact bearing
7. Design of journal bearing
8. Design of clutches and brakes
9. Welded joint design
10. Column design
11. Probabilistic concept of design and its applications
12. Factor of safety vs. probabilistic design

**Class and Laboratory Schedule**
Four one hour (50 minutes) lecture periods each week. One hour (50 minutes) problem session each week. Term project is also assigned to design naval reduction gear system which includes double helical pinion gear, shaft and journal bearing.

**Contribution of Course to Meeting Professional Component**
### Required Professional Components

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<td>(d) A major design experience incorporating engineering standards and realistic constraints including most of the following: economic, environmental, sustainability, manufacturability, ethical, health and safety, social, and political.</td>
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### Relationship of Course to Program Outcomes:

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<td>2. Ability to apply the tools of modern mechanical engineering practice</td>
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<td>3. Ability to apply knowledge acquired in academic study</td>
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<td>4. Ability to communicate effectively in oral and written form</td>
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<td>5. Ability to understand the broader societal impacts</td>
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Prepared by
Young S. Shin
ME 3712: Capstone Design (1-6)

Required or Elective  Required (may be waived based on individual circumstances)

Course (Catalog) Description
Design teams apply integrated and systematic design processes to real multifunctional and multidisciplinary problems in mechanical systems. Students develop process concepts, planning, design methodology, material selection, manufacturing and engineering analysis. Capstone design projects include projects provided by industry partners as well as DoD sponsors. The scope of design problems ranges across both engineering and non-engineering issues in the integrated design process.

Prerequisites and Co-requisites
ME2801, ME3150, ME3201, ME3450, ME3521, ME3711, MS3202, OS3104.

Reference Materials
Gerard Voland, “Engineering by Design,” Addison Wesley
Mark’s Mechanical Engineering Handbook

Course Objectives
1. To enable students to synthesize the knowledge and skills acquired in the context of a realistic design project.
2. To develop in students the ability to address a broad range of requirements, including most of the following: performance, economic, marketing, environmental, manufacturing, ethical, safety, social, and political issues.
3. To prepare for the professional design environment by learning how to learn, by working in teams, and by enhancing communications skills.

Topics Covered in Lecture
1. ENGINEERING DESIGN: What is “Engineering Design”? ; The Difference Between Design, Analysis, and Reproduction; Good Design vs. Bad Design
2. The Design Cycle: Define the Overall Objective; Gather Information; Choose a Design Strategy; Make a First Cut at the Design; Build, Document, and Test; Revise and Revise Again; Thoroughly Test the Finished Product
3. WORKING IN TEAMS: Teamwork Skills; Brainstorming; Documentation; Project Management
4. ENGINEERING DESIGN TOOLS; MATLAB, SOLID WORKS, ABAQUS, NASTRAN, ETC.
5. THE HUMAN-MACHINE INTERFACE: Ergonomics: Science of how the human interacts with machines (i.e. key board); Cognition: The way a user learns about the device and masters its features fast; Case Studies
6. ENGINEERS AND REAL WORLD; Society’s View of Engineering; How Engineers Learn from Mistakes; The Role of Failure in Engineering Design: Case Studies
7. LEARNING TO SPEAK, WRITE, AND MAKE PRESENTATION

Evaluation
1. Final Report and Presentation/Show.
2. Weekly/Regular Presentations/Deliverables.
3. Prototypes, where possible.

Course Outcomes
1. Students will be able to identify relevant topics from earlier courses, then apply them to their design project.
2. Students will be able to critically evaluate designs using engineering criteria and predictive usage.
3. Students will demonstrate an ability to identify and specify design requirements from general problem descriptions.
4. Students will be able to systematically develop a design from concept to prototype.
5. Students will be able to clearly communicate design ideas and information.
6. Students will be able to work collaboratively and responsibly as members of a team.
7. Students will demonstrate the ability to facilitate their learning by identifying design issues and questions that require additional investigation, and then formulating appropriate courses of action.

Example Design Project on Autonomous Underwater Vehicle (AUV)
1. Produce a concept level design for the next generation mine-hunting robot submarine.
   Background: The navy needs small smart submarines to perform autonomous mine-hunting missions in shallow water. These vehicles carry a side-scan sonar to produce images of the ocean bottom from which mines can be identified. Their sweep rates need to be fast enough to permit in stride mine hunting, and identification and classification. At the same time, the vehicles need to travel slow enough to produce high-resolution imagery.

2. Requirements: An autonomous submarine vehicle (with respect to power and control) that will have a range of 50 nmiles at a cruising speed of 3 knots, able to cruise at 3(+/-0.5) meters above the ocean bottom and record side scan sonar images out to a swath of 150m each side. The vehicle should be structurally capable of operating in up to 150m
of water depth. The vehicle should be self-navigating using inertial means with GPS correction when surfaced. Navigational accuracy should be within 0.1% of distance traveled.

The computer system should be capable of reading data from all onboard sensors and computing all required functions for the automatic control of speed heading, depth and or altitude above bottom. Failure detection means should be built in to protect against propeller failure, leaks, and low battery conditions.

Consideration shall be given to

1. Design of the propulsion system
2. Design of the energy storage system (high energy density batteries are preferred, but consideration to charging and replenishment is critical. Fuel cells may be an option)
3. Design of the hull form for minimal drag
4. Design of the control surfaces and their drive motors.
5. Modular mechanical design is preferred to accommodate a wide range of sensor payloads (Optical Back Scatter, CTD, Forward Look Sonar, Video Camera, Acoustic Camera), (Details of sensors can be provided)
6. Thermal Control inside the hull.
7. Design of the Electrical Power Distribution System
8. Transportation, Costs, and Lifetime Maintenance
9. Acoustic Modem Communications Link.

The following items would be nice to consider if time permits:
10. GPS, Radio Communications Antennas

**Contribution of Course to Meeting the Professional Component**

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Prepared by
Young S. Shin
ME3750  PLATFORM SURVIVABILITY  (4-0)

Required or Elective  Elective

Course (Catalog) Description
This course introduces the concepts and analytical tools used in designing and testing survivable combat platforms and weapon systems. The applications are to a broad range of platforms and weapons, including submarines, surface ships, fixed and rotary wing aircraft, cruise missiles, and satellites in a hostile (non-nuclear) environment. The technology for increasing survivability and the methodology for assessing the probability of surviving hostile environments are presented. Topics covered include: current and future threat descriptions; the mission/threat analysis; combat analysis of SEA, vulnerability reduction technology for the major systems and subsystems; susceptibility reduction concepts, including stealth; vulnerability, susceptibility, and survivability assessment; and trade-off methodology. PREREQUISITES: None.

Prerequisites and Co-requisites
None

Textbook(s) and/or other Required Material

Course Objectives
Students are expected to gain a fundamental understanding of the principles of platform survivability and be able to use this knowledge in improving system survivability and improve operations to limit losses due to hostile actions.

Topics Covered
1. Introduction to statistical analysis and methods.
2. Definitions of terminology of the kill chain.
3. Platform layout and systems interconnections.
4. Physical principles of detection, tracking and engagement.
5. Mechanics of damage and kill mechanisms.
6. Design of survivability.

Class/Laboratory Schedule
This course meets 4 times per week for lectures of 50 minutes and a separate computer laboratory period is used to perform calculations and have design discussions.
Contribution of Course to Meeting the Professional Component

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* This course teaches both design tools and process.

Prepared by
Knox Millsaps
ME3801  Autonomous Systems and Vehicle Control I

Required or Elective  Required (may be waived based on individual circumstances)

Course (Catalog) Description
The course will focus on the part of the classical control theory, which implies the frequency-domain analysis. This approach is still widely used and has many practical applications; analysis tools learned here will be used in your follow-on controls and dynamics courses. Modern control theory - state-space analysis working in the time domain - will also be introduced to provide a smooth transition between the two methods.

Prerequisites and Co-requisites
ME 2801

Textbook(s) and/or other Required Material
Text:

Course Objectives
Students are expected to understand and practice how to:
1. Develop a mathematical model and represent it using different frequency response methods;
2. Analyze stability and performance of any Naval engineering system in the frequency domain;
3. Design a feedback controller/compensator to meet the stability and performance requirements.

Students completing this course will have the fundamentals of how to apply these techniques to the analysis and design of control systems. Upon successful completion of this course, they will be able to:
1. Describe the behavior of a linear system by its time history response to various inputs or by a frequency-domain analysis (response to steady sinusoidal input);
2. Recognize the problems a naval engineering system might have in terms of accuracy, relative stability, speed of response;
3. Model simple systems by differential equations, block diagrams, and transfer functions;
4. Understand the basic principles of feedback stabilization via a frequency-domain analysis;
5. Produce a root-locus plot of a system in the complex plane, and examine its stability;
6. Analyze the frequency response of a system and construct a Bode diagram for a stability analysis;
7. Employ Nyquist stability theory and the concepts of gain and phase margin for a stability analysis;
8. Apply the concepts of lead, lag, and lag-lead compensation for stabilizing or improving the dynamics of a system and estimate the increase of system's performance;

Topics Covered
7. BODE DIAGRAM
   ▪ Bode Diagrams of Simple Transfer Functions
8. BODE ANALYSIS, STABILITY, AND GAIN AND PHASE MARGINS
   ▪ Conditional Stability
   ▪ Gain and Phase Margins in the Bode Diagram
   ▪ System Type and Steady-State Error from Bode Diagrams
   ▪ Further Discussion of Gain and Phase Margins

9. FREQUENCY RESPONSE AND NYQUIST DIAGRAMS
   ▪ Frequency Response
   ▪ Nyquist Diagrams from Transfer Functions

10. NYQUIST STABILITY CRITERION
    ▪ Conformal Mapping: Cauchy's Theorem
    ▪ Application to Stability
    ▪ Some Comments on Nyquist Stability
    ▪ Alternative Approach to Nyquist Stability Criterion

11. NYQUIST ANALYSIS AND RELATIVE STABILITY
    ▪ Conditional Stability
    ▪ Gain and Phase Margins

12. FREQUENCY-DOMAIN SPECIFICATIONS AND CLOSED-LOOP FREQUENCY RESPONSE
    ▪ Frequency-Domain Specifications
    ▪ Closed-Loop Frequency Response from Nyquist Diagram
    ▪ Closed-Loop Frequency Response from Bode Diagram
    ▪ Gain for a Desired $M_p$ from the Nyquist Diagram
    ▪ Gain For a Desired $M_p$ from the Nichols Chart
    ▪ Non-Unity-Feedback Gain Systems

13. PHASE LEAD COMPENSATION
    ▪ Multiple-Design Constraints
    ▪ Transfer Function of Phase Lead Element
    ▪ Phase Lead Compensation Process
    ▪ Comments on the Applicability and Results of Phase Lead Compensation

14. PHASE LAG AND LAG-LEAD COMPENSATION
    ▪ Transfer Function of Phase Lag Element
    ▪ Phase Lag Compensation Process
    ▪ Comments on Phase Lag Compensation
    ▪ Lag-lead Compensation
    ▪ Transfer Function of a Lag-lead Element
    ▪ Lag-lead Compensation Process

15. LOOP SHAPING
    ▪ Disturbance attenuation
    ▪ Reference following
    ▪ Noise reduction
    ▪ Sensitivity to plant uncertainty
    ▪ Actuator limits
    ▪ Loop shaping design examples
    ▪ Intrinsic limitations on achievable performance
10. INTRODUCTION TO STATE-SPACE DESIGN

- Advantages of state space
- Analysis of the state equations
- Block diagrams and canonical forms

Class/Laboratory Schedule
This course requires 3 Lecture hours and 2 Lab hours per week.

Contribution of Course to Meeting the Professional Component

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Prepared by
Vladimir N. Dobrokhodov
ME4101    ADVANCED THERMODYNAMICS     (4-0)

Required or Elective  Elective

Course (Catalog) Description
This course reviews elementary definitions, concepts and laws of thermodynamics and then extends these to cover general thermodynamics and advanced topics. The concepts of availability, exergy, irreversibility, and general equilibrium conditions in single and multi-component systems are presented. Ideal and non-ideal solutions and chemical potential are treated along with an introduction to statistical thermodynamics and non-equilibrium concepts such as Osager's reciprocal relations. PREREQUISITE: ME2101.

Prerequisites and Co-requisites
ME2101

Textbook(s) and/or other Required Material

References:

Course Objectives
Students are expected to gain a deeper understanding of thermodynamics and extend a students grasp on multi-component and reacting systems and general equilibrium, and well as the statistical foundations of macroscopic thermodynamic quantities. Students completing this course are expected to be able to calculate thermodynamics properties of complex mixtures, and be able to use general thermodynamic relationships to relate changes in properties. Students should also be able to analyze and design complex thermodynamics systems for engineering applications.

Topics Covered
1. Review of first and second laws of thermodynamics along with combined formulations – Gibbs Equations.
2. General thermodynamic relationships – Maxwell’s relationships.
3. Thermodynamic properties of mixtures of non-reacting systems.
4. Thermodynamics of chemically reacting systems.
5. General equilibrium conditions for systems – Gibbs and Helmholtz free energies.
6. Introduction to statistical thermodynamics.
7. Introduction to non-equilibrium thermodynamics – Onsager’s relations.

Class/Laboratory Schedule
This course meets 4 times per week for lectures of 50 minutes.
Contribution of Course to Meeting the Professional Component

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Prepared by
Knox Millsaps
ME4161  CONDUCTION HEAT TRANSFER  (4-0)

Required or Elective  Elective

Course (Catalog) Description
PREREQUISITE: ME3150.

Prerequisites and Co-requisites
ME3150

Textbook(s) and/or other Required Material
Texts:

Additional References:
4. Farlow, S. J., Partial Differential Equations for Scientist and Engineers, Dover. (A good introduction to PDEs at the undergraduate level.)
5. Generally, two or three Journal articles are provided as required reading.

Course Objectives
Students are expected to have a fundamental understanding of the physics and mathematics of steady and transient conduction problems. Students should be able to use standard analytical and computational methods to calculate temperature fields and heat fluxes in solids and stationary fluids. Students should also be able to analyze and design complex thermal systems typical of engineering applications involving both thermal and thermal induced stress considerations.

Topics Covered
2. Formulation of fundamental equations and boundary conditions for conduction problems.
3. Mathematical solutions to steady conduction in one, two and three dimensions in finite and unbounded regions in a variety of coordinate systems.
4. Mathematical solutions to transient conduction in one, two and three dimensions in finite and unbounded regions in a variety of coordinate systems.
5. Problems with short time or distance scales. Non–Fourier conductions.
6. Approximate and asymptotic solutions to linear and non-linear problems.
7. Engineering design applications: contact resistance, coupled thermal-stress problems, etc.

Class/Laboratory Schedule
This course meets 4 times per week for lectures of 50 minutes.
Contribution of Course to Meeting the Professional Component

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Prepared by
Knox Millsaps
ME4162 CONVECTION HEAT TRANSFER
(4-0)

**Required or Elective**  Elective

**Course (Catalog) Description**

**Prerequisites and Co-requisites**
Prerequisites: ME 3150, ME 3201, ME4220, or consent of instructor.

**Textbook(s) and/or other Required Material**

**Course Objectives**
This is a graduate level heat transfer course. The major objective of the course is to enable the students a deep physical understanding of the subject of Convective Heat Transfer through a physical and insightful study. It also prepares the students to solve practical convective heat transfer problems that involve a variety of boundary conditions and apply the knowledge to heat exchanger design. Various closed form and approximate solutions are taught so that the students can apply these to solve the multitude of open ended engineering problems in their work related situations. It is offered as a VTC course in the Distance Learning environment to the Navy Nuclear Reactors students from Washington, D.C. to participate and earn their graduate degrees.

**Topics Covered**
1. Review of basic concepts.
2. Derivation of governing equations.
3. Solutions of the governing equations for specific cases:
   a. Laminar internal flows: Momentum and heat transfer.
   b. Laminar external flows: Momentum and heat transfer.
4. Turbulent internal and external flows.
5. Natural convection.
6. Two phase flows: boiling, condensing flows.

**Class/Laboratory Schedule**
This course meets 2 times per week for lectures of 100 minutes.
Contribution of Course to Meeting the Professional Component

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Prepared by
Muguru S. Chandrasekhara
ME4163 Radiation Heat Transfer
( 4-0 )

Required or Elective: Elective

Course (Catalog) Description:

Prerequisites and Co-requisites: ME 3150

Textbook(s) and/or other Required Material:

Course Objectives:
The student will learn about:

- Basic concepts of electromagnetic radiation, the Planck distribution, definition of black body, concept of radiation intensity
- Directional and Spectral radiative properties of real surfaces and their predictions from electromagnetic theory
- View factors and grey, diffuse body heat transfer
- Radiative heat transfer between gray, diffuse surfaces under both diffuse & specular conditions
- Applications to solar collectors, radiation shields, and selective surfaces
- Radiative transfer in participating media including absorption, emission, and scattering
- Spectral radiative properties of molecular gases and the use of various band models in calculating heat transfer
- Radiative heat transfer in particulate media, with emphasis on small and large particle limits, as well as soot properties
- Radiative Transport Equation and its application in gray media
- Approximate methods for optically thick and thin gases
- Combined mode problems where conduction and/or convection are coupled to radiation
- Applications such as furnace gas heat transfer, IR thermometry, and IR signature reduction issues.

Topics Covered:
1. Fundamentals of thermal radiation
2. Radiative properties of real surfaces and their prediction from electromagnetic wave theory
3. View factors for diffuse surface exchange
4. Radiative exchange in enclosures of grey diffuse surfaces as well as specular surfaces
5. Radiation transport equation
6. Molecular gas radiation properties and processes
7. Radiative transport in particulate media
8. Exact solutions of the Radiative Transport Equation in 1-D media and comparison with total gas property approach
9. Combined mode heat transfer: Conduction and/or convection with radiation

Class/Laboratory Schedule:
This course meets 4 times per week for lectures of 50 minutes.

**Contribution of Course to Meeting the Professional Component**

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**Prepared by**
John R. Lloyd
February 23, 2007
ME4211    APPLIED HYDRODYNAMICS     (4-0)

Required or Elective   Elective

Course (Catalog) Description

Prerequisites and Co-requisites
ME3201

Textbook(s) and/or other Required Material

References:

Course Objectives
Students are expected to gain a fundamental understanding of the classical solutions and phenomena of potential flow and vortex methods. Various exact and approximate methods are provided as well as experimental data. Students completing this course are expected to be able to calculate the hydrodynamic coefficients and free surface flows associated with typical naval systems.

Topics Covered
1. Review of the fundamentals equations of fluid mechanics.
2. Potential flow calculations and pressure distributions for incompressible flow.
3. Classical solution methods of potential equations, including sources, sinks, distributed vortex, and image methods. Aerodynamics and hydrodynamics of bodies of revolution.
4. Free surface and stratified flow.
5. Vortex and panel methods.

Class/Laboratory Schedule
This course meets 4 times per week for lectures of 50 minutes.
Contribution of Course to Meeting the Professional Component

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Prepared by
Knox Millsaps
ME4220 ME4220 VISCOUS FLOW  
( 4 - 0 )

**Required or Elective**  Elective

**Course (Catalog) Description**

**Prerequisites and Co-requisites**
ME3201 and instructor's permission.

**Textbook(s) and/or other Required Material**

**Course Objectives**
This is a graduate level fluids course. The major objective of the course is to give the students a deep physical understanding of viscous flows through a physical and insightful study of viscous fluid flows, and solutions of their governing equations. It also prepares the students for the follow-on course on convective heat transfer. Upon completion of the course, the students will be able to see the order in and develop a “quantitative feel” for the chaos known as turbulence. Significant viscous fluid flow knowledge is imparted to enable the students to solve a multitude of open ended engineering fluid mechanics problems. It is offered as a VTC course in the Distance Learning environment to the Navy Nuclear Reactors students from Washington, D.C. to participate and earn their graduate degrees.

**Topics Covered**
1. Review of basic concepts.
2. Derivation of governing (continuity and Navier-Stokes) equations.
3. Solutions of Navier-Stokes equations for specific cases.
4. Laminar boundary layers: Derivations of Prandtl boundary layer equations, properties, Blasius solution, Falkner-Skan solution, approximate methods, flow separation and its control.
5. Instability, origins of turbulence, Orr-Sommerfeld equation.
6. Turbulent flows, Reynolds averaging, Closure problem, gradient transport, law of the wall and related topics on turbulent boundary layers, turbulent kinetic energy, energy spectrum.
7. Turbulent pipe and flat plate flows.
8. Turbulence modeling.
9. Separation and its control

**Class/Laboratory Schedule**
This course meets 2 times per week for lectures of 100 minutes.
Contribution of Course to Meeting the Professional Component

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Prepared by
Muguru S. Chandrasekhar
ME4225  Computational Fluid Dynamics and Heat transfer  
(3 - 2)

Required or Elective  Elective

Course (Catalog) Description
This course presents numerical solution of sets, of partial differential equations, that describe fluid flow and heat transfer. The governing equations for fluid dynamics are reviewed and turbulence modeling is introduced. Discretization techniques are applied to selected model equations and numerical methods are developed for inviscid and viscous, compressible and incompressible flows. Individual term projects include application of CFD to thesis research and to current military problems.

Prerequisites and Co-requisites
ME3201, ME3450, MA4243

Textbook(s) and/or other Required Material
Instructors Notes

Course Objectives
The emphasis will be on the numerical solution of sets, of partial differential equations, that describe fluid flow. The philosophy used throughout the course, is the construction and use of computer programs, leading to an understanding of the various algorithms

Topics Covered
INTRODUCTION
- Computational trends and historical perspective

GOVERNING EQUATIONS OF FLUID DYNAMICS (Inviscid)
SOLUTION OF THE STEADY ONE-DIMENSIONAL EULER EQUATIONS
- Implicit and Explicit schemes for the one-dimensional Euler equations
- Flux splitting and upwind differencing
- Implementation of boundary conditions

STEADY STATE SOLUTIONS OF THE TWO-DIMENSIONAL EULER EQUATIONS
- Explicit algorithms for the two-dimensional Euler equations
- Implicit methods for the solution of the Euler equations

NUMERICAL METHODS FOR THE NAVIER-STOKES EQUATIONS
- Tensors
- Reynolds equations for turbulent flow
- Introduction to turbulence modeling
- Turbulent flows, two-equation turbulence models
- Unsteady two-dimensional N-S calculations
- Selected topics (dependant on the selection of term projects)
. Advanced Topics – Turbulence models

Class/Laboratory Schedule
This course meets 3 times per week for lectures of 50 minutes and once for a 2-hour lab.
**Contribution of Course to Meeting the Professional Component**

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**Prepared by**
Garth V. Hobson
ME4240  ADVANCED TOPICS IN FLUID DYNAMICS   (4-0)

Required or Elective  Elective

Course (Catalog) Description
Topics selected in accordance with the current interests of the students and faculty. Examples include fluid-structure interactions, cable strumming, wave forces on structures, free-streamline analysis of jets, wakes, and cavities with emphasis on computational fluid dynamics. PREREQUISITES: ME4220 and ME4211.

Prerequisites and Co-requisites
ME4220 and ME4211

Textbook(s) and/or other Required Material
Text: Various.

Course Objectives
This is a second level graduate course that treats topics of mutual interest of the faculty and students.

Topics Covered
No fixed set of topics.

Class/Laboratory Schedule
This course meets 4 times per week for lectures of 50 minutes.
Contribution of Course to Meeting the Professional Component

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Prepared by
Knox Millsaps
ME4420  ADVANCED POWER AND PROPULSION  (4-0)

Required or Elective  Elective

Course (Catalog) Description
This course presents an advanced treatment of power and propulsion topics, primarily for naval applications. Thermodynamic analysis of simple, advanced and complex cycles, such as combined and augmented cycles (e.g., RACER and STIG) are presented along with new and direct energy conversion concepts. Design integration of single and multi-type (CODAG, CODOG, etc.) power and propulsion systems with vehicles. Engine installation considerations, including the design of auxiliary equipment and inlet/exhaust systems, are presented. Design and current research topics in fluid mechanics and rotordynamics of turbomachinery are presented. Repair, condition-based maintenance and machinery operation, including balancing techniques, are discussed. PREREQUISITE: ME3240.

Prerequisites and Co-requisites
ME3240

Textbook(s) and/or other Required Material
Texts:

Course Objectives
This course presents both advanced special topics in gas turbines and Diesel engines, along with design related topics, useful for understanding modern naval power and propulsion platforms and weapons. Students are expected to gain an advanced level understanding of the aerothermodynamics gas turbine components, such as inlets, compressors, combustors, turbines and exhausts. Design and integration of engines into naval platforms and weapon systems for power and propulsion is covered. Students are expected to demonstrate competence in preliminary design of warship power and propulsion, through a comprehensive design project.

Topics Covered
1. Review of the fundamentals of thermodynamic cycles.
2. Advanced gas turbine cycles, including intercooling, reheat, and regeneration.
3. Steam injected cycles.
4. Mission and platform requirements.
5. Analysis and design of inlets and exhausts.
6. Auxiliary systems.
7. Gears and shafting.
8. Propeller and propulsor systems

Class/Laboratory Schedule
This course meets 4 times per week for lectures of 50 minutes.
**Contribution of Course to Meeting the Professional Component**

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* This course requires a substantial preliminary design project.
** Oral presentations and written reports are required.
*** The process for creating and satisfying military requirements are treated and students must submit engineering design that satisfy the requirements.

**Prepared by**
Knox Millsaps
ME4522       FINITE ELEMENT METHODS IN STRUCTURAL DYNAMICS
(4 - 0)

Required or Elective               Elective

Course (Catalog) Description
This course provides an introduction to the principles and methods of computational structural dynamics and vibration analysis. Modern computational methods make use of the matrix structural models provided by finite element analysis. Therefore, this course provides an introduction to dynamic analysis using the finite element method, and introduces concepts and methods in the calculation of modal parameters, dynamic response via mode superposition, frequency response, model reduction, and structural synthesis techniques. Experimental modal identification techniques will be introduced.

Prerequisites and Co-requisites
ME3521

Textbook(s) and/or other Required Material

Course Objectives
(1) Finite Element Modeling for Structural Dynamics: Provide students with an introduction to computer-based modeling of structural dynamic systems. Such computer modeling is the way real world complex vibration problems are modeled, analyzed, and solved. Students learn the basic theory of the finite element method for structural dynamics, and each student writes his/her own simple finite element program for analyzing structural dynamics problems.

(2) Advanced Theory of Dynamics and Vibration: Provide students with an understanding of the mathematical theory of multi-degree of freedom systems. The underlying theory of linear systems, and the associated mathematical concepts in ordinary differential equations and linear algebra are presented in a manner that facilitates the use of these concepts to solve problems in structural dynamics. Several homeworks reinforce mathematical ideas discussed in class.

(3) Computational Techniques: Each student uses his/her finite element program written as part of the course requirements to solve simple but representative problems in structural dynamics, including the calculation of dynamic response, frequency response, and reduced order models.

Topics Covered
Review: Lagrange’s Equations, Derivation of Equations of Motion Coordinate Coupling.
Model reduction, Structural Synthesis Techniques: An Introduction

Class/Laboratory Schedule
This course meets 2 times per week for lectures of 1 hour 50 minutes.

Contribution of Course to Meeting the Professional Component

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Prepared by
Joshua H. Gordis
ME4525: NAVAL SHIP SHOCK DESIGN AND ANALYSIS (4-0)

Required or Elective  Elective

Course (Catalog) Description
Characteristics of underwater phenomena, including shock wave, bubble behavior and bubble pulse loading, and bulk cavitation. Surface ship/submarine bodily response to shock loading. Application of shock spectra to component design. Dynamic Design Analysis Method (DDAM) and applications to shipboard equipment design. Fluid-structure interaction (FSI) analysis, including Doubly Asymptotic Approximation and surface ship FSI. Current design requirements for shipboard equipment.

Prerequisites and Co-requisites
ME3521 or equivalent.

Textbook(s) and/or other Required Material
Text: Response of Marine Structure to Underwater Explosions by Y. S. Shin (Instructor’s Notes)
(2) A. H. Keil, “Introduction to Underwater Explosion Research”, UERD Report 19-56 (Confidential)

Course Objectives
The course objective is to provide full understanding of fundamentals of underwater explosions and their effects to the responses of surface ships and submarines.

Topics Covered
(1) Sequence of underwater explosion events and hydrodynamic relations
(2) Plane and spherical shock wave: air-water interface problem
(3) Shock wave parameters, bubble loading, scaling laws
(4) Taylor plate theory and its applications, bodily responses, shock spectra
(5) Fluid-structure interaction: doubly asymptotic approximation, hull cavitation
(6) Dynamic design analysis method and its application to shipboard equipment design
(7) Current design requirement for shipboard equipment design
(8) Ship/submarine vulnerability and survivability

Class and Laboratory Schedule
Two 2-hour (100 minutes) lecture periods each week.
Contribution of Course to Meeting Professional Component

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ME4550: RANDOM VIBRATION AND SPECTRAL ANALYSIS (3-2)

Required or Elective  Elective

Course (Catalog) Description

Engineering application of spectral analysis techniques to characterize system responses under a random vibration environment. The topics include: characteristics of physical random data and physical system responses, applications of probability concepts to random data and response analysis, correlations and spectral density functions, transmission of random vibration, and failure due to random vibration. The supporting labs are included. PREREQUISITE: ME3521 or equivalent.

Prerequisites and Co-requisites
ME3521 or equivalent

Text and References


Course Objectives

The course objective is to provide full understanding of random vibration and spectral analysis and their applications to engineering analysis and design.

Topics Covered

1. Introduction: Characteristics of Random Data
2. Physical System Response
3. Probability Functions
4. Correlations
5. Spectral Density Function
7. Frequency Response Function Measurements and Error Analysis
8. Single Input/Multiple Output Relationships
9. System Identification and Response Prediction
10. Identification of Propagation Paths and Velocities
11. Source Location and System Estimation
12. Multiple Input/Multiple Output Relationships
13. Procedures for Solving Multiple Input/Output Problems
14. Multiple Input/Output Applications
15. Identification of Energy Sources
16. Applications to Condition Monitoring

Class and Laboratory Schedule

Three one hour (50 minutes) lecture periods each week. Two hour (100 minutes)
laboratory session each week. 3~4 laboratory random vibration and spectral analysis experiments

**Contribution of Course to Meeting Professional Component**

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Prepared by
Young S. Shin
ME4611 ADVANCED MECHANICS OF SOLIDS (4-0)

Required or Elective    Elective

Course (Catalog) Description
Selected topics from advanced mechanics of materials and elasticity. Stress and strain tensors. Governing equations such as equations of equilibrium, constitutive equations, kinematic equations and compatibility equations. Two-dimensional elasticity problems in rectangular and polar coordinate systems. Airy stress function and semi-inverse technique. Energy methods with approximate solution techniques including Rayleigh-Ritz method. Buckling of imperfect columns. Introduction to plate and shell bending theory.

Prerequisites and Co-requisites
ME3611

Textbook(s) and/or other Required Material

Course Objectives
Students are expected to understand theory of elasticity, structural instability, energy methods, and plate bending as well as proper solution techniques. Students are also expected to understand the engineering modeling (or mathematical modeling) of real world solid/structure problems as well as various important factors to be considered in designing structures. Skill for literature review in the related subject is expected for students.

Topics Covered
1. Stress tensor, transformation of stresses and Mohr's circle in three-dimension, Stress invariant, deviatoric stresses, equations of equilibrium, principal stresses in three-dimension, octahedral plane, and traction boundary condition.
2. Strain tensor, kinematic equations for finite and infinitesimal strains, equations of compatibility, strain transformation, deviatoric strain, constitutive equations, strain energy, and Saint-Venant's principle.
3. Two-dimensional elasticity problems in Cartesian and polar coordinate systems, Airy stress function, semi-inverse technique to determine the solutions, stress concentration factors, and elasticity solutions for beam bending.
4. Energy methods including principle of virtual work and principle of minimum potential energy, trigonometric series solution technique, Rayleigh-Ritz method.
5. Buckling of Imperfect columns including initial curvature and eccentricity, and energy method for buckling analyses.
6. Introduction of plate bending theory, biharmonic governing equations, various boundary conditions, and Navier solution technique.

Class/Laboratory Schedule
This course meets 2 times per week for lectures of 100 minutes.
Contribution of Course to Meeting the Professional Component

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* Projects are assigned throughout the class so that students have to analyze the given problems and submit written reports.

Prepared by
Young W. Kwon
ME4613      FINITE ELEMENT METHODS
( 4-0 )

Required or Elective   Elective

Course (Catalog) Description
Introduction to the fundamental concepts of the finite element method. Weighted residual methods and weak formulation. Element discretization concept and shape functions. Generation of element matrices and vectors, and their assembly into the matrix equation. Application of boundary and initial conditions. Isoparametric elements and numerical integration techniques. Computer programming and application to engineering problems such as boundary value, initial value and eigenvalue problems.

Prerequisites and Co-requisites
ME3611, ME3450, or Consent of Instructor

Textbook(s) and/or other Required Material

Course Objectives
The student is expected to understand the basic formulation and programming structure of the finite element method. The fundamental concepts will be understood including weighted residual methods; piecewise continuous functions; shape functions; construction of element matrices and vectors for ordinary and partial differential equations; assembly into the system of equations; application of boundary conditions; and solution techniques. The student is also expected to understand both static (or steady-state) or transient problems along with the computer programming techniques. Understanding design process will be expected of students by undertaking design projects.

Topics Covered
1. Introduction of weighted residual methods including collocation method, least squares method and Galerkin's method as well as concepts of residual, trial functions and test functions. Weak formulation. Direct approach for finite element methods using one-dimensional spring, bar, torsion, heat conduction, laminar pipe flow and electric circuit.
2. Introduction of piecewise continuous functions and shape functions for one-dimensional, two-dimensional and three-dimensional elements for various shape of elements. Emphasis is placed on the basic characteristics of the shape functions. Continuity requirement of shape functions.
3. Element discretization concept, computation of element matrices and vectors as well as their assembly into a system of equations. Evaluation of boundary integrals and application of boundary conditions to the system of equations.
4. Mathematical mapping, isoparametric elements and numerical integration techniques.
5. Introduction of common program structures for the finite element analyses and programming techniques. Application of the finite element method for design process.
6. Both static (or steady-state) and dynamic (or transient) problems are selected for application problems including beam bending, elasticity, eigenvalue problems, transient dynamics, and Laplace equation.

Class/Laboratory Schedule
This course meets 2 times per week for lectures of 100 minutes.
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* A term design project is assigned. Students present their report orally in class as well as submit written reports.

Prepared by
Young W. Kwon
ME4731  ENGINEERING DESIGN OPTIMIZATION  
(4 - 0)

Required or Elective  Elective

Course (Catalog) Description
Application of automated numerical optimization techniques to design of engineering systems. Algorithms for solution of nonlinear constrained design problems. Familiarization with available design optimization programs. State-of-the-art applications. Solution of a variety of design problems in mechanical engineering, using numerical optimization techniques.

Prerequisites and Co-requisites
ME3450, ME3150, ME3201, ME3611

Textbook(s) and/or other Required Material

Course Objectives
(1) Formulation of Engineering Problems as Optimization Problems:  Students are expected to be able to translate an engineering problem into the standard form of a general linear or nonlinear, constrained or unconstrained, optimization problem. Not only is this required in order to actually solve a problem as an optimization problem, but it forces students to identify the dependent and independent variables in a problem, and to identify what quantity is to be minimized/maximized, and what constraints are important.

(2) Understanding and Implementing Algorithms for Numerical Optimization:  Provide students with an understanding of the mathematical theory of unconstrained and constrained linear and nonlinear optimization. The underlying theory and the associated mathematical concepts are presented in a manner that facilitates the use of these concepts to develop optimization strategies. Several programming projects reinforce mathematical ideas discussed in class, and familiarize students with the structure of optimization programs.

(3) Engineering Design and Analysis: The students consider a variety of problems in engineering design, and economics in studying and applying the optimization techniques covered. In addition to the concepts in optimization, general consideration of fundamental issues in design are discussed. Most importantly among them is the prediction and subsequent modeling of failure modes.

Topics Covered
(1) Introduction, Sample engineering problems, Basic notation, Problem formulation Optimum design concepts, case studies
(2) Unconstrained problems, Single variable functions - Properties and optimality, Region elimination methods, Line searching, Functions of several variables, Properties and optimality
(3) Gradient based methods - Cauchy's, Newton's, Conjugate gradient, Quasi-Newton
(4) Constrained problems: Linear programming, Problem definition, canonical form, Graphical solution, Simplex method, Sample problems
(5) Constrained problems: Nonlinear Constrained optimality conditions, Lagrange multipliers, Karush-Kuhn-Tucker conditions, Successive linear programming, Generalized reduced gradient method, Multi-objective problems, Sensitivity analysis, Mechanism optimization

10. beams.

Class/Laboratory Schedule
This course meets 2 times per week for lectures of 1 hour m50 minutes.

Contribution of Course to Meeting the Professional Component

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* A project was assigned to students to find a real world engineering problem in the military application related to the course contents, and to present the simplified solution and discussion of the solution in a written report.

Prepared by
Joshua H. Gordis
ME4751 COMBAT SURVIVABILITY, RELIABILITY, AND SYSTEMS SAFETY ENGINEERING (4-1)

Required or Elective  Elective

Course (Catalog) Description
Description:
This course provides the student with an understanding of the essential elements in the study of survivability, reliability and systems safety engineering for military platforms including submarines, surface ships, fixed-wing and rotary wing aircraft, as well as missiles, unmanned vehicles and satellites. Technologies for increasing survivability and methodologies for assessing the probability of survival in a hostile (non-nuclear) environment from conventional and directed energy weapons will be presented. Several in-depth studies of the survivability various vehicles will give the student practical knowledge in the design of battle-ready platforms and weapons. An introduction to reliability and system safety engineering examines system and subsystem failure in a non-hostile environment. Safety analyses (hazard analysis, fault-tree analysis, and component redundancy design), safety criteria and life cycle considerations are presented with applications to aircraft maintenance, repair and retirement strategies, along with the mathematical foundations of statistical sampling, set theory, probability modeling and probability distribution functions. PREREQUISITES: Consent of Instructor.

Prerequisites and Co-requisites
Consent of Instructor.

Textbook(s) and/or other Required Material

Course Objectives
Students are expected to gain a fundamental understanding of the principles of platform survivability and be able to use this knowledge in improving system survivability and improve operations to limit losses due to hostile actions.

Topics Covered
1. Introduction to statistical analysis and methods.
2. Definitions of terminology of the kill chain.
3. Platform layout and systems interconnections.
4. Physical principles of detection, tracking and engagement.
5. Mechanics of damage and kill mechanisms.
6. Design of survivability.

Class/Laboratory Schedule
This course meets 4 times per week for lectures of 50 minutes and a separate computer laboratory period is used to perform calculations and have design discussions.
Contribution of Course to Meeting the Professional Component

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* This course teaches both design tools and process.

Prepared by
Knox Millsaps
ME4811 MULTIVARIABLE CONTROL OF SHIP SYSTEMS
(3-2)

Required or Elective Elective

Course (Catalog) Description

Prerequisites and Co-requisites
Me3801

Textbook(s) and/or other Required Material
Web-based notes by F. Papoulias

Course Objectives
Students are expected to know how to design a compensator (controller and observer) for a linear system and verify its response using simulations, design a disturbance estimation and compensation control law, perform an integral control design in state space, set up the LQR/LQG optimization problems and solve using MATLAB/SIMULINK, utilize Lyapunov functions to analyze simple nonlinear control systems and limit cycle behavior.

Topics Covered
1. State Feedback Control Law Design.
2. Observer Design.
3. Tracking Systems.
5. Optimal/Sliding Mode Control.
6. Discrete Time Control.
7. Effects of Noise.
8. Robust Control.
9. Nonlinear Systems

Class/Laboratory Schedule
This course meets 4 times per week for 3 lectures of 50 minutes and 2 hours of lab
Contribution of Course to Meeting the Professional Component

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* A project was assigned to students to develop an integrated guidance and control algorithms that guides an Autonomous Underwater Vehicle through a mine field to a rendezvous point and back to the mother ship and test it in the Simulink environment. The discussion of the developed solution is presented in a written report.

Prepared by
Isaac Kaminer
ME4821 MARINE NAVIGATION  
( 3 - 2 )

**Required or Elective**  Elective

**Course (Catalog) Description**
This course presents the fundamentals of inertial navigation, principles of inertial accelerometers, and gyroscopes. Derivation of gimbaled and strapdown navigation equations and corresponding error analysis. Navigation using external navigation aids (navaids): LORAN, TACAN, and GPS. Introduction to Kalman filtering as a means of integrating data from navaids and inertial sensors...

**Prerequisites and Co-requisites**
ME3801

**Textbook(s) and/or other Required Material**
Lecture Notes Provided by instructor

**Course Objectives**
Students are expected to be able to:
1. Explain principles of operation of inertial sensors such a fiber optic gyros and accelerometers
2. Define typical coordinate systems and derive transformations between them
3. Derive inertial navigation equations
4. Derive inertial navigation error equations
5. Derive navigation aids models including bearings, GPS and vision.
6. Design complementary and Kalman filters that integrate inertial sensors with navaids

**Topics Covered**

**Class/Laboratory Schedule**
This course meets 4 times per week for 3 lectures of 50 minutes and 2 hours of lab
**Contribution of Course to Meeting the Professional Component**

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* A project is assigned to students to develop an integrated GPS/INS system, test it in Simulink environment and to present the solution and discussion of the solution in a written report.

**Prepared by**
Isaac Kaminer
MS2201 INTRODUCTION TO MATERIALS SCIENCE & ENGINEERING (3 - 2)

Required or Elective Required

Course (Catalog) Description
This is a first course in Materials Science and Engineering and emphasizes the basic principles of microstructure-property relationships in materials of engineering and Naval relevance. Topics include crystalline structure and bonding, defects, thermodynamics and kinetics of reactions in solids, deformation, strengthening mechanisms and heat treatment. Students will acquire a working vocabulary and conceptual understanding necessary for advance study and for communication with materials experts.

Prerequisites and Co-requisites
Undergraduate courses in calculus, physics and chemistry.

Textbook(s) and/or other Required Material

Course Objectives
To understand the correlation between microstructure, property and processing of materials, based on the following areas.
1. Structure of materials - including atomic structure, bonding in the solid state and crystal structure;
2. Defects in structure - including point, line, interfacial and bulk defects, and how these affect material properties such as strength, ductility and toughness;
3. Mechanical behavior - the role of microstructure in determining mechanical response;
4. Phase transformations - the principal means for controlling alloy microstructure and thus mechanical and other material properties.

The overall objective of the course is that the students learn to understand the observed characteristics of engineering materials in terms of structure-property-processing correlations. The specific goals of the course are to: (1) enable students to appreciate how the service properties of materials depend on both fabrication history and service environment, and (2) provide a foundation for subsequent Materials Science courses.

Topics Covered
1. Introduction
2. Atomic Structure/Bonding
3. Crystalline Solids
4. Imperfections in Solids
5. Diffusion
6. Mechanical Behavior
7. Phase Diagrams
8. Dislocations and Strengthening Mechanisms
9. Phase Transformations in Metals
10. Thermal Processing of Metals

Class/Laboratory Schedule
This course meets 3 times per week for lectures of 50 minutes, plus once a week for a 2 hour laboratory.
### Contribution of Course to Meeting the Professional Component

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**Prepared by**

Indranath Dutta
MS3202 Properties, Performance and Failure of Engineering Materials (3-2)

Required or Elective Required (may be waived based on individual circumstances)

Course (Catalog) Description
The purpose of this course is to advance the students' understanding of the fundamentals of materials science, while putting that understanding in the context of the behavior of materials in engineering applications. Contemporary developments in engineering materials such as composites, ceramics and polymers are considered, as well as traditional engineering alloys such as steels and aluminum alloys. Performance and failure histories of materials in service will be studied, as well as conventional textbook subjects. Examples pertinent to Naval, Aero and Combat Systems Science are emphasized. Topics include mechanical properties, fracture, fatigue, failure analysis and corrosion.

Prerequisites and Co-requisites
MS2201 or equivalent or consent of instructor.

Textbook(s) and/or other Required Material

Course Objectives
Upon completion of MS3202, students are expected to understand the mechanisms governing strength, ductility, fracture toughness, fatigue and creep, as well as the mechanisms controlling the environmental degradation of materials, and to understand the procedures for analyzing service failures related to materials issues. Students will complete a failure analysis project on a failed component from an engineering system and report the results of the analysis orally and in written form.

Topics Covered
8. Review of selected topics in basic materials science
9. Mechanical behavior and mechanical failure modes.
10. Corrosion and corrosion failure modes.
12. Fractography.
13. Failure analysis.
14. Applications of failure analysis to components of naval systems.

Class/Laboratory Schedule
This course meets 3 times per week for lectures of 50 minutes and once per week for laboratory sessions of 110 minutes.
Contribution of Course to Meeting the Professional Component

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* Students must identify a failed component from an engineering systems of military relevance and conduct a laboratory failure analysis on it; the results of the analysis will be reported in both oral and written form.

Prepared by
Terry R Mc Nelley
MS3304: CORROSION AND MARINE ENVIRONMENTAL DETERIORATION  
(3 - 2)

Required or Elective  Required (may be waived based on individual circumstances)

Course (Catalog) Description
The fundamentals of corrosion science and the practice of corrosion engineering are discussed. The objectives include an appreciation of the varied causes, mechanisms and effects of corrosion. Fundamental topics such as basic electrochemistry, polarization and passivity are covered. A primary goal of the course is the development of skill in the recognition and prevention of a wide variety of types of corrosion. Standard methods of corrosion control are discussed, including cathodic protection, coatings, alloy selection and inhibitors.

Prerequisites and Co-requisites
MS2201 or equivalent or consent of instructor

Textbook(s) and/or other Required Material

Course Objectives
The fundamentals of corrosion science and the practice of corrosion engineering are discussed. The objectives include an appreciation of the varied causes, mechanisms and effects of corrosion. Fundamental topics such as basic electrochemistry, polarization and passivity are covered. A primary goal of the course is the development of skill in the recognition and prevention of a wide variety of types of corrosion. Standard methods of corrosion control are discussed, including cathodic protection, coatings, alloy selection and inhibitors.

Topics Covered
1. Modes of Corrosion
2. Corrosion Rates
3. Electrochemical Thermodynamics
4. Pourbaix Diagram
5. Electrochemical Potentials
6. Electrochemical Kinetics
7. Experimental Polarization Measurement
8. Passivity
10. Pitting & Crevice Corrosion
11. Environmentally Assited Cracking
12. Intergranular Attack & De-alloying
13. Cathodic Protection
14. Coatings
15. Inhibitors
16. Materials Selection

Class/Laboratory Schedule
This course meets 2 times per week for lectures of 50 minutes, plus one 2-hour laboratory session.
Contribution of Course to Meeting the Professional Component

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* Students are required to write a critical review of a published archival journal paper, including a summary of the principal findings and a review of associated literature.

Prepared by
Indranath Dutta
MS3606 Introduction to Welding and Joining Metallurgy (3-2)

**Required or Elective**  Required (may be waived based on individual circumstances)

**Course (Catalog) Description**
Welding and joining are presented from the point of view of metallurgy. Topics include the nature and applications of welding and joining processes; the welding thermal cycle; metallurgical effects of the welding thermal cycle; welding and joining of steels, aluminum alloys, stainless steels and heat-resistant alloys. Also, weldment inspection and quality assurance are introduced.

**Prerequisites and Co-requisites**
MS2201 and MS3202 or consent of instructor.

**Textbook(s) and/or other Required Material**

**Course Objectives**
Upon completion of MS3606, students are expected to know the basic vocabulary of welding and welding metallurgy, especially for fusion welding processes; to be able to explain the advantages and limitations of the more common welding processes; to understand heat flow in fusion welding and the effect of the welding thermal cycle in welded materials; to understand gas-metal interactions and their implications in fusion welding; to understand the effect of solidification processes on microstructures in various regions of a weldment; to recognize the origin of various welding defects and how to prevent their occurrence; to be able to apply the physical metallurgy principles which were presented in MS2201 and further developed in MS3202; and, finally, to recognize the limitations on structural performance due to welding

**Topics Covered**
1. Introduction to welding and joining processes.
2. Allied processes
3. The molten zone in fusion welding processes.
4. The heat affected zone.
5. Recent developments in welding and joining processes.

**Class/Laboratory Schedule**
This course meets 3 times per week for lectures of 50 minutes and once per week for laboratory sessions of 110 minutes.
Contribution of Course to Meeting the Professional Component

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Prepared by
Terry R Mc Nelley
MS4215: PHASE TRANSFORMATIONS (3-2)

Required or Elective  Elective

Course (Catalog) Description
The mechanisms and kinetics of structural changes in solid materials are considered in detail. A wide variety of transformation mechanisms are studied, including solidification, recrystallization, precipitation and martensitic transformation. The basic principles which govern these reactions are developed, including principles of nucleation and growth, diffusion and lattice distortion. The relevance of various transformations to practical heat treatment, thermomechanical processing, and technological advances is discussed. Microstructural recognition and methods of monitoring phase transformations are included. Changes in properties which result from phase transformations are given limited attention. Prerequisites: MS3214 or equivalent or consent of instructor.

Prerequisites and Co-requisites
MS3202, and MS3214 or consent of the instructor

Textbook(s) and/or other Required Material
Required:
References:

Course Objectives
This course is concerned with the thermodynamics and kinetics of phase transformations in metallic materials of naval interest for structural and functional applications. Upon completion of MS4215, students will be able to describe the temperature, pressure and composition dependence of the Gibbs free energy in single and two-component systems and calculate unary and binary phase diagrams from free energy data; to understand diffusion mechanisms and to apply solutions to diffusion equations for steady-state and non-steady-state problems in phase transformations; to state the roles of interfacial energies in transformation processes; and to apply concepts of diffusional and diffusionless transformations to problems of materials processing

Topics Covered
1. Thermodynamics and phase diagrams
2. Diffusion
3. Microstructure and interfaces
4. Solidification
5. Diffusional transformations in solids: nucleation and growth processes
6. Diffusionless transformations: martensitic transformations

Class/Laboratory Schedule
This course meets 4 times per week for lectures of 50 minutes.
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  summary of the principal findings and a review of associated literature.

**Prepared by**

Terry R. Mc Nelley
MS4312: CHARACTERIZATION OF ADVANCED MATERIALS (3-2)

Required or Elective  Elective

Course (Catalog) Description
This course is structured to provide an insight into the various tools available for advanced physical examination of engineering materials. Topics covered include X-ray diffraction and optical, scanning, transmission and scanning transmission electron microscopy methods.

Prerequisites and Co-requisites
MS3202 or consent of the instructor

Textbook(s) and/or other Required Material
Required:

References:

Course Objectives
This course is concerned with the theories of modern methods of materials characterization and the experimental evaluation of material microstructure by optical microscopy, x-ray diffraction and electron diffraction methods. At the conclusion of MS4312, students will be able to explain the applications and resolution limits of light microscopy, x-ray diffraction and electron diffraction methods. Also, students will be able to prepare samples for these techniques and obtain and interpret data, including structural, imaging and composition data, from typical naval materials of structural and functional interest.

Topics Covered
1. Atom structure, crystallography and diffraction
2. Defects in crystals
3. X-ray diffraction
4. Neutron diffraction
5. Electron diffraction
6. Optical microscopy and interferometry
7. Transmission electron microscopy
8. Scanning electron microscopy
9. Microanalysis

Class/Laboratory Schedule
This course meets 3 times per week for lectures of 50 minutes and once per week for a 110 minute laboratory.
**Contribution of Course to Meeting the Professional Component**

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**Prepared by**
Terry R. Mc Nelley
MS4811: MECHANICAL BEHAVIOR OF ENGINEERING MATERIALS
(4-0)

Required or Elective  Elective

Course (Catalog) Description
The response of structural materials to stress is discussed, including elastic and plastic deformation
and fracture. Topics include elastic response and the modules of elasticity; plasticity; deformation
mechanisms and dislocation theory; strengthening mechanisms; and fatigue and fracture. Application
to materials development is also considered.

Prerequisites and Co-requisites
MS3202, and MS3214 or consent of the instructor

Textbook(s) and/or other Required Material
References:

Course Objectives
This course is concerned with strength, deformation and fracture of crystalline solids, and can be
divided broadly into three parts. The first part deals with elastic and plastic deformation of
crystalline materials, with particular emphasis on low temperature plastic deformation, including
dislocation theory and strengthening mechanisms. The second part deals with high temperature
deforation (creep), and develops a mechanistic approach based on available analytical
formulations. The third part addresses failure in materials, where a fracture-mechanics based
approach is adopted to supplement the fracture mode / mechanism based approach of MS 3202.
The failure of materials via fatigue is also addressed.

Topics Covered
1. Tensile Response
2. Dislocations
3. Strengthening Mechanisms
4. Elevated Temperature Deformation (Creep, Stress relaxation)
5. Fracture
6. Fatigue

Class/Laboratory Schedule
This course meets 4 times per week for lectures of 50 minutes.
### Contribution of Course to Meeting the Professional Component

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* Students are required to write a critical review of a published archival journal paper, including a summary of the principal findings and a review of associated literature.

**Prepared by**
Indranath Dutta
MS4822 THE ENGINEERING AND SCIENCE OF COMPOSITE MATERIALS  
( 4 - 0 )

Required or Elective  Elective

Course (Catalog) Description
This course focuses on the structure-property correlation in composites utilizing a multi-disciplinary approach, covering the areas of materials science and engineering and solid mechanics. Emphasis is given to the theoretical constitutive behavior at the micro- and macro-levels, as well as on how such behavior can be altered by processing and service variables. The course is divided into three broad parts: (1) Theoretical predictions of composite properties; (2) Materials issues (including processing) complicating accurate performance prediction; and (3) Thermo-mechanical behavior in actual service conditions.

Prerequisites and Co-requisites
ME3611, MS3202 or equivalent

Textbook(s) and/or other Required Material
Required :

References :
1. Handouts based on selected journal papers.

Course Objectives
To yield an understanding of the design, performance and fabrication of composites, based on :
(1) Theoretical predictions of composite properties
(2) Materials issues complicating accurate performance prediction
(3) Suitability of different types of composites to different applications
(4) Methods of fabrication of different types of composites
(5) Performance under service conditions as different from predicted performance, with creep and fatigue as specific examples

Topics Covered
1. Introduction and Definitions
2. Elasticity, Plasticity and Visco-Plasticity  - Constitutive Relations
3. Constitutive Thermo-Mechanical Behavior of Composites  - Micro-level
4. Constitutive Thermo-Mechanical Behavior of Composites - Macro-level
5. Materials and Fabrication : Polymer, Metal and Ceramic Matrix Composites
6. Design of Reinforcement-Matrix Interfaces - Chemical and Mechanical
7. Behavior under Service Conditions - Effect of Material and Design Parameters on Creep and Fatigue

Class/Laboratory Schedule
This course meets 4 times per week for lectures of 50 minutes.
**Contribution of Course to Meeting the Professional Component**

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**Prepared by**
Indranath Dutta
TS3001  FUNDAMENTAL PRINCIPLES OF NAVAL ARCHITECTURE
(3-2)

Required or Elective  Required (may be waived based on individual circumstances)

Course (Catalog) Description
The geometry, hydrostatics and hydrodynamics of monohull and other floating and submerged bodies; Froude similarity; wave and skin friction resistance; powering determination. Longitudinal and transverse stability of floating bodies. Hull girder strength. Introduction to seakeeping and passive survivability principles.

Prerequisites and Co-requisites
ME2201, ME2601

Textbook(s) and/or other Required Material

Course Objectives
Students are expected to understand the fundamental principles of ship hydrostatics, damage stability, structures, and powering principles. Students completing this course will have the rudiments of how to apply this understanding to the analysis of ships.

Topics Covered
1. Ships and ship types.
2. Hull form, geometry, and definitions.
4. Trim and longitudinal stability.
5. Flooding and subdivision.
7. Ship powering.

Class/Laboratory Schedule
This course meets 3 times per week for lectures of 50 minutes. A lab meeting of 90 minutes per week is primarily used for projects and recitation sessions.
### Contribution of Course to Meeting the Professional Component

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Prepared by
Fotis A. Papoulias
**Course (Catalog) Description**
This course will cover combat system detection and engagement elements. This includes radar, ESM, active and passive sonar, infrared, warheads, guns, missiles, torpedoes, fire control and countermeasures. The emphasis will be on what the elements contribute to a combat system, their basic principles of operation, their performance limitations, and their interfaces with the rest of the combat system. Details on specific elements and systems will be limited to those needed to illustrate basic principles of operation and interactions affecting systems engineering.

**Prerequisites and Co-requisites**
ME2503 or equivalent or consent of instructor.

**Textbook(s) and/or other Required Material**

**Course Objectives**
Students are expected to understand the basic organization and implementation, principles of operation, and limitations of the principal detection and engagement elements of naval combat systems. Students completing this course will have the rudiments of how to apply this understanding to the design of those elements.

**Topics Covered**
3. Radiometry and radiometric analysis of sensor systems.
6. Imaging systems and image-based perception.
7. Tracking systems and tracking filters.
8. Microwave and laser radar systems. Synthetic aperture radar, bistatic radar, and over-the-horizon radar.
9. Infrared and electro-optical imaging systems.
11. Active and passive sonar systems.

**Class/Laboratory Schedule**
This course meets 5 times per week for lectures of 50 minutes. A laboratory component is being developed but inauguration of that component cannot begin before Winter Quarter 2007.
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Prepared by
Robert C. Harney
TS4000 NAVAL COMBAT SYSTEM ENGINEERING
(3 - 2)

Required or Elective  Elective

Course (Catalog) Description
Covers the definition and integration of naval combat systems. The emphasis will be on how the various detection, engagement, and control elements interact with each other and on how to combine them into an efficient and survivable combat system. Also addressed will be topside arrangements, signature reduction, readiness assessment, embedded training, and support system interfaces.

Prerequisites and Co-requisites
TS3000 and TS3003.

Textbook(s) and/or other Required Material
Text: Lecture notes prepared by instructor.

Course Objectives
Students are expected to understand the basic process of systems engineering as specifically applied to combat systems. Students completing this course will have the rudiments of how to apply this understanding to the design and integration of complete combat systems.

Topics Covered
2. Combat systems engineering process.
4. Topside design and internal combat systems arrangements. Sensor selection priorities.
7. Signature (observables) prediction, reduction, and control.
8. Electromagnetic interference analysis, prevention, and elimination.
10. The system environment. Environmental effects in design.
11. System safety considerations and design.
12. Embedded training.
13. Supportability considerations.

Class/Laboratory Schedule
This course meets 5 times per week for lectures of 50 minutes. A laboratory component is being developed but inauguration of that component cannot begin before Spring Quarter 2007.
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**Prepared by**
Robert C. Harney
Course (Catalog) Description
A system-oriented approach to integrating the principles of Naval Architecture and Marine Engineering in the design of ship subsystems. Lectures and projects exploring engineering design tools and analysis methods to meet specified systems requirements are used. Projects on hull, mechanical and electrical ship systems design are emphasized. The impact of systems design on other systems and subsystems and on the ship, including affordability, military effectiveness and survivability at the whole ship level are considered.

Prerequisites and Co-requisites
TS3000, TS3001

Textbook(s) and/or other Required Material
Text: Lecture notes and other material prepared and assembled by the instructor.

Course Objectives
Students are expected to understand the process of systems engineering and integration as applied to naval ships with particular emphasis on hull, mechanical, and electrical systems. Students completing this course will have the rudiments of how to apply this understanding to the design and integration of complete naval ship systems.

Topics Covered
1. Introduction to Systems Engineering. The Systems Engineering process.
2. Cost considerations, optimization, and parametric methods.
3. The US Navy ship design environment. Naval ship design considerations and design impacts.
5. Introduction to electric drive and integrated power systems.
6. Maneuvering and seakeeping considerations in design.
7. Risk analysis and decision making methodologies.
8. Naval tactics and ship design implications.
10. Ship production, CAD, and topside design.
11. Systems Engineering management.

Class/Laboratory Schedule
This course meets 3 times per week for lectures of 50 minutes and once per week for lab exercises for 90 minutes.
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* A project was assigned to students to find a real world engineering problem in the military application related to the course contents, and to present the simplified solution and discussion of the solution in a written report.

Prepared by
Fotis A. Papoulias
Required or Elective  Elective

Course (Catalog) Description
The ship-impact of requirements/cost/performance tradeoffs within technical and acquisition constraints. Conversion of broad military requirements to mission-based ship requirements and specific tasks resulting from those requirements. Exploration of alternative methods of satisfying requirements, leading to combat systems (payload) definition. Conduct of feasibility studies to investigate whole-ship alternatives which meet requirements. Selection of a best design approach. Design considerations for unusual ship types and an assessment of future Navy ship and combat systems needs and trends.

Prerequisites and Co-requisites
TS4001/TS4000

Textbook(s) and/or other Required Material
Instructor notes and other material.

Course Objectives
Students are expected to understand the basic principles and process of converting broad customer requirements into ship design requirements. Students completing this course will have the rudiments of how to apply this understanding to the design of naval ship systems.

Topics Covered
1. Requirement traceability and functional decomposition.
2. Feasibility studies.
3. Design selection.

Class/Laboratory Schedule
This course nominally meets 2 times per week for lectures of 50 minutes and two times per week for lab exercises of 90 minutes. It is primarily done in a group (design oriented) environment.
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Prepared by
Fotis A. Papoulias
Required or Elective  Elective

Course (Catalog) Description
The design of a Naval vessel as a single engineering system satisfying mission requirements, with emphasis on affordability and survivability. The interaction and interfacing of various subsystems such as hull, propulsion, and combat systems will be explored through a joint ship “preliminary design” project to produce a balanced ship design based on the alternative chosen from feasibility studies conducted in TS4002. Concepts of design optimization within constraints.

Prerequisites and Co-requisites
TS4002

Textbook(s) and/or other Required Material
Instructor notes and other material.

Course Objectives
Students are expected to understand the process of converting ship design requirements into a balanced ship design. Students completing this course will have the rudiments of how to apply this understanding to the design of naval ships.

Topics Covered
1. Naval ship design spiral.
2. Ship hydrostatics, structures, powering, survivability, and arrangement trade-off studies.
3. Design selection.

Class/Laboratory Schedule
This course nominally meets 2 times per week for lectures of 50 minutes and two times per week for lab exercises of 90 minutes. It is primarily done in a group (design oriented) environment.
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Prepared by
Fotis A. Papoulias
Appendix I-C

Faculty Resumes
Brij N. Agrawal
Distinguished Professor of Mechanical and Astronautical Engineering
Naval Postgraduate School

Education
B.S. Mechanical Engineering  Banares University  1964
M.E. Mechanical Engineering  IIT, Roorkee       1966
M.S. Mechanical Engineering  McMaster University  1968
Ph.D. Mechanical Engineering  Syracuse University  1970

NPS Experience
Employment details:
Distinguished Professor, 1989--Present,
Director,  Spacecraft Research and Design Center. www.aa.nps.navy.mil/~agrawal/srdc/

Areas of research:
Acquisition, tracking, and pointing of Bifocal Relay Mirror Spacecraft. Vibration isolation,
optical beam jitter control, and active structural control. Structural, control, and optics
interaction for large flexible space mirrors. Adaptive optics and adaptive control. Space
system design.

Areas of teaching:
Dynamics and Control of Flexible Spacecraft, Spacecraft Design, Acquisition, Tracking, and
Pointing of Military systems, and Spacecraft Testing.

Other Related Work Experience
1969-1989, conducted research in spacecraft attitude dynamics and control, spacecraft
structures, spacecraft system design, and spacecraft testing and participated in the
development of communications satellites at Communications Satellite Corporation
(COMSAT) and International Telecommunications Satellite Corporation (INTELSAT).
Consulting Professor, Stanford University, Adjunct Professor at George Washington
University and University of Maryland.

Consulting and Patents

Consulted for INTELSAT and Space Systems Loral. Consulted DoD on several classified
space programs.

Patent:
Attitude Pointing Error Correction System and Methods for Geosynchronous Satellites,
US patent No. 4,911,385, March 27, 1990

Book:
Design of Geosynchronous
### Professional Registration

P.E., State of Maryland

### Principal Publications of Last Five Years


### Scientific and Professional Society Memberships

Associate Fellow, American Institute of Aeronautics and Astronautics, Member of Directed Energy Professional Society, Member of International Society for Optical Engineering.

### Honors and Awards

- INTELSAT award for Inventiveness and Technological Contribution-1990
- NPS top performance Award-1990
- NPS Outstanding Teaching Award-1993, 1994, and 2000
- NPS Outstanding Research Award-1992 and 1997
- AIAA the Lockheed Graduate Team Space design Competition Award- 1993 and 1994
- Distinguished Professor Award 2002
- Richard Hamming Award for Interdisciplinary Innovation, 2007

### Institutional and Professional Service in Last Five Years

Associate Chairman, Dept. of Aeronautics and Astronautics; Chairman Ph.D. Committee, Department of Aeronautics and Astronautics; Chairman, Astronautics Oversight Committee; Associate Editor, AIAA Journal of Guidance, Control and Dynamics; Member, International Astronautical Federation (IAF) Technical Committee.

### Professional Development Activities in Last Five Years

Developed laboratory and research program in optical beam control and adaptive optics. Attended several national and international conferences and presented papers.
Christopher M. Brophy  
Professor of Mechanical and Astronautical Engineering  
Naval Postgraduate School

Education
B.S.  Aerospace Engineering  The Pennsylvania State University  1991  
M.S.  Aerospace Engineering  The Pennsylvania State University  1993  
Ph.D.  Mechanical Engineering  The University of Alabama in Huntsville  1997

NPS Experience
Employment details:  
Research Associate Professor, 2005-Present, term appointment.  Research Assistant Professor, 1999-2004, term appointment.  NRC Postdoctoral Associate, 1997-1999.

Academic Associate, Space Systems Engineering, 2006-Present

Areas of research:  
Rocket propulsion, air-breathing propulsion, combustion, and optical diagnostics.
Areas of teaching:  
Thermodynamics, Fluid Dynamics, Propulsion, and Design

Other Related Work Experience
Director, NPS Rocket Propulsion Laboratory, 2000-Present

Consulting and Patents
None

Professional Registration
None

Principal Publications of Last Five Years


**Scientific and Professional Society Memberships**
Member of the American Society of Mechanical Engineers, 1997-present.
Senior Member of the American Institute of Aeronautics and Astronautics, 1993-present.

**Honors and Awards**
None.

**Institutional and Professional Service in Last Five Years**
JANNAF Pulse Detonation Working Group Co-Chair, 2005-present
AIAA Propellants and Combustion Technical Committee Member, 2005-present
Reviewer for AIAA Journal of Propulsion and Power
Academic Advisor, NPS, 2006-present

**Professional Development Activities in Last Five Years**
None.
Muguru S. Chandrasekhara  
Research Professor of Mechanical and Astronautical Engineering  
Naval Postgraduate School

**Education**

<table>
<thead>
<tr>
<th>Degree</th>
<th>Field</th>
<th>Institution</th>
<th>Year</th>
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<tbody>
<tr>
<td>B.E.</td>
<td>Mechanical Engineering</td>
<td>Bangalore University</td>
<td>1974</td>
</tr>
<tr>
<td>M.E.</td>
<td>Mechanical Engineering</td>
<td>Indian Institute of Science</td>
<td>1976</td>
</tr>
<tr>
<td>Ph.D.</td>
<td>Mechanical Engineering</td>
<td>University of Iowa</td>
<td>1983</td>
</tr>
</tbody>
</table>

**NPS Experience**

Employment details:

Areas of research:
- Unsteady aerodynamics, fluid mechanics of compressible dynamic stall and control

Areas of teaching:
- Fluid Dynamics and Convective Heat Transfer

**Other Related Work Experience**


**Consulting and Patents**

None

**Professional Registration**

None

**Principal Publications of Last Five Years**


**Scientific and Professional Society Memberships**
1. Fellow of the American Society of Mechanical Engineers, 2003-Present, Member since 1984
2. Associate Fellow of the American Institute of Aeronautics and Astronautics, 1989-Present, Member and Senior Member (1981-1989)

**Honors and Awards**
American Helicopter Society, BEST PAPER Award 2003
NASA Ames Fluid Dynamics Division, BEST PAPER Award 1994
NPS, OUTSTANDING RESEARCH ACHIEVEMENT Award 1992
NASA, TECHNICAL BRIEF Award 1992
NASA, GROUP ACHIEVEMENT Award 1989
Bangalore University, BEST STUDENT Award 1974

**Institutional and Professional Service in Last Five Years**

**Professional Development Activities in Last Five Years**
ASME 34d Annual MEMS Technology Seminar, ASME Continuing Education Institute, Los Angeles, May 2003.
Jarema M. Didoszak  
Research Assistant Professor, Department of Mechanical and Astronautical Engineering  
Naval Postgraduate School

Education
B.S. Naval Architecture & Marine Engineering University of Michigan 1994
M.S. Mechanical Engineering Naval Postgraduate School 1992

NPS Experience
Employment details:
- Research Assistant Professor, 2005-present, full-time appointment.
Areas of research:
- Underwater Explosions, Shock and Vibrations, Modeling and Simulation
Areas of teaching:
- Naval Architecture, Shock and Vibrations

Other Related Work Experience
Engineering Duty Officer, US Navy Reserve, NAVSEA Reserve Unit Alameda, 2004-present

Consulting and Patents
None to report.

Professional Registration
E.I.T., State of California, No. 117627

Principal Publications of Last Five Years


Scientific and Professional Society Memberships
Member of the Society of Naval Architects and Marine Engineers, 1994-present.
Member of the American Society of Naval Engineers, 2001-present.
Member of the Ukrainian Engineering Society of America, currently inactive.

Honors and Awards
None to Report

Institutional and Professional Service in Last Five Years
None to Report

Professional Development Activities in Last Five Years
Doctoral Study in Mechanical Engineering
Vladimir N. Dobrokhodov  
Assistant Professor of Mechanical and Astronautical Engineering  
Naval Postgraduate School

Education  
B.S. Computer Science  Moscow State Aviation Institute  1989  
M.S. Aerospace Engineering  Moscow State Aviation Institute  1991  
M.S. Operations Research  Air Force Engineering Academy  1993  
Ph.D. Aerospace Engineering  Air Force Engineering Academy  1999

NPS Experience  
Employment details:  
Research Assistant Professor, 2004-Present, full-time appointment.  
Areas of research:  
Flight Mechanics and Trajectory Optimization  
Guidance, Navigation and Control of Unmanned Aerial Systems  
Cooperative Control of Multi-Vehicle Formations and their Effectiveness  
Integration of Vision into Guidance and Control  
Multidimensional Vector Optimization and Systems Identification  
Real-Time Avionics and Flight Control  
Modeling and Simulation of Mechanical Systems  
Areas of teaching:  
Flight Mechanics  
Flight Dynamics and Control  
Classical and Modern Control, Optimal Control  
Modeling and Simulation  
Numerical Methods and Digital Computations  
Operations Research and Applied Optimization  
Real Time Embedded Control Systems

Other Related Work Experience  
Post-Doctoral Researcher, Dept. of Electrical & Computer Eng of University of California at Santa-Barbara, CA, USA. August 2004 - December 2004  
National Research Council (NRC) Research Associate, Department of Aeronautics and Astronautics, Naval Postgraduate School, Monterey, CA, USA, February 2001 - August 2004  
Senior Research Associate, Zhukovskiy Air Force Engineering Academy, Moscow, Russia, 1997-1999  
Research Associate, Zhukovskiy Air Force Engineering Academy, Moscow, Russia, 1995-1997.  
Senior Engineer, Zhukovskiy Air Force Engineering Academy, Moscow, Russia, 1991-1995.

Principal Publications of Last Five Years  


Scientific and Professional Society Memberships
Senior Member, American Institute of Aeronautics and Astronautics (AIAA), 2001-present.

Honors and Awards

Professional Development Activities in Last Five Years
Every year I serve as a reviewer for the multiple conferences and technical (peer review) journals including:
- Journal of Guidance, Control, and Dynamics
- International Committee on Electronic letters, The Institution of Engineering and Technology (IEE)
- International Program Committee of the annual American Control Conference (ACC)
- International Committee of the annual AIAA 2006-07 GNC and MST conferences
Morris R. Driels
Professor of Mechanical and Astronautical Engineering
Naval Postgraduate School

Education
B.S. Mechanical Engineering University of Surrey 1969
Ph.D. Mechanical Engineering City University, London 1973

NPS Experience
Professor, 1989-Present, full-time appointment.
Areas of research: Conventional Weapons Effects (Weaponeering)
Areas of teaching: Weaponeering, Controls

Other Related Work Experience
1. Professor, Mechanical Engineering Department, Texas A&M University 1985-1989
2. Associate Professor, Mechanical Engineering Department, University of Rhode Island 1982-1985
3. Lecturer, Edinburgh University, Scotland, 1973-1982

Consulting and Patents

Professional Registration
Chartered Engineer, UK

Principal Publications of Last Five Years
2. Several classified manuals and computer programs in conventional weapons effects.

Scientific and Professional Society Memberships
• Fellow, Institution of Mechanical Engineers. Chartered Engineer (I Mech E).
• Member, American Society of Mechanical Engineers (ASME).
• Member, Institute of Electrical & Electronic Engineers (IEEE).

Honors and Awards
• Halliburton Professor of Mechanical Engineering, Texas A&M University, 1987.
• Senior Research Fellow, ONR/ASEE Summer Faculty Research Program, 1989.
• Outstanding Instructional Contribution Award, Naval Postgraduate School, 1991.

Institutional and Professional Service in Last Five Years
Provided Weaponeering short course to military and civilian audiences about twice/year since 2000, in the US and overseas

Professional Development Activities in Last Five Years
Developed the subject of Weaponeering into an academic discipline.
INDRANATH DUTTA
Professor, Department of Mechanical Engineering
Center for Materials Science and Engineering
Naval Postgraduate School, Monterey, CA 93943
Ph : 831-656-2851 ; Fax : 831-656-2238 ; E-mail : idutta@nps.edu
Web: web.nps.navy.mil/~me/dutta.html

EDUCATION
• Ph.D., Materials Science and Engineering, University of Texas at Austin, December 1988
• M.S., Metallurgy and Materials Science, Case Western Reserve University, August 1985
• B. Tech., Metallurgical Engineering, Indian Institute of Technology, Kharagpur, July 1983

NPS EXPERIENCE
• Professor of Mechanical Engineering, Naval Postgraduate School, April 2001-present
• Associate Professor, Naval Postgraduate School, 1993-2001
• Assistant Professor, Naval Postgraduate School, 1988-1993

Areas of research: Materials Science and Micro-mechanics of Thermo-Mechanical Effects in Multi-Component Materials Systems (supported by NSF, ARO, ONR, SRC, industry)

Areas of teaching: Materials Science

OTHER PROFESSIONAL EXPERIENCE
• Visiting Faculty, Assembly Tech. Dev., Intel Corporation, Chandler, AZ, Apr’01-June-’01
• Visiting Consultant, Interconnect Systems Lab, Motorola, Tempe, Aug’00-Mar’01
• Visiting Fellow, Corpus Christi College / Dept. of Materials, Oxford University (U.K.), 1996
• AFOSR Summer Faculty Fellow, Wright Patterson Air Force Base, May-July 1995

AWARDS & HONORS
• Exemplary Service Award, Electronic, Magnetic and Photonic Materials Division, TMS, 2005
• Fellow, ASM International, 2004
• Who's Who in America (Marquis Who's Who), 2003-present
• Who’s Who in the World (Marquis Who’s Who), 2002-present
• Who's Who in Science and Engineering (Marquis Who's Who), 2003-present
• Carl E. and Jessie W. Menneken Award for Excellence in Scientific Research, NPS, 1998
• Outstanding Research Achievement Award, Naval Postgraduate School, 1997

JOURNAL PUBLICATIONS (last 5 years)


PATENTS


CONSULTING (last 5 years)

- Freescale Semiconductor, Tempe, AZ, September 2005-present
- Intel Corporation, Chandler, AZ, 2003-present
- Motorola, Tempe, AZ, 2000-2001

INSTITUTIONAL AND PROFESSIONAL SERVICE (last 5 years)

- Editorial Board Member, Key Engineering Materials series

PROFESSIONAL AFFILIATIONS

- Member, ASM International, TMS, MRS
Joshua H. Gordis
Associate Professor of Mechanical Engineering
Naval Postgraduate School

Education
B.S. Mechanical Engineering University of Vermont 1983
M.S. Mechanical Engineering Rensselaer Polytechnic Institute 1987
Ph.D. Mechanical Engineering Rensselaer Polytechnic Institute 1990

NPS Experience
Employment details:
Associate Professor, 1998-Present, full-time appointment.
Assistant Professor, 1992-1998, full-time appointment.
Associate Chair for Academics, 2006-Present
Areas of research:
Vibrations & Structural Dynamics, Ballistics,
Areas of teaching:
Vibrations & Structural Dynamics, Design Optimization,

Other Related Work Experience
Developer of motorcycle chassis geometry measurement and analysis system.

Consulting and Patents
Lansmont Corporation, Monterey CA 2002
Pagos Corp. Cambria, CA 2001
Indian Motorcycle Company, Gilroy CA. 2000

Professional Registration
EIT (1983)

Principal Publications of Last Five Years

Scientific and Professional Society Memberships
Member of the American Society of Mechanical Engineers, 1990-present.

**Honors and Awards**
NPS Outstanding Instructional Performance Award, 2001
NPS Outstanding Research Achievement Award, 1997
Recognition of Excellence, Naval Surface Warfare Center, 1993
American Helicopter Society Robert L. Lichten Award, 1990

**Institutional and Professional Service in Last Five Years**
Academic Associate, NPS, 2006-present
Faculty Council (alternate) 2005-Present

**Professional Development Activities in Last Five Years**
Robert C. Harney
Associate Professor of Systems Engineering
Naval Postgraduate School

**Education**

- B.S. Chemistry and Physics 
  Harvey Mudd College 1971
- M.S. Engineering – Applied Science  
  University of California, Davis  1972
- Ph.D. Engineering – Applied Science  
  University of California, Davis  1976

**NPS Experience**

Employment details:
- Associate Professor, Physics Department, 1995-2001, full-time appointment.
- Naval Sea Systems Command Faculty Chair of Total Ship Systems Engineering (Combat Systems), 1995-present.
- Senior Lecturer, Wayne E. Meyer Institute of Systems Engineering, 2001-2002, full-time appointment.
- Associate Professor, Department of Systems Engineering, 2002-present, full-time appointment.
- Associate Chair for Research, Department of Systems Engineering, 2003-present.

Areas of research:
- Total Ship Systems Engineering, Counter-proliferation of Weapons of Mass Destruction (WMD), Unconventional WMD

Areas of teaching:
- Combat Systems (Sensors, Weapons, Weapons Effects, and Systems Integration),
- Technical Aspects of WMD Proliferation

**Other Related Work Experience**

- Staff Scientist, MIT Lincoln Laboratory, Lexington, Massachusetts, 1976-1982.

**Consulting and Patents**


**Professional Registration**

None

**Principal Publications of Last Five Years**

Scientific and Professional Society Memberships
Member of the American Chemical Society, 1970-present.
Member of the American Association of Physics Teachers, 1971-present.
Member of the Optical Society of America, 1972-present.
  Vice President, Florida Section, 1984-1985
  President, Florida Section, 1985-1986
Technical Member of the Astronomical Society of the Pacific, 1975-present.
Life Member of Sigma Xi, 1980-present.
Member of the Society of Photo-Optical Instrumentation Engineers, 1980-present
Life Member of the Association of Old Crows, 1985-present.
Member of the American Society of Naval Engineers, 1999-present.
Member of the Military Operations Research Society, 2004-present.

Honors and Awards
President’s [of the United States] Executive Intern, 1969.
Fannie and John Hertz Foundation Fellow, 1972.
Outstanding Technical Achievement Award, Martin Marietta Corporation, 1985 and 1989.
Outstanding Engineer, IEEE Orlando Section and Florida Council, 1990.

Institutional and Professional Service in Last Five Years
Research Board, NPS, 2003-present.
Academic Council, NPS, 2004-present.

Professional Development Activities in Last Five Years
Video Tele-Education (VTE) Faculty Training, Office of Continuous Learning, NPS, September 2006.
Anthony J. Healey  
Distinguished Professor of Mechanical and Astronautical Engineering  
Naval Postgraduate School

**Education**

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<td>B.S.</td>
<td>Mechanical Engineering</td>
<td>University of London, UK</td>
<td>1961</td>
<td></td>
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<tr>
<td>Ph.D.</td>
<td>Mechanical Engineering</td>
<td>University of Sheffield, UK</td>
<td>1966</td>
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**NPS Experience**

Professor, 1986-2003, full-time appointment. Distinguished Professor 2003-present  
Chairman, ME Department, 1986-1992, Chairman, MAE Department 2003-present

**Other Related Work Experience**

Penn State University, Assistant Professor Mechanical Engineering, 1967-71  
M.I.T., Visiting Assistant Professor, Mechanical Engineering, 1970  
The University of Texas at Austin, Associate Professor Mechanical Engineering, 1971-74  
The University of Texas at Austin, Professor Mechanical Engineering, 1974-81  
Cambridge University, Visiting Professor, 1978  
Director, Center for Autonomous Underwater Vehicle Research, NPS 1995-present


**Consulting and Patents**

Several

**Professional Registration**

P.E., State of Texas, #41281

**Principal Publications of Last Five Years**

2006


http://web.nps.navy.mil/~me/healey/papers/MWHealey2.doc

http://web.nps.navy.mil/~me/healey/papers/IEEBOOKCHPT.pdf

Scientific and Professional Society Memberships

Dynamic Systems and Control Division, Member, 1967-Present
Associate Editor, ASME Transactions Journal of System Dynamics, Measurement and Control, 1971-74,
Secretary, Dynamic Systems and Control Division, 1973-76
Executive Committee, Dynamic Systems and Control Division,, 1976-81
Chairman, Dynamic Systems and Control Division, 1979-80
Past Chairman, Dynamic Systems and Control Division,, 1980-81
IEEE Robotics and Automation Society, Underwater Robotics Committee, 1995-present
Editorial Board: International Journal of Autonomous Systems (IJAVS)

Honors and Awards

American Society of Mechanical Engineers, Distinguished Service Award 1994
American Society of Mechanical Engineers, Fellow
Faculty Teaching Award, University of Texas at Austin, 1975
Pi Tau Sigma, Honorary Member
Elected to IEEE Oceanic Engineering Society Administrative Committee, 1995-present
Research Achievement Award, Naval Postgraduate School, 1995

Institutional and Professional Service in Last Five Years
None

Professional Development Activities in Last Five Years
None
Sheshagiri K. Hebbar  
Senior Lecturer of Mechanical and Astronautical Engineering  
Naval Postgraduate School

**Education**

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<th>Institution</th>
<th>Year</th>
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<tr>
<td>B.E.</td>
<td>Mechanical Engineering</td>
<td>University of Mysore</td>
<td>1963</td>
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<tr>
<td>M.E</td>
<td>Aeronautical Engineering</td>
<td>Indian Institute of Science</td>
<td>1965</td>
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<tr>
<td>Ph.D.</td>
<td>Aerospace Engineering</td>
<td>University of Maryland</td>
<td>1976</td>
</tr>
</tbody>
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**NPS Experience**

Employment details:
- Senior Lecturer, 1997-present, full-time appointment. Adjunct Professor, 1988-1995, full-time appointment.

Areas of research:
- Basic and applied research and developmental work in experimental fluid mechanics and aerodynamics, Wind tunnel and water tunnel testing, Vortical flows at high angles of attack, and Fluid flow instrumentation.

Areas of teaching:
- Fluid mechanics, Thermodynamics, Heat transfer, Missile aerodynamics, Statics and dynamics, Solid mechanics, Machine design, Spacecraft structures, Spacecraft thermal control, and Spacecraft propulsion.

**Other Related Work Experience**

Associate Professor, Department of Aerospace Engineering Science, Tuskegee University, Tuskegee, AL, 1985-1987.
- Scientist/Assistant Director, Aerodynamics and Propulsion Divisions, National Aerospace Laboratories (NAL), Bangalore, India, 1965-1983.
- Research Assistant/Research Associate, Department of Aerospace Engineering, University of Maryland, College Park, MD, 1971-1976.
- German Academic Exchange Service Scholar, Technical University, Braunschweig, Germany, 1966-1967.

**Consulting and Patents**

None

**Professional Registration**

None

**Principal Publications of Last Five Years**

None

**Scientific and Professional Society Memberships**

Member, ASME, 1993-present.
- Associate Fellow, AIAA, 1988-present.

**Honors and Awards**

German Academic Exchange Service Scholar Award, 1966-1967.
ABET REPORT
Mechanical Engineering Program

Minta-Martin Pre-doctoral Fellowship Award, University of Maryland, 1975.
Senior NRC-NASA Research Associate Award, 1983-1985.
Tuskegee University Most Outstanding Aerospace Engineering Professor Award, 1987.
NASA Group Achievement Award, 1993.
NPS Outstanding Research Achievement Award, 1994.

**Institutional and Professional Service in Last Five Years**

**Professional Development Activities in Last Five Years**
None
Garth V. Hobson  
Professor of Mechanical and Astronautical Engineering  
Naval Postgraduate School

**Education**  
B.Sc.M.E., Aeronautical Option; University of the Witwatersrand, Johannesburg (1979)  
M.Sc.M.E. University of the Witwatersrand, Johannesburg, South Africa (1983)  
Ph.D. in Aerospace Engineering; Penn State University (1990)

**NPS Experience**  
Employment details:  
2003 – Date, Professor, Department of Mechanical and Astronautical Engineering, Director – Turbopropulsion Laboratory  
2001 – 2003, Professor, Department of Aeronautics and Astronautics, Associate Director – Turbopropulsion Laboratory  
1990 – 2001, Associate Professor, Department of Aeronautics and Astronautics, Areas of research:  
- Propulsion and Energy Conversion, Aerospace Propulsion and Power,  
- Propulsion Computational Fluid Dynamics  
Areas of teaching:  
- Gas Dynamics, Propulsion and Power, Computational Methods,  
- Computational Fluid Dynamics, Fluid Mechanics Measurements

**Other Related Work Experience**  
1980 - 1990, Council for Scientific and Industrial Research (CSIR), Pretoria, Engineer, Section Head, Facility Head (Aero-Thermodynamic Facility)

**Consulting and Patents**  
Consulting; NAVAIR, ADENA (Duke Energy)

**Professional Registration**

**Principal Publications of Last Five Years**


Scientific and Professional Society Memberships
1. Member, American Institute of Aeronautics and Astronautics (AIAA)
2. Member, American Society of Mechanical Engineers (ASME)

Honors and Awards
1. Certificate of Recognition for Outstanding Performance in Instruction, Naval Postgraduate School
2. Director's Award for Innovative Engineering, CSIR

Institutional and Professional Service in Last Five Years
1. Vanguard Chair for the sessions on Viscous Effects in Turbomachinery for the 2001 IGTI Conference in New Orleans.
2. Chaired two sessions on Unsteady Effects in Axial Flow Compressors at the 2005 Turbo Expo and Conference, in Reno, NV.

Professional Development Activities in Last Five Years
Isaac I Kaminer
Professor of Mechanical and Astronautical Engineering
Naval Postgraduate School

Education
B.S.    Electrical Engineering   U of Minnesota   1983
M.S.    Electrical Engineering   U of Minnesota   1985
Ph.D.   Electrical Engineering   U of Michigan    1992

NPS Experience
Employment details:
  Professor, 2006-Present, full-time appointment.
  Associate Professor, 1998-2006, full-time appointment.
  Assistant Professor, 1992-1998, full-time appointment

Areas of research:
  Control Systems

Areas of teaching:
  Control Systems, Navigation

Principal Publications of Last Five Years

Scientific and Professional Society Memberships
Member of the American Institute of Aeronautics and Astronautics, 1992-present.
Honors and Awards
2. 1994 NATO Fellowship for Scientific and Technological Exchange.
   3. 1994 Excellence in Research Award, Naval Postgraduate School.
4. 1995 ASEE/NASA Summer Faculty Fellowship.
6. 1995 AIAA Outstanding Service Award.
7. 1999 NPS Menneken Annual Faculty Award for Excellence in Scientific Research.

Institutional and Professional Service in Last Five Years
1. Member, Editorial Board, Journal of Autonomous Systems
2. Reviewer for the following American and international scientific journals
   IEEE Transactions on Automatic Control
   IEEE Transactions on Control Technology
   IFAC Automatica
   AIAA Journal of Guidance, Control and Dynamics
   International Journal of Nonlinear and Robust Control
   Mathematics of Control, Signals and Systems

2. Reviewer for the following American and international conferences
   American Control Conference
   European Control Conference
   AIAA Conference on Guidance, Navigation and Control
   IEEE Conference on Decision and Control

3. Organizer and Chairman of the Invited Session *Motion Control of Autonomous Vehicles* at 1995 American Control Conference, June 1995, Seattle, WA
5. Organizer with Prof. H. McClamroch of University of Michigan an invited session on UAVs at 1998 American Control Conference
6. Topic Chair, 1999 *AIAA Navigation, and Control Conference*
7. Member NSF CAREER Award panel, October 20-21, 2005.

Professional Development Activities in Last Five Years
None
Ramesh Kolar
Research Assistant Professor of Mechanical and Astronautical Engineering
Naval Postgraduate School

Education
B.S. Mechanical Engineering, University of Mysore, India
M.S. Aeronautical Engineering, Indian Institute of Science, India
Ph.D. Engineering Mechanics, University of Arizona

NPS Experience
Employment details:
Research Assistant Professor, 1997-Present, full-time appointment, Research Assistant Professor (1989-1993), Assistant Professor, 1985-1988, full-time appointment.
Areas of research:
Solid and Structural Mechanics – Classical and Numerical Methods, Composite mechanics/dynamics, Probabilistic Methods, Multidisciplinary Coupled Analysis, Nonlinear Dynamical Systems and Applications
Areas of teaching:
Structural Mechanics, Dynamics, Composite Mechanics, Risk Benefit Analysis, Computational Methods, Vibrations, and Design

Other Related Work Experience

Consulting and Patents
<“None”>

Professional Registration
< “None”>

Principal Publications of Last Five Years

Scientific and Professional Society Memberships
Member of the American Society of Mechanical Engineers
Member of the American Institute of Aeronautics and Astronautics

Honors and Awards
< “None”>

Institutional and Professional Service in Last Five Years
Session Chair, SPIE Active Materials: Behavior and Mechanics – Smart Structures and Materials Conference, San Diego, March 2004
Session Chair, 45th AIAA/ASME/ASCE/AHS Structures, Dynamics & Materials and Non-Deterministic Approaches Forum, Palm Springs, CA 2004
Session Chair, International Modal Analysis Conference, St. Louis, Mo, January 2006.
Session Chair, SPIE Active Materials: Behavior and Mechanics – Smart Structures and Materials Conference, San Diego, March 2006
Session Chair, 47th AIAA/ASME/ASCE/AHS Structures, Dynamics & Materials and 1st AIAA Non-Deterministic Approaches Conference, Newport, RI, May 2006

Reviewer for AIAA 6th Non-Deterministic Approaches Forum, Co-hosted by ASME/ASCE/AHS, Palm Springs, CA, 2004
Reviewer for AIAA Structures Technical Committee, Co-hosted by AIAA/ASME/ASCE/AHS, Newport, RI, 2006

Professional Development Activities in Last Five Years
Young W. Kwon
Professor of Mechanical and Astronautical Engineering
Naval Postgraduate School

Education
B.S. Mechanical Engineering Seoul National University 1981
M.S. Mechanical Engineering Oklahoma State University 1983
Ph.D. Mechanical Engineering Rice University 1985

NPS Experience
Professor, 2000-present; Associate Professor, 1993-2000; Assistant Professor, 1990-1993;
Chair, 2002-2003; Associate Chair, 1999-2002
Areas of research:
  Multiscale and Multilevel Computational Methods, Solid and Structures, Composite
  Materials, Biomechanics
Areas of teaching:
  Statics, Dynamics, Solid Mechanics, Finite Element Method

Other Related Work Experience
Professor and Chair, Dept. of Mechanical Engineering and Energy Processes, Southern Illinois
University, 2003-2005; Assistant Professor, Dept. of Mechanical and Aerospace Engineering,

Consulting and Patents
Consultant on L3 Communications

Professional Registration
None

Principal Publications of Last Five Years
Y. W. Kwon, “Chapter 18: Nanomechanics”, Nanoengineering of Structural, Functional and
Smart Materials, (ed. by M. J. Schulz, A. Kelkar, and M. J. Sundaresan), CRC Press,
Y. W. Kwon, “Chapter 7: Multi-scale Computational Modeling and Simulation”, Progress in
Engineering Computational Technology, (ed. by B.H.V. Topping and C. A. Mota Soares),
Y. W. Kwon, “Chapter 4: Multiscale and Multilevel Modelling of Composites”, Multiscale
Modeling and Simulation of Composite Materials and Structures, (ed. By Y. W. Kwon, D.
Y. W. Kwon, R. E. Cooke, and C. Park, “Representative Unit-Cell Models for Open-Cell Metal
Foams with or without Elastic Fillers”, Materials Science and Engineering A, Vol. 343,
2003, pp. 63-70.
Y. W. Kwon and C. T. Liu, “Microstructural Effects on Damage Behavior in Particle Reinforced
Y. W. Kwon, “Discrete Atomic and Smeared Continuum Modeling for Static Analysis”, Engineering
Y. W. Kwon and K. Roach, “Unit-Cell Model of 2/2-Twill Woven Fabric Composites for Multi-

Scientific and Professional Society Memberships
Fellow of American Society of Mechanical Engineers

Honors and Awards
American Society of Mechanical Engineers, Pressure Vessel and Piping Division Outstanding Service Award, 2004
Guest Editor, Special Issue on Fluid-Solid Interaction Problems, ASME Journal of Pressure Vessel Technology, Nov. 2001
Excellence in Research Award, American Orthopaedic Society of Sports Medicine, 1997
Menneken Faculty Award for Excellence in Scientific Research, NPS, 1995
Cedric K. Ferguson Medal (the Best Paper Award), Society of Petroleum Engineers, 1989

Institutional and Professional Service in Last Five Years
ASME PVPD – Division Chair: 2010-2011
ASME PVPD – Conference Chair: 2009 – 2010, Division Chair: 2010-2011
ASME PVPD – Conference Technical Program Chair 2008 – 2009
ASME PVPD – Executive Committee Publication Chair: 2005 – 2009,
University Policy Committee of Center for Advanced Friction Studies, SIUC, 2003-2005
National Science Foundation Review Panelist, Division of Materials Research
Associate Editor of ASME Transaction, Journal of Pressure Vessel Technology: 1996-2002
ASME IMECE 2005 & 2006 Pressure Technology Group Representative
ASME PVPD – Administrative Committee (Chair of Membership Committee): 2003-2005
ASME PVPD - Fluid Structure Interaction Committee (Chairman): 1998-2002

Professional Development Activities in Last Five Years
ABET REPORT
Mechanical Engineering Program

John R. Lloyd
Distinguished Visiting Professor of Mechanical and Astronautical Engineering
Naval Postgraduate School

Education
B.S. Mechanical Engineering U. Minnesota 1964
M.S. Mechanical Engineering U. Minnesota 1966
Ph.D. Mechanical Engineering U. Minnesota 1971

NPS Experience
Employment details:
Visiting Professor, 1990, Distinguished Visiting Professor, 2007-present
Areas of research: Nanotechnology, Heat Transfer, Distributed Team Function
Areas of teaching: Thermodynamics, Heat Transfer

Other Related Work Experience
Michigan State University, East Lansing, Michigan October 1983 to 1992 - Professor and Chairperson, Department of Mechanical Engineering,
July 1990 to Present - University Distinguished Professor, Department of Mechanical Engineering, Michigan State University, East Lansing, Michigan
October 1994 to present - Guest Professor, Department of Engineering Mechanics, Tsinghua University, Beijing, China
July 1997 to December 2000 - Director, The Institute for Global Engineering Education, College of Engineering, Michigan State University, East Lansing, Michigan
January 2003 – May 2003, Visiting Scholar, Department of Mechanical Engineering, the University of California at Berkeley, Berkeley, California

Consulting and Patents

Professional Registration
None

Principal Publications of Last Five Years
ABET REPORT
Mechanical Engineering Program


Scientific and Professional Society Memberships
Member of the American Society of Mechanical Engineers, 1971-present.

Honors and Awards
1978 ASME Melville Medal for best paper in the field of Mechanical Engineering.
1986 Ralph R. Teetor Educational Award, Society of Automotive Engineers.
1986 Election to Fellow of ASME.
1990 University Distinguished Professor, Michigan State University
1995 ASME Heat Transfer Memorial Award
2000 Doctor of Technical Science Honorus Causa, Russian Academy of Sciences
2002 Elected to Member, European Academy of Sciences
2004 ASME Curriculum Innovation Award, Honorable Mention

Institutional and Professional Service in Last Five Years
Advisory Editor, Journal of Heat Transfer Research, 1997-present
Member, Executive Committee of Int. Center Heat and Mass Transfer, Turkey, 2002- 2006.
Member, planning committee, Minority Serving Institutions Research Partnerships Conf. 2006
Member, Planning group 14th Intl Heat Transfer Conference, Aug 2010, Washington DC
Member, ASME Board on Research and Technology Development, Nov. 2006 – present.
Member, Board of Directors, ASME Nanotechnology Institute, November 2006-present

Professional Development Activities in Last Five Years
None
Fernand D. S. Marquis
Visiting Professor of Mechanical and Astronautical Engineering
Naval Postgraduate School

Education
B. S. Chem. Eng., Univ. of Coimbra, 1967
Dipl. Eng. Chem-Industrial Eng., Instituto Superior Tecnico, Univ. of Lisbon, 1970
DIC Metallurgical Eng., Imperial College of Science and Technology, University of London, 1973
Ph.D. Metallurgical Eng., Imperial College of Science and Technology, University of London, 1977
Ph.D. Metallurgy and Materials Science, Univ. of Lisbon, 1977

NPS Experience
January 2006–Present: Visiting/Adjunt Professor, Dept. of Mechanical and Astronautical Engineering, Naval Postgraduate School.
Areas of research:
Nanomaterials; Nanotechnology; Nanotribology; Shock Synthesis and Densification and Combustion Synthesis and Densification of Ceramics, Composites and Intermetallics; Ceramic and Ceramic/Metal Armor; High Strain, High-Strain Rate Deformation Behavior; Airplane and Aerospace Materials and Structures; Failure Analysis and Mechanisms in Structural Components.
Areas of teaching:

Other Related Work Experience
1988-2005 Professor of Materials and Metallurgical Engineering, South Dakota School of Mines and Technology (SDSMT)
1993-1994 Visiting Professor, Dept. of Applied Mechanics and Engineering Science, University of California, San Diego (UCSD)

Consulting and Patents

Professional Registration
Registered Metallurgical Engineer (1979); Registered Chemical Engineer (1979); Charted Engineer, Council of Engineering Institutions, United Kingdom (1979).

Principal Publications of Last Five Years
Books

Papers

Scientific and Professional Society Memberships (Past and Present)
American Society for Metals (ASM); American Institute of Mining, Metallurgical and Petroleum Engineers (AIMME); Sigma Xi; Materials Research Society (MRS); American Society for Testing of Materials (ASTM); Past member Societe Francaise de Metallurgie.

Honors and Awards
Fellow of the Royal Microscopical Society, United Kingdom, 1977; Editorial Advisory Board, Portualgiae Physica, 1978-1986; Chartered Engineer, Council of Engineering Institutions, 1979, UK; Professional Chemical Engineer, Portugal, 1979; Professional Metallurgical Engineer, Portugal, 1979; Member of the Board of Governors of the International Congress on Mechanical Behavior of Materials, 1979-1981; Who’s Who in Engineering; Biography International; Outstanding Award for Service, as Organizer of the International Symposium on “In Situ Reactions for Synthesis of Composites, Ceramics and Intermetallics”, TMS, 1995; Special Recognition from Entrepreneurs of America, 1998.

Institutional and Professional Service in Last Five Years
1. ABET Program Evaluator for the programs in: (1) Materials Engineering and Science and (2) Metallurgical Engineering. Performed four ABET visits in the last five years.
2. Board of Trustees of Alpha Sigma Mu.
4. Executive Council of the Materials Processing and Manufacturing Division of TMS
5. Treasurer of the Materials Processing and Manufacturing Division of TMS
6. Mechanical Behavior Committee (ASM/TMS)

Professional Development Activities in Last Five Years
1. ABET Program Evaluator for the programs in: (1) Materials Engineering and Science and (2) Metallurgical Engineering. Performed four ABET visits in the last five years.
2. Board of Trustees of Alpha Sigma Mu
TERRY R. MCNELLEY
Distinguished Professor of Materials Science
Department of Mechanical and Astronautical Engineering
Naval Postgraduate School
700 Dyer Road
Monterey, CA 93943-5146

EDUCATION
Purdue University, West Lafayette, Indiana; B.S. in Metallurgical Engineering, June 1967
Stanford University, Stanford, CA; Ph.D. in Materials Science and Engineering; dissertation: “The Mechanical Behavior of Powder Metallurgy Zinc-Alumina Particulate Composite Materials” (advised by Professor Emeritus Oleg D. Sherby), January 1973

ACADEMIC EXPERIENCE
1972-1976: Department of Mechanical Engineering, University of Wyoming, Laramie, WY. Appointed as Assistant Professor; Advancement to Tenure: June, 1976
1976-present: Department of Mechanical Engineering, Naval Postgraduate School, Monterey, CA. Original appointment: Assistant Professor, Sept., 1976; Advancement: Associate Professor (with Tenure), June, 1979; Professor, June, 1987; Associate Chairman of Mechanical Engineering, 1992-1995; Chairman of Mechanical Engineering, 1996 – 2002

PROFESSIONAL ACTIVITIES
Scientific and Professional Societies
American Society for Materials International
The Minerals, Metals and Materials Society
Materials Research Society

Distinctions and Awards
Tau Beta Pi; Sigma Xi; American Society for Testing and Materials Achievement Award, 1972 Fellow, American Society for Materials - International (ASMI), elected 2001 Distinction as ‘Plank Owner’, Reactors/Mechanical Engineering Program, by Naval Reactors (NAVSEA 08), Awarded January, 2002 Distinguished Professor, Awarded September, 2004

Other Appointments
Visiting Professor, Royal Military College of Cranfield Institute, Shrivenham, UK, 1980-81
ONR-London Scientific Liaison (intermittent, 1980-81)
Visiting Professor, Naval Research Laboratory, 1987
Visiting Distinguished Lecturer, Japan National Defense Academy, Yokuska, Japan, October - November 1993
Visiting Professor, Centro Nacional de Investigaciones Metalurgicas (CENIM), Madrid, Spain, August – December, 1999

Consulting (2000 - present)
Failure analysis report “Fuel Oil Fill and Transfer Piping on DDG90, USS Chaffee”, T. R. McNelley and C. Park, October 2004
Testimony before the Armed Services Board of Contract Appeals on 11 February 2005, in respect of docket ASBCA No. 54544, Appeal of Bath Iron Works to Denial of Claim. Testimony was on behalf of the Navy Litigation Office, Office of General Council, Washington Navy Yard, in respect of the failure analysis report “Fuel Oil Fill and Transfer Piping on DDG90, USS Chaffee”.

ACADEMIC ADMINISTRATION

Departmental
Associate Chairman of Mechanical Engineering, 1992 -95; duties included scheduling and internal administration.
Chairman of Mechanical Engineering, initial appointment 1995 - 1999; reappointed 1999 - 2002

University
Member, NPS Academic Council, 1978-80; 89-92
Chair, ad hoc committee on Distance Learning, NPS Academic Council, 1991-2
Search Committee for Chairman of Mechanical Engineering, 1986
Member, NPS Research Council, 1986-89
Member, Total Ship Systems Engineering Program Development Committee, 1989-90
Search Committee for Dean of Engineering, 1993
Search Committee for GSEAS Dean, 2001

Knox T. Millsaps  
Professor of Mechanical and Astronautical Engineering  
Naval Postgraduate School

**Education**

<table>
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<tr>
<th>Degree</th>
<th>Program</th>
<th>Institution</th>
<th>Year</th>
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<tr>
<td>B.S.</td>
<td>Engineering Science/Physics</td>
<td>University of Florida</td>
<td>1983</td>
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<tr>
<td>S.M.</td>
<td>Aeronautics and Astronautics</td>
<td>MIT</td>
<td>1986</td>
</tr>
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</table>

**NPS Experience**

Employment details:
- Professor, 2004-Present, full-time appointment.
- Associate Professor, 1998-2004, full-time appointment.
- Assistant Professor, 1992-1998, full-time appointment.
- Associate Provost for Academic Affairs, 2005
- Associate Provost for Institutional Development, 2006
- Associate Department Chairman, 2002-Present

Areas of research:
- Power and propulsion for aircraft, ships, submarines, missiles and spacecraft.
- Gas turbines and Diesels. Turbomachinery aerodynamics and heat transfer.
- Rotordynamics. Thermodynamics and energy conversion. Signal processing for condition based maintenance. Platform and weapon system low observable technology.

Areas of teaching:

**Other Related Work Experience**

- Visiting Professor: Institute für Thermische Stromungsmaschinen. University of Karlsruhe, Germany. Worked with o.Prof. Sigmar Wittig, currently, Executive Director DLR (equivalent to NASA Administrator) 1997. Also, Post-doctoral Fellow. 1991.
- Senior Staff Engineer: Pratt and Whitney. East Hartford, CT. Turbine Group. 1988

**Consulting and Patents**

- United Technologies Research Center, East Hartford, CT
- Electric Power Research Institute, Palo Alto, CA
- Integrated Devices, San Jose, CA
- Kurz Instruments, Monterey, CA
- Northrop-Grumman, Aircraft Division, El Segundo, CA
- Cidra Inc., Hamilton, CT
- Consultants in Engineering Acoustics
Professional Registration
None

Principal Publications of Last Five Years

Scientific and Professional Society Memberships
ASME, Turbomachinery and Marine Committees of IGTI, AIAA and SAE.

Honors and Awards

Institutional and Professional Service in Last Five Years
ASME Student Chapter Advisor
Chairman, Marine Committee of IGTI (Gas Turbine Division of ASME)
Chairman, Council of Chairs IGTI
Member Board of Directors IGTI
Executive Chairman and Technical Editor, Eleventh International Symposium of Rotating Machinery and Transport Phenomena (ISROMAC-11).

Professional Development Activities in Last Five Years
None
Fotis A. Papoulias  
Associate Professor of Mechanical Engineering  
Naval Postgraduate School

**Education**

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<th>Degree</th>
<th>Field</th>
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<th>Year</th>
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<tr>
<td>B.S.</td>
<td>Mechanical Engineering</td>
<td>National Technical University, Athens, Greece</td>
<td>1983</td>
</tr>
<tr>
<td>M.S.</td>
<td>Naval Architecture and Marine Engineering</td>
<td>The University of Michigan, Ann Arbor</td>
<td>1986</td>
</tr>
<tr>
<td>M.S.</td>
<td>Aerospace Engineering</td>
<td>The University of Michigan, Ann Arbor</td>
<td>1986</td>
</tr>
<tr>
<td>Ph.D.</td>
<td>Naval Architecture and Marine Engineering</td>
<td>The University of Michigan, Ann Arbor</td>
<td>1987</td>
</tr>
</tbody>
</table>

**NPS Experience**

Employment details:
- Associate Professor, 1995-Present, full-time appointment.
- Assistant Professor, 1989-1994, full-time appointment.
- Associate Chair for Academics, 2005-Present

Areas of research:
- Nonlinear Dynamics, Multi-body dynamics, Ship Design

Areas of teaching:
- Dynamics and Control, Ship Design

**Consulting and Patents**

The University of Michigan
CISCO Systems
U.S. Army, DLI

**Principal Publications of Last Five Years**


**Scientific and Professional Society Memberships**

Member of the American Society of Mechanical Engineers, 1990-present.
Member of the Society of Naval Architects and Marine Engineers, 1989-present.

**Institutional and Professional Service in Last Five Years**

Academic Associate, NPS, 2003-present
Faculty Council (alternate) 2002-2005
Max F. Platzer
Distinguished Professor Emeritus of Mechanical and Astronautical Engineering
Naval Postgraduate School

Education
Diploma Engineer    Mechanical Engineering     Technical University of Vienna   1957
Doctor of Technical Sciences                              Technical University of Vienna   1964

NPS Experience
Employment details:
Associate Professor of Aeronautics, 1970-1976
Professor of Aeronautics, 1976 -1988
Chairman, Department of Aeronautics, 1978-1988
Professor of Aeronautics and Astronautics, 1988-1995
Distinguished Professor of Aeronautics and Astronautics, 1995-2003
Chairman, Department of Aeronautics and Astronautics, 2000-2003
Chairman, Naval Postgraduate School Faculty, 1993 and 2000
Member of NPS Faculty Executive Board, 1993 – 2003
Distinguished Professor Emeritus of Mechanical & Astronautical Engineering, 2004-

Areas of Research: Fluid and Gas Dynamics, Aeroelasticity, Flight Mechanics, Propulsion
Areas of Teaching: as above

Other Related Work Experience
Research Scientist, Lockheed-Georgia Research Center, 1966-1970

Consulting and Patents:
Three US patents

Professional Registration: None

Principal Publications of Last Five Years:


**Scientific and Professional Society Memberships**
American Society of Mechanical Engineers, 1976 - present
American Institute of Aeronautics and Astronautics, 1963 – present

**Honors and Awards**
NASA Superior Achievement Award, 1965
Fellow, American Society of Mechanical Engineers, 1992
NPS Distinguished Professor Award, 1995
Fellow, American Institute of Aeronautics and Astronautics, 2000

**Institutional and Professional Service in Last Five Years**
Editor of International Review Journal “Progress in Aerospace Sciences”
Member of Editorial Board of Journal “Design and Nature”
Reviewer for AIAA Journal, Physics of Fluids, Design and Nature
Mark M. Rhoades  
Lecturer of Mechanical and Astronautical Engineering  
Naval Postgraduate School

**Education**

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<th>Year</th>
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<tr>
<td>B.S.</td>
<td>Aerospace Engineering</td>
<td>Univ. of Michigan</td>
<td>1983</td>
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<tr>
<td>M.S.</td>
<td>Aeronautical Engineering</td>
<td>NPS</td>
<td>1990</td>
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<tr>
<td>M.S.</td>
<td>Systems Engineering</td>
<td>NPS</td>
<td>2006</td>
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**NPS Experience**

Employment details:
- Lecturer, 2005-Present, part-time appointment.
- Program Officer, 2001-2005

Areas of research:
- Engineering Risk
- Unmanned Aerial Systems
- Combat Modeling and Simulation

Areas of teaching:
- Engineering Risk Benefit Analysis
- Space Systems
- Unmanned Aerial Systems

**Other Related Work Experience**

- Systems Engineering, Space Systems and Aeronautical Engineering Program Officer 2001-2005
- Navy Deputy Program Manager for GPS Joint Program Officer 1998-2001
- Adversary Aircraft Class Desk Officer, COMNAVAIRPAC 1993-1995
- Field Service Deputy Program Manager, NADEP North Island, 1990-1993

**Consulting and Patents**

None

**Professional Registration**

None

**Principal Publications of Last Five Years**

None

**Scientific and Professional Society Memberships**

INCOSE 2007

**Honors and Awards**

Instructor of the Year Leadership award in 2005

**Institutional and Professional Service in Last Five Years**

- Academic Advisor, NPS, MS-Space Systems Operations 2006-present
- Program Officer, NPS, Product Development and MS Systems Engineering Distance Learning programs – 2005-present

**Professional Development Activities in Last Five Years**
Certified Risk Manager by International Institute of Professional Education and Research™ through Real Options, Inc, 2007
Marcello Romano  
Assistant Professor of Mechanical and Astronautical Engineering  
Naval Postgraduate School

**Education**  
M.S. Aeronautical Engineering Milan Polytechnic, Milan, Italy 1997  
Ph.D. Astronautical Engineering Milan Polytechnic, Milan, Italy 2001

**NPS Experience**  
Employment details:  
Assistant Professor, 2004-present, full-time appointment. Assistant Research Professor, February-September 2004, full-time appointment.  
Areas of research: Autonomous Spacecraft Dynamics and Control, Robotics  
Areas of teaching: Spacecraft Dynamics and Control

**Other Related Work Experience**  
Milan Polytechnic, Milan, Italy, Tenured Assistant Professor, full-time appointment from January 2004 to February 2004, on-leave from March 2004 to December 2006.  
U.S. National Research Council, Research Associate Fellow, Department of Aeronautics and Astronautics, Naval Postgraduate School, Monterey, CA, from July 2001 to December 2003.  
Milan Polytechnic, Milan, Italy, Research Associate, from December 2000 to July 2001.  
Milan Polytechnic, Milan, Italy, Ph.D. candidate, from 1997 to 2000.  
European Centre for Particle Physics (CERN), Geneva, Switzerland, Research Associate, summer 1997.  
Scuola Superiore Sant’Anna, Pisa, Italy, Research Associate, spring 1997.  
European Space Agency (ESA) Astronaut Centre, Cologne, Germany, Research Associate, fall 1996.

**Consulting and Patents**  
“None”

**Professional Registration**  
Professional Aeronautical Engineer, Italy, 1997

**Principal Publications of Last Five Years**  
R. Bevilacqua, M.Romano, Fuel Optimal Spacecraft Rendezvous with Hybrid On-Off Continuous and Impulsive Thrust. Accepted for publication. To appear on AIAA Journal of Guidance, Control, and Dynamics.  


**Scientific and Professional Society Memberships**
Member of the American Institute of Aeronautics and Astronautics, 1997-present.
Member of the International Institute of Electrical and Electronics Engineers, 2002-present.
Member of the American Astronautics Society, 2002-present.

**Honors and Awards**
2006 recipient of the Carl E. and Jesse W. Menneken Annual Faculty Award for Excellence in Scientific Research

**Institutional and Professional Service in Last Five Years**
Member of the AIAA Space Automation and Robotics Technical Committee, since 2004.
Member of the AIAA Guidance Navigation and Control Technical Committee, since 2004.
Founding Member of the IEEE Space Robotics Technical Committee, since 2006.

**Professional Development Activities in Last Five Years**
I. Michael Ross  
Professor of Mechanical and Astronautical Engineering  
Naval Postgraduate School  

**Education**  
Ph.D.  Aerospace Engineering  Penn State  1991  

**NPS Experience**  
July 2005 - present  
*Professor of Mechanical and Astronautical Engineering*  
The Naval Postgraduate School, Monterey, CA  
October 2003 – June 2005  
*Associate Professor of Mechanical and Astronautical Engineering*  
The Naval Postgraduate School, Monterey, CA  
July 1998-September 2003  
*Associate Professor of Aeronautics and Astronautics*  
The Naval Postgraduate School, Monterey, CA  
April 1992-June 1998  
*Assistant Professor of Aeronautics and Astronautics*  
The Naval Postgraduate School, Monterey, CA  

Areas of research:  
Pseudospectral methods for optimal control and optimal control theory  

Areas of teaching:  
Guidance, Control and Optimization  

**Other Related Work Experience**  
October 1999-June 2001  
*Visiting Associate Professor of Aeronautics and Astronautics*  
The Charles Stark Draper Laboratory, Cambridge, MA  

**Principal Publications of Last Five Years**  
(Special Issue: Optimization and Control for Military Applications)  


Scientific and Professional Society Memberships

Member, AAS Space Flight Mechanics Committee, 1995-2000
Member, AIAA Mechanics and Control of Flight Award Committee, 1998
AIAA Technical Chair, AAS/AIAA Astrodynamics Specialist Conference, 1995
Founding Chair, AAS Breakwell Travel Award Committee, 1995-96
Member, AIAA Mechanics and Control of Flight Award Committee, 1992-1994
Chair, AIAA Mechanics and Control of Flight Award Committee, 1992
Member, AIAA Astrodynamics Awards Subcommittee, 1991-1994

Honors and Awards

Carl E. and Jessie W. Menneken Award for Excellence in Research, 2002
Associate Fellow, American Institute of Aeronautics and Astronautics
AIAA Outstanding Leadership Award, 1998
Outstanding Research Award, Space Systems Engineering, NPS, 1998
Provost’s Award for Excellence in Course Design, NPS, 1996
Outstanding Research Award, Astronautical Engineering, NPS, 1995
Meritorious Teaching Award, Astronautical Engineering, NPS, 1994
Meritorious Teaching Award, Space Systems Engineering, NPS, 1992

Institutional and Professional Service in Last Five Years

Academic Associate for Space Systems Engineering Curriculum, 2003-2004
Member, Astronautics Curriculum Committee, 1992-present
Team Leader, NPS Team for Nonlinear Dynamics and Control, 2002-03
Member, Dissertation Committee (various)

Professional Development Activities in Last Five Years

Classified
Young S. Shin
Distinguished Professor of Mechanical and Astronautical Engineering
Naval Postgraduate School

Education:
Ph.D. Case Western Reserve University, Cleveland, Ohio; Mechanical Engineering
M.S. University of Minnesota, Minneapolis, MN; Civil (Structural) Engineering
B.S. Seoul National University, Seoul, Korea; Civil Engineering

Experiences:
1981 - Present Naval Postgraduate School
Distinguished Professor of Mechanical Engineering
Department of Mechanical and Astronautical Engineering
General responsibilities include teaching and research in Navy relevant research projects: (i) underwater explosions / acoustics, shock qualification of shipboard electronic weapon systems, (ii) ship silencing, acoustic/material damping, wave-guide absorbers and tuned damper, (iii) shock and vibration isolation and suppression, (iv) shipboard machinery condition monitoring and diagnostics, (v) finite element techniques, modeling and simulation.


Developed the graduate courses, ME4525: Naval Ship Shock Analysis and Design, and ME4550: Random Vibration and Spectral Analysis.

Research: Fundamental and applied research in Shock and Vibration: underwater shock response analysis and testing, shock modeling and simulation, shock and vibration isolation and suppression, shipboard machinery condition monitoring and diagnostics, modal testing and acoustic damping measurement, acoustic-structure interaction, noise cancellation, fatigue reliability, joint damping characteristics, and passive vibration control by constrained viscoelastic layers and wave guide absorber.

1981 – Present Engineering Consultant
Provides series of lectures and consultancy in “ship shock response to underwater explosions” to Electric Boats Co. of General Dynamics, Newport News Shipbuildings, Bath Iron Works, NWSC-White Oaks, TNO Research Center in Delft, Netherlands, Mishubishi Shipbuilding Research Center in Nagasaki, Japan, National University of Singapore, Seoul National University in Seoul, Korea, IZAR in Spain, EAC in Norway.

San Jose, California
Performed research on fluid-structure interaction effect in Boiling Water Reactor (BWR) for loss of coolant accident (LOCA) situation. New transient loading in LOCA was identified and I was in charge of the research project to assess if this additional dynamic loading is within design boundary.
ABET REPORT
Mechanical Engineering Program

1974 - 1979  Argonne National Laboratories, Components Technology Division, Argonne, Illinois

Performed research on flow-induced vibrations in Fast Breeder Reactor and also steam generator. The design configuration is the bundle of parallel tubes. Both parallel and cross flow-induced vibration problems in tube bundle have to be resolved. The work involved in analysis, design and testing.

Major Honors, Awards & Professional Societies

• Fellow in American Society of Mechanical Engineers since January 1992
• NPS Certificate of Recognition for Outstanding Research Achievement in 1993
• ASME PVP Service Award for Chairman of Fluid-Structure Interaction Technical Committee in 1992
• Director’s Award on Developing a Special Session on Ship Shock Modeling and Simulation at the 74th Shock & Vibration Symposium (2003)

Current Research Programs and Sponsors

M&S Education & Training for Life Long Learning, DoD Washington, DC (2007 - Present)

  Shock & Vibration Analysis in Support of DD(X) & DDG Shock Follow on Action

  Ship Shock Trial Modeling and Simulation, LPD-17 Class Ships

  Ship Shock Trial Modeling and Simulation, DDG-51 Class Ships

  Force Protection In Threat Environments: Weapons Effects on Target and Damage Models

Selected Recent Publications

Jose O. Sinibaldi  
Professor of Mechanical and Astronautical Engineering  
Naval Postgraduate School

Education
B.E.  Mechanical Engineering  Cooper Union  1992
M.E.  Mechanical Engineering  Cooper Union  1995
M.S.  Aerospace Engineering  University of Michigan  1995
Ph.D.  Aerospace Engineering  University of Michigan  1999

NPS Experience
Department of Mechanical and Astronautical Engineering: 3.5 yrs
  Research Associate Professor, 2006-Present, full-time appointment. Research Assistant

Department of Aeronautics and Astronautics: 4 yrs
  Research Assistant Professor, 2001-2003, full-time appointment. ONR Postdoctoral Fellow,

Areas of research:
  Advanced Air Breathing Propulsion, Gasdynamics and Detonation Physics, Imaging Laser
  Diagnostics for Combustion, and micro-Acoustics

Areas of teaching:
  Fluid Dynamics, Heat Transfer, Experimental High-Temperature Gasdynamics

Other Related Work Experience
None

Consulting and Patents
None

Professional Registration
None

Principal Publications of Last Five Years
Pulsed and Continuous Detonations, Edited by G. Roy, S. Frolov, and J. Sinibaldi, Moscow: TORUS

Wang, F. Liu, J.B., Sinibaldi, J., Brophy, C., Kuthi, A., Jiang, C., Ronney, P., and Gundersen, M.A.,
“Transient Plasma Ignition Of Quiescent And Flowing Air/Fuel Mixtures,” IEEE Transactions on

Stretch Rates Measured Along Wrinkled Flames to Assess the Theory of Flame Stretch,” Combustion
Scientific and Professional Society Memberships

Member of the American Institute for Aeronautics and Astronautics, 1992-present.
Member of the American Physical Society, 2005-present

Honors and Awards

NPS Outstanding Research Achievement, 2003

Institutional and Professional Service in Last Five Years
None

Professional Development Activities in Last Five Years
None
William A Solitario  
Visiting Professor of the Practice of Systems Engineering  
Naval Postgraduate School

Education

B.S. Chemical Engineering The City College of New York 1962

Graduate Courses Economics and Systems Engineering UCLA and UC Long Beach 1964

NPS Experience

Visiting Professor 2003 to present  
Northrop Grumman Ship Systems Chair

Wayne E. Meyer Institute  
Systems Engineering Department

Currently:  
Visiting Professor of the Practice of Systems Engineering

Other Related Work Experience

Northrop Grumman Ship Systems/Litton Industries

Director of Technology Development

Engineering  
Director of Technology Development

Forty years of shipbuilding experience starting as a Systems Engineer during the LHA, Tarawa and DD963, Spruance proposals and systems design in the late 1960’s: Director of Engineering Test and Trials and Director of Design Engineering during the system and detail design of the Spruance, Kidd and Ticonderoga Class Destroyers and Cruisers. The Design Directorate consisted of 800 professionals in the shipbuilding disciplines of Naval Architecture, Marine Engineering, Electrical Engineering, Combat Systems Integration and Integrated Logistics Support. Responsible for the System and Detail Design, including the procurement specifications and logistic support package, associated with three major combatant classes built by Ingalls Shipbuilding.

Director of Research and Development during the development and application of composite and integrated topside initiatives, as well as superconducting motor and fuel cell technologies.
Business Development

*Marketing Director.*

Domestic and international market assignments including new combatant designs as well as floating petrochemical modules.

**TRW Systems and North American Rockwell**

*Systems Engineer* on aerospace programs ranging from the Apollo Program to the Minuteman Missile Program

**Consulting and Patents**

none

**Professional Registration**

none

**Principal Publications of Last Five Years**


**Scientific and Professional Society Memberships**

The American Society of Naval Engineers ASNE 20 years

The Society of Naval Architects and Marine Engineers SNAME 30 Years, (last year 2003)

International Council on Systems Engineering, INCOSE 2 Years

**Honors and Awards**

none

**Institutional and Professional Service in Last Five Years**

None

**Professional Development Activities in Last Five Years**

None
Oleg A. Yakimenko
Research Associate Professor of Mechanical and Astronautical Engineering
Naval Postgraduate School

Education

B.S.  Computer Science  MIPT*  1983
M.S.  Aeronautical Engineering  MIPT*  1986
M.S.  Operations Research  AFEA&  1988
M.S.  Business Administration  Russian-American University  1995
Ph.D.  Aeronautical Engineering  AFEA&  1991
Ph.D.  Operations Research  Russian Academy of Sciences  1996

*  Moscow Institute of Physics and Technology, Moscow Russia
&  Air Force Engineering Academy, Moscow Russia

NPS Experience

Employment details:
• Research Associate Professor, 2003-present: Dept. of Mechanical and Astronautical Engineering, NPS, full-time appointment;
• Research Associate Professor, 2001-2003, Dept. of Aeronautics and Astronautics, NPS, full-time appointment;
• National Research Council (NRC) Senior Research Associate, 1998-2001, full-time appointment;
• Full Professor, 1996-1998, full-time appointment, AFEA;
• Associate Professor, 1993-1996, full-time appointment, AFEA;
• Assistant Professor, 1991-1993, full-time appointment, AFEA;
• Lecturer, 1988-1991, full-time appointment, AFEA;
• Senior Engineer, 1986-1988, part-time appointment, AFEA.

Areas of research:
Guidance, Navigation and Control of Unmanned Air Vehicles, Guided Weapons and Parachutes; Cooperative Control and Combat Maneuvering of Multi-Vehicle Formations; Flight Mechanics and Trajectory Optimization; Real-Time Avionics Systems and Flight Controls; Modeling and Simulation of Mechanical Systems; Human Factors.

Areas of teaching:
Flight Mechanics; Systems Dynamics and Control; Classical and Modern Control; Optimal Control; Avionics and Integrated Navigation Systems; Introductory Gas Dynamics; Introductory Hydrodynamics; Applied Aerodynamics; Computer-Aided Design; Digital Computations and Numerical Analysis; Human Factors and Ergonomics; Operations Research and Applied Optimization

Other Related Work Experience

Active Duty, Russian Air Force, made a Colonel in 1998;

Consulting and Patents

Professional Registration
None

Principal Publications of Last Five Years

Scientific and Professional Society Memberships
Associate Fellow of the American Institute of Aeronautics and Astronautics, 1999-present
Associate Fellow of the Russian Academy of Sciences of Aviation and Aeronautics, 1998-present
Scientific Advisor of the Russian and International Engineering Academy, 1996-present

Honors and Awards
National Research Council, Fellowship for Scientific and Technological Exchange, 2000;
Society of Automotive Engineers, World Aviation Congress Best Paper Award, 2000;
National Research Council, Fellowship for Scientific and Technological Exchange, 1999;
Institute of Electrical and Electronics Engineers, International Training and Education Conference Best Paper Award, 1999;
Mikojan Design Bureau, Certificate of Recognition, 1999;
National Research Council, Fellowship for Scientific and Technological Exchange, 1998;

Institutional and Professional Service in Last Five Years
AIAA Progress in Astronautics and Aeronautics Series Editorial Board member, American Institute of Aeronautics and Astronautics, 2006-present
Aerodynamic Decelerator Systems Technical Committee member, American Institute of Aeronautics and Astronautics, 2006-present

Professional Development Activities in Last Five Years
System Engineering Fundamentals, Instructor: Dr. John Hsu (The Boeing Company), American Institute of Aeronautics and Astronautics, Reno, NV, January 2006;
Modeling of Six Degrees of Freedom: Missile and Aircraft Simulations, Instructor: Dr. Peter Zipfel (University of Florida), American Institute of Aeronautics and Astronautics, Reno NV, January 2006; AGI’s STK 7, Dr. Kevin Flood (AGI), San Jose, CA, January 2006.
Appendix I-D

Evaluation Forms
Appendix I-D-1
NPS MSME Degree Program
Supervisor Survey

Please complete the following survey to help the Mechanical Engineering Department at NPS assess the appropriateness of our Program Objectives and to what degree our graduates meet these objectives and serve your needs.

Name of person completing form: _________________________
Title of person completing form: _________________________

I. Objectives
The overall educational objective of the Mechanical Engineering program is to support the NPS mission by producing graduates who have knowledge and technical competence, at the advanced level in Mechanical Engineering, in support of national security.

In order to achieve this goal, the specific objectives are to produce graduates who have:

1. The ability to identify, formulate, and solve technical and engineering problems in Mechanical Engineering and related disciplines using the techniques, skills and tools of modern practice, including modeling and simulation. These problems may include issues of research, design, development, procurement, operation, maintenance or disposal of engineering components and systems for military applications.

2. The ability to provide leadership in the specification of military requirements, in the organization and performance of research, design, testing, procurement and operation of technically advanced, militarily effective systems. The graduate must be able to interact with personnel from other services, industry, laboratories and academic institutions, and be able to understand the role that engineering and technology have in military operations, and in the broader national and global environment.

3. The ability to communicate advanced technical information effectively in both oral and written form.

Please help us evaluate the appropriateness of these Program Objectives:

These objectives serve my needs:

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>O</th>
<th>O</th>
<th>O</th>
<th>O</th>
<th>O</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

Please provide any comments on the appropriateness of these Program Objectives and any changes that would better align our goals with your needs:
II. Program Outcomes

Based on your overall experience with MSME graduates from NPS, please provide your opinion of their preparedness and ability to support your programs. Specifically, rate them in the following four categories:

1. NPS/MSME graduates demonstrate advanced knowledge in Mechanical Engineering and have technical competence over the expected breadth of technical subjects.
   Strongly Agree  O   O   O   O   O   O   Strongly Disagree

2. NPS/MSME graduates demonstrate the ability to communicate effectively technical information both orally and in written form.
   Strongly Agree  O   O   O   O   O   O   Strongly Disagree

3. NPS/MSME graduates have the ability to independently identify, formulate, and solve technical and engineering problems in Mechanical Engineering.
   Strongly Agree  O   O   O   O   O   O   Strongly Disagree

4. NPS/MSME graduates have the ability to apply technical knowledge in a leadership role related to national security.
   Strongly Agree  O   O   O   O   O   O   Strongly Disagree

5. Please provide any comments about your perceptions of NPS/MSME graduates, particularly with respect to their academic preparation. Comments on the appropriateness of our Program Outcomes and suggestions for improvement are particularly welcomed.
Appendix I-D-2

Checklist for BSME Degree Equivalency

The Department of Mechanical Engineering at the Naval Postgraduate School is accredited at the Master of Science degree level through the Accreditation Board of Engineering and Technology. Students earning a Master of Science in Mechanical Engineering or a Degree of Mechanical Engineer at NPS, must either have attained an ABET accredited undergraduate Mechanical Engineering degree, or earned the equivalency of a Bachelor of Science Degree in Mechanical Engineering. Some courses from the student's undergraduate institution may count toward that equivalency, even though his final undergraduate may not have been in Mechanical Engineering. Some courses taken at NPS may also be applied to meeting this undergraduate equivalency. This checklist is provided to document the completion of that equivalency.

Student Name:
E-mail Address:
Month/year Enrolled:

I certify that the information on this form is correct.

Student Signature: ____________________________

Undergraduate Institutions Attended:

<table>
<thead>
<tr>
<th>INSTITUTION</th>
<th>DATE</th>
<th>DEGREE EARNED</th>
</tr>
</thead>
<tbody>
<tr>
<td>From</td>
<td>To</td>
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<tr>
<td>From</td>
<td>To</td>
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<td>From</td>
<td>To</td>
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</tr>
</tbody>
</table>

Do you already have an ABET accredited BSME degree? Check one response only.

☑ YES - Skip the rest of this form. Go directly to the MSME Checklist form.
☐ NO - Complete the rest of this form. Then proceed to the MSME Checklist.

We certify that this student has met the minimum requirements for the equivalency of the BSME degree.

_________________________________   ________________________________
ME Program Officer, Date            ME Academic Associate, Date

_________________________________
ME Department Chair, Date
I. Mathematics

A. A minimum of 24 quarter credit hours or 16 semester credit hours of college-level mathematics is required. List all college-level mathematics courses passed with a grade of C or better. For each course, indicate the college or university where the course was taken, the course number, the course title, and the number of credit hours.

<table>
<thead>
<tr>
<th>University</th>
<th>Course Number</th>
<th>Title</th>
<th>Quarter Credit Hours</th>
<th>Semester Credit Hours</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

Quarter Credit Hours Sub Total
Semester Credit Hours Sub Total

Total Math Credits (Qtr Credits + (1.5 × Sem Credits)):

B. For each of the following mathematics subjects that has been studied, indicate the college or university where the subject was studied, the course number, and the course title. All courses must have been passed with a grade of C or better.

<table>
<thead>
<tr>
<th>Subject</th>
<th>University</th>
<th>Course Number</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multivariable Calculus</td>
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<tr>
<td>Differential Equations</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Linear Algebra</td>
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<tr>
<td>Statistics</td>
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</tbody>
</table>
II. Sciences

A. Basic Science

A minimum of 24 quarter credit hours or 16 semester credit hours of college-level basic science is required. Studies must include both general chemistry and calculus based physics. List all college-level basic science courses passed with a grade of C or better. For each course, indicate the college or university where the course was taken, the course number, the course title, and the number of credit hours.

<table>
<thead>
<tr>
<th>University</th>
<th>Course Number</th>
<th>Title</th>
<th>Quarter Credit Hours</th>
<th>Semester Credit Hours</th>
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</table>

Quarter Credit Hours Sub Total

Semester Credit Hours Sub Total

Total Basic Science Credits (Qtr Credits + (1.5 × Sem Credits)):

(24 required)
III. General Education

A. A minimum of 24-quarter credit hours or 16 semester credit hours is required in subjects other than mathematics, basic science, computer science, and engineering. These general education courses should complement the technical content of the curriculum. Examples of traditional subjects in these areas are philosophy, religions, history, literature, fine arts, sociology, psychology, political science, anthropology, economics, and foreign language. Examples of non-acceptable courses include accounting, industrial management, finance, personnel administration, engineering economy, physical education and military science and training.

<table>
<thead>
<tr>
<th>University</th>
<th>Course Number</th>
<th>Title</th>
<th>Quarter Credit Hours</th>
<th>Semester Credit Hours</th>
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Quarter Credit Hours Sub Total

Semester Credit Hours Sub Total

Total General Education Credits (Qtr Credits + (1.5 × Sem Credits)):

(24 required)
IV. Engineering Science and Engineering Design

A minimum of 72 quarter credit hours or 48 semester credit hours of engineering science and design are required. Of those 54 quarter credit hours or 36 of the semester hours must be specifically in Mechanical Engineering and include both Thermal and Mechanical Systems.

A. List all **Mechanical Engineering** courses passed with a grade of C or better. A minimum of 54 quarter hours or 36 semester hours are required. For each course, indicate the college or university where the course was taken, the course number, the course title, and the number of credit hours (weekly lecture hours plus one half of lab hours). Courses must include Thermal Systems and Mechanical Systems.

<table>
<thead>
<tr>
<th>University</th>
<th>Course Number</th>
<th>Title</th>
<th>Quarter Credit Hours</th>
<th>Semester Credit Hours</th>
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</table>

Quarter Credit Hours Sub Total
Semester Credit Hours Sub Total

Total Mechanical Engr Credits (Qtr Credits + (1.5 × Sem Credits)): (54 required)
B. List all engineering courses *not* in Mechanical Engineering passed with a grade of C or better. For each course, indicate the college or university where the course was taken, the course number, the course title, and the number of credit hours. Combined with the above Mechanical Engineering Courses, a minimum of 72 quarter hours or 48 semester hours is required.

<table>
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<tr>
<th>University</th>
<th>Course Number</th>
<th>Title</th>
<th>Quarter Credit Hours</th>
<th>Semester Credit Hours</th>
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</table>

**Quarter Credit Hours Sub Total**

**Semester Credit Hours Sub Total**

Total Non-Mech Engineering Credits (Qtr Credits + (1.5 × Sem Credits)):
C. Also, DoD officers are entitled to certain college credit based on service schools attended (Nuclear Power School, DCA School, MPA School, etc.) If you have attended any technical DoD schools, including in a prior enlisted status, list those service schools by Title. See your Program Officer for evaluation of those courses based on publications by the American Council on Education. If applicable, the Engineering Science Hours may be added to the total as identified below.

<table>
<thead>
<tr>
<th>Service School Title</th>
<th>Course Number</th>
<th>Mech Engr Semester Credit Hours</th>
<th>Eng Science Semester Credit Hours</th>
</tr>
</thead>
<tbody>
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</table>

Total Service Related Mechanical Engr Science Credit Hours

Convert Semester Hours to Quarter Hours
(1.5 x Sem Hours): Mech Engr Science Service Qtr Credit Hours

Total Service Related Engr Science Credit Hours

Convert Semester Hours to Quarter Hours
(1.5 x Sem Hours): Engr Science Service Qtr Credit Hours

D. Total Engineering Science Credit Hours:

Total Mechanical Engineering Science Credits (Sect IV. A. Previous Pages + Service Related Mechanical Engineering Science Hours Above): (54 required)

Total Non-Mech Engineering Credits (Sect IV. B. Previous Pages + Service Related Non-Mechanical Engineering Science Hours Above):

Total Engineering Science Credits (sum above): (72 required)
V. A major design experience at the advanced undergraduate level is required. It shall be based on the knowledge and skills acquired in earlier course work and incorporating engineering standards and realistic constraints. Briefly describe your major design experience. This requirement can be satisfied by completing a course with a major design experience that has been previously approved by the NPS ME department curriculum committee.
Appendix I-D-3

Checklist for MSME Degree

The Department of Mechanical Engineering at the Naval Postgraduate School is accredited at the Master of Science degree level through the Accreditation Board of Engineering and Technology and the Western Association of Schools and Colleges. Those accreditations are based on degree requirements set forth by the Mechanical Engineering Department at NPS and approved by the NPS Academic Council. This checklist is provided to document the completion of those degree requirements.

Student Name:

E-mail Address:

Month/year Enrolled:

I certify that the information on this form is correct.

Student Signature: ____________________________

We certify that this student has met the minimum requirements for the MSME degree.

________________________________________   ________________________________________
ME Program Officer, Date                     ME Academic Associate, Date

________________________________________
ME Department Chair, Date
1. **BSME Degree / Equivalence Requirement** satisfied by (fill in one):

   - BSME degree from: Month/Year
   - BSME Equivalence from NPS. Date (from completed checklist)

2. **Thesis Requirement:**

   - Number of Thesis Credits (16 minimum)
   - Thesis Advisor:
   - Thesis Title:

3. **Competency / Track Requirement:**

   In completion of the requirements for a Master of Science Degree in Mechanical Engineering, a specific Specialization Track within the discipline of Mechanical Engineering must be declared. Identify the specialization track completed below:

<table>
<thead>
<tr>
<th>Thermal Fluid Sciences</th>
<th>Must Complete Minimum of Two Courses Listed Below</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Course Number</strong></td>
<td><strong>Course Title</strong></td>
</tr>
<tr>
<td>ME4160</td>
<td>Applications of Heat Transfer</td>
</tr>
<tr>
<td>ME4161</td>
<td>Conduction of Heat Transfer</td>
</tr>
<tr>
<td>ME4162</td>
<td>Convection of Heat Transfer</td>
</tr>
<tr>
<td>ME4163</td>
<td>Radiation Heat Transfer</td>
</tr>
<tr>
<td>ME4202</td>
<td>Compressible Flow</td>
</tr>
<tr>
<td>ME4211</td>
<td>Applied Hydrodynamics</td>
</tr>
<tr>
<td>ME4220</td>
<td>Viscous Flow</td>
</tr>
<tr>
<td>ME4240</td>
<td>Advanced Topics in Fluid Dynamics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shock and Vibrations</th>
<th>Must Complete Minimum of Two Courses Listed Below</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Course Number</strong></td>
<td><strong>Course Title</strong></td>
</tr>
<tr>
<td>ME4522</td>
<td>Finite Element Methods in Structural Dynamics</td>
</tr>
<tr>
<td>ME4525</td>
<td>Naval Ship Shock Design and Analysis</td>
</tr>
<tr>
<td>ME4731</td>
<td>Engineering Design Optimization</td>
</tr>
<tr>
<td>ME4550</td>
<td>Random Vibrations</td>
</tr>
</tbody>
</table>
**Solid Mechanics**  Must Complete Minimum of Two Courses Listed Below

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Title</th>
<th>Taken</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME4612</td>
<td>Advanced Mechanics of Solids</td>
<td></td>
</tr>
<tr>
<td>ME4613</td>
<td>Finite Element Methods</td>
<td></td>
</tr>
<tr>
<td>ME4620</td>
<td>Theory of Continuous Media</td>
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</tr>
</tbody>
</table>

**Dynamic Systems and Control**  Must Complete Minimum of Two Courses Listed Below

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Title</th>
<th>Taken</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME4731</td>
<td>Engineering Design Optimization</td>
<td></td>
</tr>
<tr>
<td>ME4811</td>
<td>Multivariable Control of Ship Systems</td>
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</tr>
<tr>
<td>ME4812</td>
<td>Fluid Power Control</td>
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</tr>
<tr>
<td>ME4821</td>
<td>Advanced Dynamics</td>
<td></td>
</tr>
<tr>
<td>ME4823</td>
<td>Dynamics of Marine Vehicles</td>
<td></td>
</tr>
<tr>
<td>ME4825</td>
<td>Marine Propulsion Control</td>
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</tbody>
</table>

**System Design**  Must Complete Minimum of Two Courses Listed Below

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Title</th>
<th>Taken</th>
</tr>
</thead>
<tbody>
<tr>
<td>TS4001</td>
<td>Integration of Naval Engineering Systems</td>
<td></td>
</tr>
<tr>
<td>TS4003</td>
<td>Ship Design Integration</td>
<td></td>
</tr>
<tr>
<td>ME4731</td>
<td>Engineering Design Optimization</td>
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</table>

**Materials Science**  Must Complete Minimum of Two Courses Listed Below

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Title</th>
<th>Taken</th>
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</thead>
<tbody>
<tr>
<td>MS4215</td>
<td>Phase Transformation</td>
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</tr>
<tr>
<td>MS4312</td>
<td>Characterization of Advanced Materials</td>
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</tr>
<tr>
<td>MS4811</td>
<td>Mechanical Behavior of Engineering Materials</td>
<td></td>
</tr>
<tr>
<td>ME4613</td>
<td>Finite Element Methods</td>
<td></td>
</tr>
<tr>
<td>MS4822</td>
<td>Engineering and Science of Composite Materials</td>
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</tbody>
</table>

**Exception Track**  Must Include a Minimum of Two Courses in a Specialization Track Approved by both the Department Chairman and Academic Associate

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Title</th>
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4. Course Credit Requirements:

The Master of Science degree in Mechanical Engineering requires at least 32-quarter hours of graduate level credits. At least 12-quarter hours must be at the 4000 level and at least 24 quarter hours must be in courses offered by the Mechanical Engineering Department. Identify courses to be counted toward the MSME degree:

**NOTE: NO COURSES COUNTED TOWARD A BSME EQUIVALENCY MAY BE COUNTED TOWARD MSME GRADUATION REQUIREMENTS**

A. List 4000 Level Courses applied toward MSME degree.

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Title</th>
<th>Quarter Hours</th>
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</table>

Total 4000 Level Hours

(12 required)

B. List All 3000 and 4000 Mechanical Courses applied toward MSME. Include duplicates of Mechanical Engineering Courses listed above.

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Title</th>
<th>Quarter Hours</th>
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</table>

Total Mechanical Engineering 3000 and 4000 level courses (24 required)
C. List all 3000 and 4000 level courses applied toward MSME degree (Mechanical Engineering non-Mechanical Engineering graduate level courses):

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Title</th>
<th>Quarter Hours</th>
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<tbody>
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</tbody>
</table>

Total ALL MSME degree 3000 and 4000 level courses

(32 required)
Appendix I-D-4

MSME Degree Program
Thesis Evaluation and Rating Form

Outcome 3) Thesis: MSME degree recipients will have completed a thesis that demonstrates competence at the advanced level in one of the available disciplines of Mechanical Engineering.

<table>
<thead>
<tr>
<th>Student</th>
<th>Advisor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curriculum</td>
<td>Co-advisor</td>
</tr>
<tr>
<td>Classification</td>
<td>Reader</td>
</tr>
<tr>
<td>Title:</td>
<td></td>
</tr>
</tbody>
</table>

The ABET accredited MSME Degree Program the above-student is completing requires the student to complete a thesis that demonstrates advanced level competence in one of the available disciplines of Mechanical Engineering. Accreditation criteria require that we continually assess our success in achieving program outcomes and feed back the results of our assessment to improve the program outcomes. Please provide your assessment of the level of success for this student relative to Outcome 4, based on the student’s written thesis, the thesis presentation, and plans (if known) for subsequent publication involving this student.

1. Advanced Level Competence

<table>
<thead>
<tr>
<th>Rating</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Outstanding</td>
<td></td>
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<tr>
<td>4. Excellent</td>
<td></td>
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<tr>
<td>3. Satisfactory</td>
<td></td>
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<tr>
<td>2. Fair</td>
<td></td>
</tr>
<tr>
<td>1. Poor</td>
<td></td>
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</tbody>
</table>

2. Scientific or Technical Merit of the Thesis

<table>
<thead>
<tr>
<th>Rating</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Outstanding</td>
<td></td>
</tr>
<tr>
<td>4. Excellent</td>
<td></td>
</tr>
<tr>
<td>3. Satisfactory</td>
<td></td>
</tr>
<tr>
<td>2. Fair</td>
<td></td>
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<tr>
<td>1. Poor</td>
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</table>

3. Defense Relevance

<table>
<thead>
<tr>
<th>Rating</th>
<th>Comments</th>
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<tbody>
<tr>
<td>5. Outstanding</td>
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<tr>
<td>4. Excellent</td>
<td></td>
</tr>
<tr>
<td>3. Satisfactory</td>
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<tr>
<td>2. Fair</td>
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<tr>
<td>1. Poor</td>
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</tbody>
</table>
### 4. Written Communication

<table>
<thead>
<tr>
<th>Rating</th>
<th>Comments</th>
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</thead>
<tbody>
<tr>
<td>5. Outstanding</td>
<td></td>
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<tr>
<td>4. Excellent</td>
<td></td>
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<tr>
<td>3. Satisfactory</td>
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<td>2. Fair</td>
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<tr>
<td>1. Poor</td>
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</tbody>
</table>

### 5. Oral Communication

<table>
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<th>Rating</th>
<th>Comments</th>
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<tbody>
<tr>
<td>5. Outstanding</td>
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<td>4. Excellent</td>
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<td>3. Satisfactory</td>
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<td>2. Fair</td>
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<td>1. Poor</td>
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</tbody>
</table>

### 6. Reporting in Archival Literature

Please list citations for journal articles, conference presentations, conference publications, invention disclosures, software or other scholarly products related to the student’s work. Indicate if planned, submitted, accepted or published.

---

**Rater Information:** Rater is (please check)

- Advisor
- Co-Advisor
- Reader
- Chairman

**Date:**

**Signature:**
Appendix I-D-5

MSME DEGREE PROGRAM
GRADUATING STUDENT EXIT SURVEY

Questionnaire:
1. Name:
2. Service:
3. MOS/Designator:
4. Grad date (mm/yy):

The ABET accredited MSME Degree Program you are now completing is designed to achieve the program outcomes listed below. Accreditation criteria require that we continually assess our progress in achieving the outcomes and provide the results of our assessment as feedback to the faculty for the purpose of improving the program. Please provide your assessment of the level of success for each of the program objectives and outcomes.

5 = STRONGLY AGREE
4 = AGREE
3 = NO STRONG OPINION
2 = DISAGREE
1 = STRONGLY DISAGREE
0 = NO COMMENT

Program Objectives
The overall educational objective of the Mechanical Engineering program is to support the NPS mission by producing graduates who have knowledge and technical competence, at the advanced level in Mechanical Engineering, in support of national security.

In order to achieve this goal, the specific objectives are to produce graduates who have:

1. The ability to identify, formulate, and solve technical and engineering problems in Mechanical Engineering and related disciplines using the techniques, skills and tools of modern practice, including modeling and simulation. These problems may include issues of research, design, development, procurement, operation, maintenance or disposal of engineering components and systems for military applications.

2. The ability to provide leadership in the specification of military requirements, in the organization and performance of research, design, testing, procurement and operation of technically advanced, militarily effective systems. The graduate must be able to interact with personnel from other services, industry, laboratories and academic institutions, and be able to understand the role that engineering and technology have in military operations, and in the broader national and global environment.

3. The ability to communicate advanced technical information effectively in both oral and written form.
Rate the program relative to the stated objectives:

1. The program enabled me to meet objective #1
2. The program enabled me to meet objective #2
3. The program enabled me to meet objective #3

Please provide any comments on the appropriateness of these objectives below:
Program Outcomes:
1. Graduating students will have knowledge and skills equivalent to an ABET-accredited BSME.

2. Graduating students will have advanced knowledge in Mechanical Engineering and competence in one of the available specialized disciplines of Mechanical Engineering.

3. Graduating students will have a high level of communication skills including technical writing and oral presentation.

4. Graduating students will have the ability to independently identify, formulate and solve technical and engineering problems in Mechanical Engineering.

5. Graduating students will have the ability to apply technical knowledge in a leadership role related to national security.

Rate the program relative to the stated outcomes:
The program enabled me to:

1. Meet outcome #1:
   1.1 Have a solid grasp on statistics
   1.2 Understand the process of design
   1.3 Have an adequate foundation for study at the

5 = Strongly Agree, 4 = Agree, 3 = No Strong Opinion, 2 = Disagree, 1 = Strongly Disagree, 0 = No Comment
Advanced level.

1.4 Apply knowledge of mathematics, science, and engineering.

2. Meet outcome #2:

2.1 Achieve advanced competence in my specialization field

2.2 Achieve advanced knowledge of analytical/numerical tools.

2.3 Achieve advanced knowledge of modern laboratory techniques.

3. Meet outcome #3:

3.1 Make a contribution to the scientific or technical literature.

3.2 Perform thesis research of benefit to the military

3.3 Do an effective and clear technical presentation

3.4 Have the ability to carry out further original research in my field.

4. Meet outcome #4

5. Meet outcome #5

Please provide any comments on the appropriateness of these outcomes below:

Did you take the PE Exam? select one. Yes

If YES, did you pass? Yes

Additional questions:

1. What changes would you recommend in the refresher and transition phase of the curriculum in order to strengthen student preparation for the MSME program?

2. What program improvements, if any, are needed to guarantee that students are able to attain competence at the advanced level in their MSME programs?

3. Of the courses in your study program, which were most important to your goals?
4. Please give your opinion of the thesis process and the value of your thesis experience.

5. Do you think the student-faculty interaction is good within Mechanical Engineering and did it contribute to or detract from your educational experience?

6. Where the laboratories, library, and computing facilities sufficient to support high quality learning experience?

Other Comments:

ALL OF US IN THE MECHANICAL AND ASTRONAUTICAL ENGINEERING DEPARTMENT WISH YOU SUCCESS IN ALL YOUR FUTURE ENDEAVORS.