SELF STUDY REPORT

FOR

THE UNIVERSITY OF WASHINGTON GRADUATE PROGRAM REVIEW

OF

THE DEPARTMENT OF MECHANICAL ENGINEERING

JANUARY, 2007

Self-Study Report for the Graduate Program Review of the Department of Mechanical Engineering

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A. GENERAL SELF-EVALUATION

A1. Unit Strengths

The Mechanical Engineering Department has undergone a profound transformation over the last ten years. The roots of this transformation originate in our strong tradition in undergraduate education. The robust demand for our undergraduates by the local and national technological sector remains an important driver for who we are. Our strongest growth in the last ten years has, however, been in other areas that are markers of upper-level mechanical engineering programs, including graduate education, research funding, growth in research faculty numbers, and growth in diversity.

The UW Mechanical Engineering Department stands 28th among 164 mechanical engineering programs in the 2007 *US News and World Report* rankings, with the UW graduate engineering program at 21st in the nation. These statistics are, however, more reflective of the past than of the present or future. The department is now undergoing an unprecedented growth in its externally funded research. Our total research expenditures (including indirect costs) have steadily increased from 2.85M$ in FY01 to 6.30M$ in FY05 (see Appendix 17 for a comparison of ME *direct* research expenditure growth compared to that of the college as a whole). This growth has been the result of a number of initiatives involving both hiring of key faculty and a targeted emphasis on critical growth areas in our discipline (*e.g.,* bioengineering applications of ME, quantum engineering, sustainable energy, and advanced materials). This is part of a long-term hiring plan (summarized in Appendix 8). Each proposed hire is based on the following:

- Priority research area
- Extension of existing strength; new hire can collaborate/team with existing people
- Proposed rank based on existing strength. For example, an area presently represented by two junior faculty may be best complemented by an established leader. Hence, the proposed hire might be at the professor rank.

Another recognition of our growth is the recent allocation of the 3rd floor of the AERB building to ME for use as a nanomaterials and molecular engineering laboratory (two other space initiatives are in the works).

With respect to program quality, our faculty have received many honors including: 1 National Academy of Engineering member, 4 Endowed Professorships/Chairs awarded in the last two years, 1 Presidential Faculty Fellow, 4 Presidential Young Investigator/Career Awards, 4 Past Presidents/Chairs of Major Engineering Societies, 2 Fulbright Fellows, and 20 Fellows of Major Engineering Societies. In the following paragraphs we outline some of what we feel are our specific strengths:

Undergraduate education: Our undergraduate program has always been in high demand both from the student enrollment and from the company recruitment perspectives. At present we receive around 250 applications for the 100 seats available each year. To fill these seats, we generally make 130 offers with an acceptance rate of 70%. The GPAs of our entering classes are usually third or fourth in the college, right behind the high-demand fields of bioengineering and computer engineering. One recurring question is why, as a discipline strongly tied to

manufacturing, do we see such strong demand in light of the outsourcing phenomena. To understand this, one must look at where our undergraduates go upon leaving the University. In the past, most went to large manufacturers where many stayed their entire career. At present, the majority are approximately equally divided between going to graduate school and going to work for small entrepreneurial firms.

- *Graduate School*. A significant number of our students view the professional MSME as a logical extension of their undergraduate education. The increasing technical demands of the field, as well as the preference of employers have tended to favor continuation. Employers like the additional technically-focused coursework, and they like students who have been through the thesis cycle (project formulation, execution, and communication of results) because it closely mimics the project cycle at work. They also like the improvement in writing skills that comes from generating a closely supervised thesis.

- *Entrepreneurial Firms*. The growth in employment for these firms has two main drivers. The first is the tendency of the large manufacturers to become final assemblers, with the primary engineering being done by small contractors who compete for business and who thus must be nimble and efficient. The second is the existence of a distinct group of technical entrepreneurs who are driven by ideas and opportunities. The jobs these people generate cannot be outsourced as the entrepreneurs themselves are from within the US.

Smaller numbers of our undergraduates do go to the large manufactures (a higher percentage of those who stay for the MSME go to these firms), and to government employment. A small, but important group go on to a variety of non-ME pursuits, *e.g.,* law school, medical school, business.

The employers of our students tell us, via surveys, that our students are well prepared technically. But where our graduates get exceptional marks is in being prepared to be team members and for being focused on results. This is due in large part to one strength of our program, our capstone design experience. The largest project, the Society of Automotive Engineers car project, provides one example in which a student team designs and builds a prototype car that competes each year in Detroit. The project requires a division of labor, team coordination and leadership, and adherence to intermediate deadlines that focus on a final, inflexible delivery date. Students who have been through this experience are unusually well prepared to enter the modern employment environment.

One of the main reasons for the high demand is a perception that the broad training offered by mechanical engineering is valuable in a career. This training prepares our graduates to respond to any externally-driven changes in the employment environment that may happen during their careers. As such, mechanical engineering undergraduate education is marked by a large body of required courses in each of the major discipline areas: energy and fluids, mechanics and materials, systems and dynamics, and design and manufacturing.

We are proud of the fact that the department is able to fund approximately 40 scholarships each year, most providing full tuition support. These are principally provided by endowments from our alumni or employers. We have a strong advising office of three academic councilors that

services the students from their pre-engineering days through their search for employment.

Graduate education: The current graduate program consists of 160 students, with 59 of these pursuing a PhD. We support a large terminal MS program, something that is strongly demanded by both students and employers, and something that is a feature common in many of the top programs in our discipline. Most of our financial aid goes to our PhD students, and to those MS students who are continuing on for a PhD. In common with many other ME programs, the terminal MS students are largely self-supporting.

We view our recruiting strategy as a major strength, something that involves the participation of most of the faculty. The Graduate Program Coordinator (GPC) initially reviews each applicant file for quality and compatibility with our program. Each applicant of interest is assigned to a faculty member who shares the same research interest (and diversity background) for an initial telephone interview. The main goals are (1) to evaluate the depth of the applicant's interest in our program, and (2) to show our interest in the applicant. The buy-in of the whole faculty to this process shows that we care about the applicant, something that has repeatedly come out of surveys of our students. In the past we made an open invitation for applicants to visit campus on their own schedule, but last year we held our first prospective student visitation day, which was a complete success (see Appendix 12 for a description of our approach). We believe this one change was responsible for a 20% increase in our acceptance rate this last fall. We have also made it a strategic priority to increase our fellowship funding. During this last year, the Department led a multi-departmental IGERT team focusing on renewable energy. We also submitted a GAANN proposal focusing on renewable energy/energy self-sufficiency (a GAANN priority area for this cycle). We have initiated a new interaction with GO-MAP (the diversity office of the Graduate School) to identify means of increasing applications from underrepresented populations and to find additional support resources. Finally, we surveyed our peer institutions and determined the RA rate necessary for us to be competitive. We have made use of this enhanced RA rate for four years now. We note that our overall recruitment strategy was recognized as a "best practice" by the Graduate School just this month.

Given the nature of our discipline, many of our PhD graduates go on to research positions in industry or government labs. Around half our PhDs initially go into academia, either as post-docs or as new faculty members. Our graduates teach at a number of schools, including Florida, Massachusetts, Maryland, Minnesota, Utah, West Virginia, WSU, Seattle University, and the Stanford Center for Turbulence Research. Appendix E shows the placement of our PhD graduates for the last three years. The demand for our graduates by these employers is one indicator of our program quality.

Research: The research funding patterns adopted by the major funding agencies have changed substantially over the last 15 years, moving away from many of the traditional mechanical engineering topics and towards new areas (*e.g.,* MEMS, biotechnology, nanotechnology, advanced materials). This has been both a challenge and an opportunity. The ME department has responded to this both via a series of strategic hires and by forging new relationships with other groups on campus. Some of these new areas of strength include:

- *Biomechanics*. ME has successfully recruited several TTF and Research faculty working in biomechanics or other health-related areas, and is the lead department for the recently-formed Center for Computational Biomechanics (CCB, http://depts.washington.edu/uwccb/). New courses devoted to biomechanics have been developed and offered by ME.

- *Advanced Materials and Structures*. ME is the lead department for two research centers: the FAA-sponsored Center for Advanced Materials in Transport Aircraft Structures (AMTAS, http://depts.washington.edu/amtas/), and the Center for Intelligent Materials and Systems (CIMS, http://depts.washington.edu/cims/). Both of these centers have achieved substantial visibility, both nationally and internationally. Minoru Taya has also recently been awarded a MURI grant titled "Design of Energy Harvesting Storage System (EHSS) for Future AF Aero Vehicles".

- *Quantum Systems Engineering*. Joe Garbini, in collaboration with John Sidles of Orthopedics and Sports Medicine, leads a MURI program titled "Advancement of Magnetic Resonance Force Microscopy (MRFM) to Single Nuclear Spin Detection," (http://courses.washington.edu/goodall/MRFM/). This research has broad application in many disciplines, including advanced semiconductors, single-molecule analytical chemistry, biotechnology, infectious disease research, and solid state/quantum physics research.

- *Entrepreneurial ME faculty*. According to the FY 2005 Annual Report of the UW Office of Technology Transfer, 325 new innovations were reported by the College of Engineering during FY05. Ninety-two of these were reported by ME faculty, the most of any department within the college. Also, the top five UW innovators included three ME faculty (Wang, Taya, and Seibel). This is not a one-year phenomenon: in FY04 ME was second in the college, and 4 ME faculty (Taya, Seibel, Xu, and Wang) were ranked within the top 13 UW innovators.

As mentioned above, these efforts are one factor in the recent large growth rate in our research expenditures. Research expenditures have more than doubled over the last five years, a rate that exceeds the respectable 40% growth rate posted by the college for the same period (see Appendix 17).

Diversity: In the last 10 years, the ME Department has produced 97 PhDs students, of which 16% were women and 8% were underrepresented ethnic minorities. Growing these numbers has been an emphasis for some time, and results are starting to appear. For example, we graduated 25% and 27% women in our PhD program during the 2004-2005 and the 2005-2006 academic years respectively. Our underrepresented minority percentage increased to 11% during this same time period. During the last 10 years, we are proud to state that our Department achieved 100% retention of women and minorities in our graduate program. Our goal is to increase the participation of underrepresented minorities to at least double the average of that of our discipline (currently 9%).

Our principal tools to increase diversity include the Department's grant under the NSF ADVANCE program to the College of Engineering, and the initiation of the deeper involvement with GO-MAP mentioned above. We recognize that personal communication with role models is the best and most efficient means of recruitment and retention. To this end, the departmental hiring has resulted in a faculty that includes two women (both tenured), one African American (one of the few on campus at the full professor rank), one Hispanic, and five Asian Americans (three tenured).

Environment: The Department has a strong tradition of shared governance. This is a very collegial environment in which all work hard to formulate and realize a shared vision.

A2 Measures of Success

Our measures for success focus on means of quantifying research activity, educational productivity, and service to the technical community. Some of these measures include research expenditures per tenure track faculty (TTF), yearly PhD production per TTF (see Appendix 6), development of intellectual property (*e.g.*, patents and spin offs based on our research), awards/fellowships, placement of students in prestigious professional positions, interactions with industry, and leadership in professional organizations. Our internal merit review process has traditionally been based on a 20 point system (8-teaching, 8-research, 4-service). The ratings are based on scores recorded by all faculty senior in rank (*e.g.,* each assistant professor is scored by each associate and full professor). All professors score each other. One item under discussion is revising this to emphasize the research component (*e.g.,* 10-research, 6-teaching, 4-service, with the research component reflecting (1) research fund raising, (2) PhD advising, and (3) publication).

Our present ranking of 28th among the 164 mechanical engineering departments places us within a large group of similar programs that sit below the 10 top schools. Our goal is to do those things consistent with program quality that lead to higher ranking. As such, we view our peer schools as those of similar rankings and those top ten schools that, like us, are large state-supported institutions.

UC Irvine	Illinois
UC Los Angeles	Michigan
UC San Diego	Ohio State
UC Davis	Georgia Tech
UC Berkeley	Penn State
Minnesota	Colorado
Wisconsin	Purdue
Maryland	Connecticut

A3 Areas for Improvement, Obstacles and Challenges to be Overcome

- **The ME building and related infrastructure**. Built by the lowest bidder and first occupied in 1959, the 47-year old ME building has never been satisfactory and required major rework as early as 1960-61. The current building is simply not designed to house the modern

laboratories or classroom settings required by the Mechanical Engineering Department. Building renovations are extremely expensive, particularly those involved with fume handling for biohazards or advanced materials processing. Faculty offices are small, cramped, and fully occupied. Classrooms designed to seat 25 students are used for classes with 50 students or more. The building is an impediment in attracting promising new undergraduate students, graduate students, and faculty to the department.

- **Faculty salaries**. Compared to our peer groups faculty salaries throughout the UW are low. They are approximately 20% behind those of peer institutions. They lag the least at the assistant professor rank (where we need to be somewhat competitive to hire), and the most at the professor rank, where the cumulative effects of the under-funding of salary increases shows the most. Within the college ME faculty salaries average the lowest of all programs except Technical Communication.

- **Research Expenditures**. Although research expenditures within ME have risen tremendously in recent years (~120% increase between 2001 and 2005), the current level of about $200k/TTF-yr is still low relative to our peers and needs to be increased. Over the past decade neither the NIH nor the NSF has provided significant funding in support of the research areas traditionally pursued by ME's. In response, ME has evolved so as to take advantage of some of these opportunities, although in some cases it is an unnatural fit.

- **Staff Support**. Staff support for our ongoing operations is probably the lowest in the college, as measured by staff per TTF. This leads to faculty devoting too much time to functions that could be handled by staff. This includes development work, class scheduling, *etc.*

- **ME Department Size.** Our ranking places the ME Department within the top 18% of all ME departments. The UW-ME Department has 24 regular faculty members, and is substantially smaller in size than average ME Departments within the top-20 graduate programs, which average 43 regular ME faculty members. If the seven private institutions within the top 20 are not considered (MIT, Stanford, Cal Tech, Carnegie Mellon, Cornell, Princeton, and Harvard), then the relative difference in faculty numbers becomes even more apparent. The UW-ME Department has 24 TTF faculty members, exactly half the average number of 48 ME faculty at public institutions within the top 20. This limits our ability to meet the demand for seats in our classes, and it limits the technical areas we can pursue, an important feature of quality departments in a broad discipline such as ours.

A4. External Drivers that are Changing the Field

- **Undergraduates**. One of the major challenges in our profession is the offshoring of traditional manufacturing jobs. As we noted above, this has not resulted in a decrease in demand for seats in our undergraduate classes, and it has not reduced the ability of our graduates to find jobs. Instead, it has significantly changed the pattern of employment, which has shifted away from the large traditional manufacturers towards small agile startup firms. These companies focus on doing the primary engineering for the large firms in a cost competitive and technologically superior way. They are also involved in entrepreneurial

activities. In addition, more of our undergraduates continue for at least an MS degree in response to the increased technological demands of the workplace.

- **Advent of biotech and nanotech as critical research areas**. This requires us to be much more interdisciplinary now, and to find areas where the mechanical engineering discipline can contribute in non-traditional ways. This trend has also required us to become more nimble in dealing with non-traditional PhD students. For example, our traditional PhD qualifying exam may not be relevant to a polymer chemist that is involved in the development of smart materials.

A5. Our Role Relative to University Expectations

- **Narrow Research Funding Options.** As noted above, national research funding has been growing principally in a few high-profile areas. This, of course, tends to be an important factor in hiring decisions. Alternately, the employers of our undergraduates demand training in traditional disciplines that are not well represented by national funding. Thus, we need to hire and do research in areas that do not always match up well against what we need to teach. Thus, the demand for research funding productivity that UW rightly expects of us must be reconciled with the demands of employers for relevant advanced technical training.
- **Terminal MSME vs. PhD.** The strong employer and student demand for the professional terminal MSME tends to run against university expectations focusing on PhD production. This can create a tension for faculty seeking promotion who must balance a service demanded by our stakeholders against the expectations of a university research culture.

Possible approaches to reconcile these issues include hiring more instructors to handle the teaching/research discrepancy. The MSME issue could be approached by (1) shifting the default degree to non-thesis, and (2) providing a very well defined path to the terminal MSME degree, possibly also run with help from staff instructors or outside (industry) personnel.

A6. Faculty Role in Governance

We view our tradition of shared governance, collegiality, and respect as one of our major strengths. Due to the large size of our voting faculty (around 35 members, including research faculty), a significant amount of our governance work is done in committee. Our structure focuses on three committee levels:

1. **Research thrust committees.** These committees are charged with coordinating the planning in each of the target research thrust areas identified in our strategic plan. They focus on input into hiring decisions, space issues, and particularly coordinating strategic responses to external opportunities.

2. **Policy committees.** These four committees (Undergraduate Education, Graduate Education, Faculty Affairs, Research and Resources) deal with rules, regulations, policy, and waivers/appeals. For example, Graduate Education is the place where recommendations regarding changes in graduate degree requirements are initially discussed before eventually

being presented to the faculty. It is also the place where individual petitions for waivers in policy are decided.

3. **Interest groups**. These four groups are organized around the major traditional disciplines in mechanical engineering: Energy and Fluids, Mechanics and Materials, Systems and Dynamics, Design and Manufacturing. The role of these groups is primarily (1) to coordinate the curriculum in each area, and (2) to coordinate teaching assignments.

The committees include staff membership as appropriate (*e.g.,* members from the advising office are part of Graduate Education and Undergraduate Education). Major initiatives that fall outside these areas are handled by special committees, *e.g.*, strategic planning, ABET coordination, faculty search.

The department chair maintains a strong, formal communication link with all these committees, with a set schedule for meeting each committee chair each month.

The faculty meetings are then devoted primarily to communication by the administrators and committee chairs, and to debate on major legislation. Staff members have been important contributors to the faculty meetings outside of the rare executive session.

A7. Mentoring

Faculty. Each new faculty member selects an "advocate" whose role is (1) to act as primary mentor, and (2) to represent the faculty member during merit review and promotion decisions. The advocate often acts as an internal reviewer for proposals generated by the junior faculty member, although this task is often shared by others. The advocate helps advise the new faculty member on expectations and approaches for career development. Some of the issues that are typically considered include:

- Review of the results of teaching evaluations: Suggesting changes in approach.
- Advice on the balance between conference papers and journal publication.
- Encourage volunteering for proposal panel reviews to learn approaches for writing winning proposals.
- Advice on appropriate internal and external service expectations.
- Advice concerning networking on campus, and the availability of institutional support at college and university levels.
- Junior faculty members are encouraged to perform seminar tours to gain visibility for themselves and their work
- In addition, the Chair makes use of the annual conference as outlined in the code.

The Promotion Advisory Committee represents a formal channel for providing feedback to junior faculty, for helping them prepare their paperwork for promotion, and for making promotion recommendations to the department.

Graduate Students. For graduate students, the mentoring is roughly divided into two periods. First, during the recruitment and the initial enrollment process the primary responsibility rests

with the GPC and the advising office. The main goals are to ensure the student is initially enrolled in an appropriate series of courses, that they understand the degree requirements, and that the student is directed on the path towards selecting a research advisor. These issues are handled as follows:

- **Initial Enrollment.** Most students already have expressed an interest in one of the main graduate technical concentrations offered (*e.g.,* renewable energy, controls). Curriculum pathways for these are provided on the web, and by the advisors during the initial meeting with the student. For those who do not have an initial strong interest, a custom initial enrollment is designed to cover the multiple areas of interest expressed by the student.
- **Rules and Regulations.** Introduction to these is provided by (1) interview with the advisors and/or the GPC, (2) extensive materials available on the web (*e.g.,* see Appendices 10 and 11, and http://www.me.washington.edu/academic/advising/), and (3) an orientation presentation given by the GPC before the start of classes each fall.
- **Research Advisor Selection.** This admittedly is something the students find stressful. We do ask the students to be proactive in contacting and interviewing potential research supervisors. The GPC summarizes the process for the new students at orientation, and identifies appropriate faculty for the student where needed.

After the advisor is selected, that advisor takes prime responsibility for academic and career mentoring, and is the principal source of information on employment choices at graduation. The advising office performs graduation audit checks to ensure that students are on track to meet graduation requirements.

Undergraduates. The advising system for the BSME program is the responsibility of the Associate Chair for Academics, and is carried out by the Department's Student Services Office, which is staffed by the director, one full-time councilor, one half-time councilor, and part time support from the clerical office pool. This office has responsibility for both undergraduate and graduate students. The principal responsibilities include:

- Receipt and processing of admission records
- Maintenance of student records
- Advising prospective students on admissions
- Advising current students on coursework and graduation requirements
- Generation of deficiency reports and academic probation letters
- Auditing the degree completion checklist
- Coordinating the application and award process for undergraduate scholarships
- Organizing support events: Graduate and Undergraduate orientation in the fall, graduate application and open house day in the winter, departmental commencement in the spring.

As part of the above responsibilities, the Student Services Office has administrative procedures in place to monitor the progress of each BSME student from the time of application for admission to the BSME program until graduation.

Upon entry, each student is provided a current copy of the Department of Mechanical Engineering Undergraduate Guide (Appendix 4). This guide spells out all course requirements

for the degree, including prerequisites and recommended sequencing. It also outlines the program's continuation policy, which specifies criteria for adequacy of rate of academic progress. Information on undergraduate admission, advising, program requirements, course content/learning objectives/prerequisites, and the advising guide are also available on the departmental website (http://www.me.washington.edu/). This also includes the department's strategic plan. To aid in planning, the department has prepared a schedule of classes to be offered in the future, shown in Appendix 4.

Students register each quarter via a web-based system. Access to courses controlled by the College of Engineering and various departments is automatically restricted to students who need these courses by virtue of their programs of enrollment. At the beginning of each academic quarter the program of each student is monitored by Student Services to assure compliance with the continuation policy and that prerequisites are satisfied. At the end of each quarter when grades are in, the progress of each student is again monitored to assure compliance with the continuation policy.

A mentoring program has also been established to assist in the advising process. In the mentoring program each student is given the opportunity to associate with a full-time faculty member. The intent is to give the student an opportunity to discuss career plans, to understand what mechanical engineers do and why, and to provide a supportive personal relationship.

B. TEACHING

B1. Teaching Loads

The following table provides the actual teaching loads for the present academic year. The credit hours are based on actual enrollments for autumn and winter quarters, and projected enrollments for spring quarter. The table shows only tenured and tenure track faculty. The department employs one part-time senior lecturer who teaches our freshmen computer graphics service course (ME 123), and one professional engineer who teaches our HVAC course (ME 425) each spring. Each research faculty who wishes to teach a course is provided with state funding to teach one course in their area of expertise each year, and approximately half the research faculty avail themselves of this opportunity. We also occasionally allow senior graduate students the opportunity to be the lead lecturer in a core ME class when an opening occurs. This provides the students with a much valued instructional experience.

In reading this table, some points need to be borne in mind.

- In general, the actual lecture course load taught in any one year does not exceed 3. Seminars led and capstone projects supervised are generally in addition to the lecture courses. Those faculty shown above with large course numbers are generally leading seminars each quarter. Faculty with course loads less than 3 have either bought out of teaching a course, are junior faculty who have teaching relief as part of their startup packages, or are on a prearranged pause quarter.

Teaching Loads for 06/07			
	Courses Taught	Credits Taught	Credit Hours
Adee	8	27	384
Berg	2.5	7.5	94.5
Chung	3	11	417
Cooper	3	11	294
Devasia	3.5	11	246.5
Emery	5	19	290
Fabien	3	8	417
Ganter	3	11	424
Gao	3	12	349
Garbini	2.5	12	917
Kramlich	6	13	307
Kumar	0	0	0
Li,,J	3	13	510
Li,W	3	10	340
Malte	6	12	338
Mescher	3	10	52
Ramulu	6	12	192
Reinhall	2	7	307.5
Riley	3	13	279
Shen	1.5	7	386
Storti	2	6	312
Taya	4	10	162
Tuttle	0	0	0

- Faculty with no teaching shown are either on sabbatical or on a full-time administrative appointment (*i.e.,* the department chair).
- The credits taught vary for the same reasons as for the course numbers.
- The credit hours vary depending on who is teaching the large junior-level required courses. These courses are rotated each year, and these are relatively well supported by TA's and graders, thus reducing the impact of the large credit hour count somewhat.

B2. Allocation of Teaching Responsibilities

The normal expectation is that each faculty member should teach one course in each quarter in each academic year. As noted above, the interest groups meet in the fall to discuss the initial teaching assignments for the following academic year, and to make a group recommendation. This is the point where equity issues are addressed in a collegial atmosphere, *e.g.,* ensuring that the large junior required courses are rotated in a fair way. There are, of course, many exceptions to the three-course rule. Faculty on startup generally have two pause quarters within their first

two years. Faculty on administrative appointment can receive teaching relief. Faculty can execute a research buyout for one course each year. Sabbaticals and family leave are used. Faculty working on a new initiative or on a temporary service overload can be excused from teaching. Given our collegial atmosphere, we believe our system does a good job of assigning the teaching responsibility on a fair basis.

The initial recommendations are reviewed and consolidated by the Associate Chair for Academics and the trial teaching schedule posted on the Department website for comment around the end of fall quarter (examples for the 2006-2007 academic year are shown in Appendix 14). This tends to evolve with changing conditions (*e.g.,* unexpected medical leave) up to the point where each quarter starts.

B3. Faculty Involvement in Undergraduate Learning

The department supports a number of learning activities outside of the classroom. Probably the most noteworthy are the capstone design projects. The department offers several projects, ranging from large, organized projects that run from year to year to small groups working on *ad hoc* projects. The major pathways here include:

- **SAE Car Project**. Students design and build a small race car that competes with entries from other schools in a national event held in Detroit each year. The competitive criteria include performance, efficiency (mileage), cost, manufacturability, and recycleability. This is our largest project involving multiple subteams that require both leadership and coordination.
- **Human-Powered Submarine**. This project is similar in scale and execution to the car project, with the result entering a national competition each year.
- **Mechatronics Project**. This two-course sequence involves the design and construction of mechatronics devices. These vary each year, but generally involve a robotics or controls application.
- **Fuel Cell Project**. The fuel cell lab sponsors a variety of design projects associated with the fuel cell hardware in the lab.
- **Nanotechnology Project**. This was started this year by Prof. Jae Chung.
- **Industry-Sponsored Projects**. A variety of local and west-coast industries sponsor capstone projects. These generally involve the design and production of a prototype. Approximately six to twelve projects are sponsored each year.

Many faculty participate in a mentoring program that has been established to assist in the advising process. In the mentoring program each student is given the opportunity to associate with a full-time faculty member. The intent is to give the student an opportunity to discuss career plans, to understand what and why mechanical engineers do what they do, and to provide a supportive personal relationship.

A particular strength of the program is the amount of exposure to hands-on manufacturing techniques. We are unique in having a large machine shop devoted just to students. This is used both for instruction in manufacturing and for capstone design work. Mr. Russ Noe devotes his full time to maintaining the shop and instructing/aiding the students. We are particularly proud

of the state-of-the-art equipment in the shop, including computer controlled mills and a modern water-jet cutter. These have been made available primarily by gifts from our corporate sponsors.

B4. Undergraduates in Research and Scholarship

We routinely involve undergraduates in research, most notably via the NSF REU (Research Experiences for Undergraduates). We do not have a central list of these, although essentially every NSF grant has been involved in this. Other grants (e.g., NASA, DOE) also provide mechanisms for this. The department has not institutionalized procedures for this. Instead, the individual faculty involved have taken the lead in recruiting students for such research.

B5. Departmental Evaluation of Teaching Effectiveness and Learning

Each faculty member is required to perform an Office of Educational Assessment survey of each class they teach. Copies of these are forwarded to the chair for action as necessary. In addition, the policy adopted by the Mechanical Engineering Faculty require a peer evaluation of faculty in the various ranks according to the following time schedule:

- Assistant Professor: Each year
- Associate Professor and Professor: Every third year

The goals of this process are (1) to provide the faculty member with collegial feedback on their teaching in a confidential way for their own use, and (2) to provide a peer evaluation of their teaching for use in performance and promotion reviews.

The review is primarily based on the following three items:

1. Student evaluations (for at least one course both written comments and the computer summary, and for the remaining courses in the review period the computer summaries)
2. Instructional materials for at least one course
3. Self evaluation

The general approach is to not attempt a direct outcome assessment, but rather to evaluate teaching/learning effectiveness so far as possible based on the methods/materials used, and the perception of the outcome from the point of view of both the teacher and the students.

The evaluation procedure involves the preparation of a detailed review of the materials submitted, an independent evaluation of student teaching ratings over the last several years, and an assessment of the faculty member's self evaluation. If requested, one or more members of the committee attend a class conducted by the faculty member.

Following the preliminary assessment, the faculty member meets with committee members to discuss the preliminary findings. The goal of this interview is to provide a frank informal environment for the exchange of thoughts between the committee and the faculty member. No record of this discussion is reported. For example, at this meeting the committee could raise

observations or issues that it wishes to discuss, and the faculty member could clarify the rationale behind pedagogical approaches or innovations.

Following the interview, the committee prepares a report assessing the faculty member's teaching. The member has the opportunity to review the report and respond to it in writing before it becomes final. This then becomes part of the merit and promotion packages, and can be used by the chair in discussions of performance and improvement with the faculty member (*e.g.,* the required annual conferences).

B6. Measures of Impact of Teaching on Learning

The principal tools focus on variety ways of looking at learning assessment. The goal is to provide multiple ways of assessing each learning experience where possible.

Standardized Exam: The Fundamentals in Engineering (FE) Examination administered by the National Council of Examiners for Engineering and Surveying (NCEES) is the first formal step toward registration as a Professional Engineer (PE). As such the FE exam represents an excellent evaluation of the technical ability of students from engineering programs from all over the state and nation. Examinees are tested in both General Engineering areas (*e.g.* chemistry, electrical circuits, ethics, engineering economics, mathematics, *etc*.) as well as chosen specialty topics, in this case Mechanical Engineering (*e.g.*, controls, design, fluid mechanics, stress analysis, thermodynamics, *etc*.).

Students taking the FE exam enter the special code for the University of Washington/Department of Mechanical Engineering. This allows us to track our results relative to students from peer institutions. For example, some years ago the performance of our students on the economics section lagged those of our peers, which led us to re-examine the economics portion of the design curriculum.

Surveys: All graduating seniors are surveyed by the university as to their level of customer satisfaction with their university experience. In addition, we survey alumni at one year and five years out. The rationale for surveying at three alumni "ages" is to see if there are changes in perception of the value of the various aspects of education as the student is exposed to engineering practice (*e.g.*, the value of a course might not be as apparent to a new student as to an alumnus who has needed it for work). These survey forms were reviewed by our Visiting Committee, who suggested some broadening of the survey beyond just curriculum aspects. As an example, the form for the one-year survey is included as Appendix 15.

Rubrics: We use these for individual courses, primarily in capstone design, to allow the evaluation of proficiency levels with respect to the learning objectives for each course. This is particularly necessary for our capstone course as the course involves four major capstone projects (SAE car, human powered submarine, mechatronics design, fuel cell). In addition, there are a series of industry-sponsored projects that are conducted by small teams during spring quarter. Finally, we allow students to perform individual capstone projects with faculty in areas where there is a mutual interest. While both the students and the faculty welcome the flexibility that comes with this fairly open approach, it has created a challenge in ensuring that all the objectives and outcomes are addressed in each offering. Our approach to this has been to use a

uniform scoring rubric, performed by both the faculty and the students, to evaluate the various aspect of each offering. These allow a certain level of self assessment by students while removing the subjectivity of the instructors.

Technical Writing Assessment: This assessment is coordinated by our Department of Technical Communication. They first form a committee of three Mechanical Engineering faculty to act as reviewers. They then identify courses that have a significant writing assignment (senior level is best), and contact the instructor to make sure a copy of each of the papers is available. Generally the students are asked to turn in two copies of their papers.

TC then organizes two face-to-face meetings with the reviewers. At the first meeting, they review the evaluation forms and talk about the process. Each member then takes two sample papers to evaluate. At the second meeting everyone's evaluations are reviewed and discussed to "calibrate" the methods to be used for the rest of the papers.

At the second meeting the evaluators are given their papers to review. They can have about 3 weeks to complete these reviews. Evaluations are returned to TC, who then prepares a summary report. The report for our last cycle (August 2006) is included as Appendix 1, which indicates that our writing assessment is above the college average.

Visiting Committee: The Visiting Committee is asked to undertake various reviews of the undergraduate program. These tend to be *ad hoc* rather than systematic, and are usually focused on areas that are perceived as problems or areas where their expertise is especially helpful. Four instances where such reviews were held are:

1) A review of the student/alumni surveys shown in Appendix 15.
2) Review of the capstone rubric discussed above.
3) Completion of a survey in which the members compared the attributes of our graduates in their employment against those from peer schools.
4) A review of the capstone projects themselves.
5) An independent interview (*i.e.,* acting as a third party) with our co-op students regarding the adequacy of the curriculum to prepare them for the work they were asked to undertake.

B7. A Continuous Improvement Cycle Applied to Teaching

At the end of each academic year, the course coordinator and all instructors for that year of each course meet to assess the degree of success of that course for that academic year. The coordinator completes a pre-formatted report and forwards it to the ABET accreditation subcommittee which reviews it and documents any corrective action. The coordinator then proposes corrective action. In general, this takes the form (1) of enforcing the inclusion of material that should have been present to meet an objective or outcome, or (2) of recognizing that the course naturally does not fulfill one of the listed ABET objectives or outcomes. In the latter case the action is to recommend to the ABET Subcommittee that the objective or outcome be removed for the subject course from the mapping table. This procedure has been found to provide an added benefit as a very effective means of "institutionalizing" course material so as to

promote consistency and quality within courses with multiple instructors. This approach also provides an effective means of disseminating best practices.

B8. Promoting Innovation in Teaching

We have found that the course assessment meeting outlined in the previous section (i.e., the meeting each year of the course coordinators and each instructor for a given course) provides a valuable mechanism for sharing best practices. We have found that the normal course of events does not promote detailed comparison of teaching approaches and best practices. Thus, any such mechanism that promotes interaction among teachers has a first-order benefit. A major emphasis is the inclusion of additional lab work in all the major courses to support an experiential learning goal. To this end, we recently hired an instructional technician who is devoted just to instructional labs.

Other innovations include the development of the mechatronics capstone design sequence, and the development of a fuel cell lab for the fuel cell capstone sequence. The most recent is a nanotechnology capstone sequence that was initiated by Prof. Jae Chung this year. The challenge has been to develop a complementary classroom and lab curriculum for these emerging areas.

C. RESEARCH AND PRODUCTIVITY

C1. Faculty Promotion, Compensation, and Retention

The Mechanical Engineering Department is committed to research, teaching, and service as cornerstones of a balanced academic career. Our merit review and promotion criteria attempt to institutionalize the evaluation of these characteristics in a faculty member in as fair a way as possible. Mechanical engineering is an unusually broad technical discipline, and as such, it can be difficult for each colleague to accurately evaluate the contribution of every other colleague. Thus, an institutional process that is seen to be fair is necessary to ensure an accurate evaluation.

Merit raises are based on a total score of 20 points, 8 for research, 8 for teaching, and 4 for service. Each faculty member is reviewed by all those superior in rank (*e.g.,* all assistant professors are reviewed by all associates and full professors). Full professors review the cv's of each other full professor. As part of the review, each score includes a recommended merit raise based on the total amount in the merit pool. The faculty superior in rank then meet to discuss the overall score of the junior faculty (*e.g.,* all associate and full professors meet to individually discuss the assistant professors). The aggregate performance scores and recommended merit increase are discussed. As required by the code, equity and compression are considered as part of the discussion. At the end of the meeting, a recommended merit increase for each person in the rank under consideration is approved. At the full professor rank, a committee of four selected by the full professors performs the review of the raw performance rankings and makes a recommendation on each case to the Chair. The Chair then can make his or her own recommendations and forwards these to the Dean. At the same time, the senior faculty discuss the progression of each eligible faculty toward promotion. This is communicated to the junior faculty member by the advocate.

The Department also has a procedure in place for retention pay increases (*i.e.,* countering competitive offers). We have not, as yet, dealt with a competing offer.

Each faculty member below the rank of Professor is asked each year (normally in May) if they wish to be considered for promotion. If they wish, their case it taken up in a faculty meeting in late May, where a vote is taken as to whether the faculty recommends proceeding with the promotion process. If the vote is negative, the reasons for this are discussed with the candidate, who can then choose to drop it at this point or insist that it move forward. The department's Promotion Advisory Committee, working with the Chair, then proceeds to identify outside reviewers for the reference letters and to solicit/collect the letters. They then write a detailed evaluation report, which is shared with the candidate. The Department's recommendation is made at a faculty meeting in the fall, with all the paperwork then moving forward to the College level.

The department maintains an active awards committee to ensure that faculty who are eligible for university awards or awards outside the university (*e.g.,* society fellowships), have their cases assembled in the best manner possible.

C2. Faculty Research Mentoring

Our general approach to faculty mentoring (including research mentoring) is described in Section A7. In addition, the College provides information on writing proposals, CAREER proposals in particular. Many of the proposals from junior faculty are read by their advocates before being finalized, as discussed elsewhere. The Department does now provide teaching pause quarters for those attempting initiatives in new areas or who are coordinating large proposal efforts (*e.g.,* MURI).

C3. Our Research Impact on the Field

Our research has impacted the mechanical engineering field both via basic research and creative innovation. Additionally, the societal impact of our work is enhanced through collaboration with government agencies and industry. As mentioned earlier, one measure of our impacts is the large fraction of the invention disclosures filed with the UW Office of Technology Transfer by ME faculty.

A few of our most important long-term contributions include, for example, Minoru Taya's basic research into smart materials that change conductivity radically, from a semi-conductor to a conductor state, which led to the development of electrochromatic polymers that change color. This research was built upon a strong partnership with Boeing; currenet efforts are focusing on smart dimmable windows for airplanes.

Basic research on composites in the ME department has led to collaborations with Boeing on existing, near- and long-term applications of composites and advanced materials for large transport commercial aircraft. The impact of this work is enhanced through a collaboration of academic institutions, aerospace companies, and government agencies led by Mark Tuttle

through the UW **Center of Excellence for Advanced Materials in Transport Aircraft Structures (AMTAS)**.

Recent focus on biomedical applications has led to research with significant clinical impact. For example, Eric Seibel developed an ultrathin and flexible scanning fiber endoscope (SFE). Rather than many optical fibers, the use of a single scanned optical fiber reduces the overall diameter of the endoscope. The smaller diameter allows access to regions of the body that were previously inaccessible such as the bronchia for the early detection and treatment of cancers within the body.

Magnetic Resonance Force Microscopy (Garbini). This novel approach offers the potential to directly observe single atoms within molecules. This multi-year effort has been well supported by a range of funding agencies.

Microgreen Technologies (Kumar). Fundamental work on the injection molding of plastics that outgas within the mold has led to easily shaped objects with excellent thermal and mechanical properties. These can range from a coffee cup that is light, well-insulated, and uses little raw material, to lightweight aircraft interior panels that insulate better than existing materials. This work has led to a spin-off company that is commercializing these materials.

Composite Machining (Ramulu). Composites are used in modern aircraft, but they are very difficult to drill, cut, or finish. Prof. Ramulu has been working for years on a series of approaches to machining these materials in a fast, cost-effective manner that leads to acceptable results. Many of his approaches have been adopted in the manufacture of the 787, and these are in large part major contributors to the success of the design.

On the more fundamental side, members of our faculty have had the kind of impact that comes from years of dedicated, cutting edge research. One example is Prof. Riley's work in science and engineering when the prediction of a two-phase flow, *i.e.,* a carrier fluid with particles embedded, is required. For example, this is usually the case in combustion, where the reactants are introduced in droplet or particulate form into a gaseous carrier phase. In the atmosphere this is the case in predicting cloud development and also often the dispersion of contaminants from a source. Professor Riley has developed the fundamental equations for the motion of the embedded phase (Maxey, M.R., and Riley, J.J. 1983. “Equation of motion for a small rigid sphere in a non-uniform flow”, *Phys. Fluids*, **26**:883-889) and in fact performed the first direct numerical simulations of turbulence (Riley, J.J., and G.S. Patterson, Jr. 1974. “Diffusion experiments with numerically integrated isotropic turbulence”, *Phys. Fluids*, **17**: 292-297). This work has had a tremendous impact in research and in applications, having been referenced over 550 times, much of which is in the past 5 years, and quoted in recent texts and reference books.

C4. Impact of External Drivers on our Research

The advent of biotech and nanotech as critical research areas has had significant impact on faculty research. New faculty hires in these areas and increased interest in existing faculty have made bio and nano areas a significant portion of current ME research. About half of the faculty are involved in Bio and Nano research as summarized in the following table.

Faculty	Area
Ao	Modeling of Biological Networks
Ching	Injury Biomechanics of Adult and Pediatric Spines
Chung	Fabrication of Nanostructures and Nanodevices
Devasia	Nanoscale Imaging of Human Cell Movement
Gao	Cryopreservation of Biological cells and tissue
Garbini	Molecular imaging with Magnetic Resonance Force Microscopy
Kramlich	Particle inhalation epidemeological studies
Li,,J	Conductive and Dielectric Nanocomposites
Li,W	Biomaterials processing and tissue engineering
Mescher	Carbon nanotube based polymer composite fiber
Nuckley	Biomechanics
Reinhall	Biomedical Sensors
Riley	CFD applied to arterial stenoses
Seibel	Scanning Fiber Endoscopes
Taya	Bioinspired smart materials; artificial muscles
Wang	Fiber-optic Biomedical Sensors; smart shoes
Xu	Surface plasmon resonance (SPR) for early cancer detection

C5. Balancing Faculty Cultural Differences

Mechanical engineering can probably be best characterized as a broadly diverse technical discipline whose members share a fairly homogeneous culture. Some faculty members choose to work in very fundamental research, while others focus on design, practice, and practical applications. The diversity in technical disciplines and approach to technical problems can create some tensions when attempting to evaluate faculty members for promotion or merit. The unusually collegial and respectful environment we maintain has always allowed us to work through any such challenges.

Most faculty labs and offices are in the Mechanical Engineering Building (MEB). We do have a few lab spaces elsewhere (Prof. Seibel is in Fluke Hall, and Prof. Ching is in rented space off campus). Our growing research presence has required some other labs to be moved to more appropriate space, in particular the newest bio labs have been established in excellent space with the help of the college and the Dean's office. Within the MEB, a number of faculty share lab space, *e.g.,* Fabien/Shen/Reinhall/Wang, Tuttle/Chung.

C6. Impediments to Productivity

As discussed above, the principal difficulties are associated with the quality and amount of modern laboratory space and inadequate staff support. Our staff/faculty ratio is low, with the result that faculty are doing tasks that could be done more effectively by staff. We generally believe that additional clerical staff members are not the greatest need, but rather staff that could

independently take on professional tasks, *e.g.*, development, diversity, outreach, class scheduling, facilities planning, *etc.*

C7. Staff Productivity

The awards nomination committee mentioned above has been active in nominating staff for appropriate awards. All staff are included in weekly meetings with the chair and associate chairs. For example, the entire academic advising office staff meets each Monday morning with the chair and the associate chair for academics to review workload and issues. The faculty policy committees include appropriate staff representatives. All of this has the goal of keeping the staff as members of the team. In addition, the department sponsors quarterly staff luncheons.

D. RELATIONSHIPS WITH OTHER UNITS

Each of our major research thrust areas involves collaboration with people outside the department. This is clearly a response to the evolution of modern critical research areas as cross-disciplinary. Appendix 16 list the major collaborations by research area. Other examples of collaboration include:

- We often chair the committees of students from other departments, and other departments often chair the committees of our students.
- We have an extensive adjunct faculty membership in our department of those who hold primary appointments elsewhere. Also, our faculty are well represented as adjuncts outside the Department.

One important example is the work of our faculty with those of EE and AA to develop a single controls curriculum at the graduate level. This includes a year-long Controls Colloquium that is jointly managed by the three departments.

The NSF funded center MDITR (Materials and Devices for Information Technology), headed in the UW Department of Chemistry, has engaged several of our Mechanical Engineering faculty, both through invited research seminars, and to a greater extent through our involvement with the center's activities in diversity. One of our faculty members serves as the center's Associate Director for Diversity, and it is in this capacity that our department has had the opportunity not only to help develop new diversity initiatives but also participate in larger multidisciplinary events, such as "Hands-On FutureTech" which is described further in the diversity section of this report. Development of the "leadership lunch" series for graduate students is another example of a new initiative that grew out of our collaboration with MDITR; these represent new opportunities for our graduate students to meet informally with students from more diverse backgrounds and other disciplines and in some cases engage in the center's multidisciplinary research.

E. DIVERSITY

E1. Diversity Representation

Graduate student applications, admission and enrollment data for Autumn 2006 indicate that Mechanical Engineering's greatest weakness is in recruiting and enrolling Native American and African American graduate students. We have done somewhat better in recruiting and enrolling women and Hispanic American graduate students. Detailed data are provided in Appendix 9.

Autumn 2006 full time masters student admissions:
Of the 145 students who applied for full time study in our master's program, 17% were women, 2% were African American, 4% were Hispanic American, 0% were Native American, 6% were Asian American, and 10% did not report ethnicity.

Of the 111 students who were accepted for full time study in our master's program, 19% were women, 1% were African American, 5% were Hispanic American, 0% were Native American, 7% were Asian American, and 8% did not report ethnicity.

Of the 40 full time masters students who actually enrolled, 32% were women, 2% were African American, 12% were Hispanic American, 0% were Native American, 12% were Asian American, and 7% did not report ethnicity.

Autumn 2006 full time doctoral student admissions:
Of the 42 students who applied for full time study in our doctoral program, 19% were women, 2% were African American, 2% were Hispanic American, 2% were Native American, 5% were Asian American, and 7% did not report ethnicity.

Of the 16 students who were accepted for full time study in our doctoral program, 25% were women, 0% were African American, 6% were Hispanic American, 0% were Native American, 6% were Asian American, and 6% did not report ethnicity.

Of the 9 full time doctoral students who actually enrolled, 22% were women, 0% were African American, 11% were Hispanic American, 0% were Native American, 0% were Asian American, and 0% did not report ethnicity.

Faculty and Staff:
Among the department's 24 tenured or tenure track faculty, two are women (8%; both associate), one is African American (4%; full), one is Hispanic (4%; assistant), and five are Asian American (21%; two assistant, one associate, two full).

Among the department's 12 state supported staff, five are women (42%), one is African American (8%), and three are Asian American (25%).

E2. Diversity and Workload

Teaching loads for faculty members in Mechanical Engineering are evenly distributed, at a nominal load of one course per quarter. The numbers of credit hours for large sections of undergraduate courses tend to be very high; however, these courses are supported with 1-2 teaching assistants, whereas smaller graduate courses do not have teaching assistantship support.

A review of teaching loads over the past several years confirms that the nominal one course per quarter is followed quite closely, with the exception of faculty who: a) have administrative load, b) are on sabbatical, c) received transitional support, d) have additional research load, or e) are in their start-up year.

E3. Integration of Diversity into the Department

As discussed above, our present PhD graduates are approximately 25% women and 10% underrepresented minorities. Our retention record has been excellent, with 100% retention of members of these groups over the last 10 years. The most critical challenge to increasing diversity is increasing the number of qualified applicants. This problem arises partly because of lower numbers of minorities in ME relative to other engineering disciplines, and partly because many of the potential candidates are not aware of the opportunities or environment here.

As discussed elsewhere, some of our approaches to these issues involve the NSF ADVANCE program, a GAANN proposal, an IGERT proposal, and a deeper involvement with the GO-MAP program at the graduate school. Two examples of this approach are leveraging the National Name Exchange (NNE) and the GEM database. NNE was founded in 1976 as a consortium of 30 nationally known universities which annually collect and exchange the names of talented but underrepresented ethnic minority undergraduate students who could be recruited to the graduate programs at these institutions. The UW has been providing institutional coordination and data distribution for NNE since 1986. With the help of GO-MAP staff, we review the list of accredited postsecondary minority institutions at ed.gov to determine which have active MS programs in engineering. We contact our counterparts to identify faculty or individual students to contact about research and education opportunities.

Our department is working to identify minority faculty members from other campuses who might be interested in visiting our campus, giving a technical seminar, collaborating with our faculty, or possibly having one of our faculty serve on their graduate student's advisory committee. This is an important area in which the University could provide various levels of support, including travel funds or honorarium for minority faculty visiting the UW campus.

E4. Diversity Interaction with the Graduate School

Our department is working to increase the diversity of students through our collaborations with the UW graduate school and a national consortium called GEM (Graduate Degrees for Minorities in Engineering and Science.) Over 600 minority students apply annually for GEM fellowships; however, in a typical year, less than 200 are supported by corporate fellowships for graduate study. The department recognizes this pool as an outstanding resource for recruitment

of underrepresented groups. Although the competition is keen, we will continue our efforts to recruit GEM applicants with offers of graduate research or teaching assistantships, which could be supplemented by GEM corporate fellowships. GEM fellowships require summer internships with the corporate sponsor, and we expect that these should be excellent practical experiences, increasing the yield of students who complete their degrees and further enhancing their marketability.

One of our faculty members is working closely with the GEM administration to address two key issues associated with the university's access to the GEM database. These include the timing of our access (to allow recruitment prior to graduate school application deadlines) and the need for additional information such as GRE scores and graduate study interest statement for each of the applicants. By collaborating with GO-MAP, our goal is to have access to the GEM database centralized and coordinated by the UW graduate school, so that the applicant list can be sorted by discipline as well as sub-discipline, and then be distributed to the appropriate units and faculty. We believe that personal communication between the students and individual faculty is key in our ability to recruit prospective graduate students. Contacting prospective candidates will be far less overwhelming for faculty members if they receive short lists of students interested in their sub-discipline, rather than access to very large databases.

Several of our faculty members have participated in (OMA/GO-MAP) workshops for underrepresented minority students interested in academic careers. Meetings with OMA administration are aimed at keeping an ongoing dialog so that we can continue to improve our department's minority outreach. At one of our monthly department meetings, all Mechanical Engineering faculty had an opportunity to meet and talk with Sibrina Collins, who is the new Director of Graduate Diversity Recruiting.

An additional way that our department will work to increase diversity, and an area in which we would like to collaborate with the graduate school, is through our continued planning and participation in an annual recruitment event called "Hands-On FutureTech." In conjunction with several NSF funded centers, the department has participated over the last two years to present exciting hands-on research activities to minority students. At each event, over 100 minority students in STEM attended. Last year's event was hosted by Norfolk State University, a minority serving institution. The department will continue to develop this event for its recruitment of minority students in collaboration with minority serving institutions.

E5. Influence of Diversity on Climate and Curriculum

The increased diversity in both our student body and in the faculty has improved our culture and climate, and we continue to work towards further progress in this area. As part of our department's ADVANCE grant, several of our faculty carried out interviews with volunteer groups of graduate students. The feedback from these interviews has been a central component in our work to shift towards a more inclusive culture and climate that gives all students a greater sense of belonging in the discipline and the unit.

In addition, one of our faculty members has initiated a "leadership lunch" series for STEM female graduate students, which has been running every month for almost a year now. This

lunch series provides a forum in which graduate students have the opportunity to meet with female role models from academia as well as industry. Students ask about career paths, successes and challenges, as well as balancing career and family. We think this is especially valuable for women who are significantly underrepresented in departments such as Mechanical Engineering.

The attendance at the leadership lunches has been consistent with 25-30 participants each month, and this has only been limited by funding sources, which include the UW Chemistry Department (typically over half the participants are from this department) and MDITR (Materials and Devices for Information Technology Research) which is a NSF funded center headed by Professor Larry Dalton (UW Chemistry). The leadership lunch series has truly spawned additional leadership and it has been so successful that we would like to expand this to include minority students as well. This is an area where the College or University could be especially helpful in supporting an expanded lunch series for minority and women students in STEM. We believe that this would improve the College and University culture for minority and women students not only in our own department but many others as well.

F. DEGREE PROGRAMS

F1. Doctoral Program

The PhD program in mechanical engineering was authorized in 1959, with the first degree awarded in 1963. The program has consistently focused on engineering science with the goal of preparing academic professionals, industrial and government researchers, and leaders in the profession. The program presently graduates around 10 students per year.

The principal goals of our PhD program are to:

1. Prepare individuals for careers in academia, for research in corporate and government settings, and for leadership in the profession.
2. Establish a community of faculty and PhD scholars whose goal is the creation and dissemination of new knowledge.

These goals are consistent with those of top research university programs across the country.

The standards we use to measure our achievement of these goals consist of *internal* quality measures that are applied to the students during their degree program, and *external* measures. The latter primarily consists of evaluating the success of our graduates in finding appropriate employment positions and their success in these positions.

Appendix 10 is a checklist of milestones for our PhD program that provides the framework for our internal quality measures. The major steps are as follows:

Admission. We require an MS degree before entry into the PhD program. Very broadly, we look for individuals who are consistently in the upper half of their classes during their MS degree who have distinguished themselves in their research. In the latter we are looking for self-starters who are able to think critically about their work and who can project ahead to identify the next

logical steps. In other words, we look for people with good raw intellectual resources who show the potential of becoming independent researchers.

Qualifying Exam. The qualifying exam must be attempted within the first year following entry into the PhD program. It is primarily designed to provide an initial assessment of the academic preparation and quality of the new student, as well as an indication of the promise of the student to become an independent scholar. The exam is given in November and May of each year. The formal exam format is as follows:

- Two hour written math exam
- Four hour general engineering exam (given the day following the math exam). This focuses on advanced undergraduate material in the student's major area and in one minor area.
- One hour oral exam focusing on graduate-level work in the student's major area

Each case is discussed at a faculty meeting, with the overall exam outcome based on the following three points:

1. Exam performance
2. Performance in graduate coursework taken to date
3. Research performance promise, as reported by the student's faculty advisor

Four outcomes are possible:

1. Pass exam.
2. Conditional pass. Student is generally required to fulfill specified requirements before taking the general exam (*e.g.,* additional courses with minimum grade).
3. Fail with permission to retake the exam for a second and final attempt.
4. Fail with withdrawal from the Ph.D. program.

Approximately 30% of the students fail the exam on the first attempt. Almost all are afforded a second attempt. Speaking in very broad terms, the students who take the exam fall into the following categories:

- Very strong students who do well on all parts of the exam. These always become strong PhD students
- Students who failed the exam due to either not preparing, or having a background deficiency. Most of these do the work required to pass the exam credibly on the second try.
- Students who failed and do not appear to have adequate potential for the program. Although these students are generally allowed the option of retaking the exam, upon reflection and during discussion with their advisors they realize that the PhD program is probably not for them and they choose to pursue other options. We feel that this is a much more positive outcome than a simple "fail" because the student takes the initiative in deciding his or her future.

Following the exam, the student selects the advisory committee. The advisory committee often includes members from outside the University, *e.g.*, other schools or national laboratories.

General Exam. The general exam is the hurdle to candidacy at the UW, and it consists of the preparation and defense of a dissertation proposal. This normally takes place during thee student's third year in the program. The exam is usually taken at the point where sufficient research work has been performed (1) to show that the topic is viable (neither too simple or difficult), and (2) to allow a clear identification of the tasks remaining to complete the dissertation. Thus, a passed general exam can be viewed as a contract between the student and committee regarding what is needed to complete the degree. Of course this can change if the research takes an unexpected turn, but the goal is to take the exam at the point where the remaining work can be fairly well defined.

Dissertation and Final Defense. The dissertation is reviewed and approved by the advisor and reading committee, and it is presented and defended.

Publication. All of our students present their research in the archival literature and at conferences. This ensures that the results of their research are disseminated to the community.

These procedures are designed to measure our program's internal quality control. Our external measure is in the acceptance of our graduates by the community, and their success following graduation. Appendix E list the placement of PhD graduates over the last three years. Approximately half have gone into academics, either directly as new faculty or as post-docs. A majority of the remainder have gone into the corporate world in research labs or in advanced development positions. This success in placing these students indicates that we meet our external goal.

A new event started last year is our *Leadership Seminar Series*. This series, held for the first time in Winter 2006, invites distinguished alumni back to campus as speakers. The list of speakers for Winter 2007 is listed in Appendix 18. These speakers generally focus on both the technical issues associated with their professional lives as well as the factors that led them to make career decisions at various critical points. More than almost anything we have done, we feel this provides the most direct and meaningful help to our graduate students in beginning to think about career choices following graduation.

Finally, each PhD student who wishes to teach a lecture class at some point in their graduate career is afforded that opportunity. This is normally (but not always) done with a summer school section, and the student is supervised during that time by the faculty course coordinator. Teaching performance is measured via student evaluations and a peer assessment by the coordinator. This is shared with the graduate student teacher.

F2. Master's Degrees

The Department offers the Master of Science in Mechanical Engineering, and administers the Master of Science in Engineering. The latter is a degree formally offered by the College of Engineering. The two degrees can be broadly described as follows:

Master of Science in Mechanical Engineering (MSME). The MSME degree is intended for students with an undergraduate degree in Mechanical Engineering or a closely related field, such as Aerospace Engineering. Students' undergraduate backgrounds should include Mechanical Engineering core courses in fluid mechanics, thermodynamics, heat transfer, mechanics of materials, dynamics of mechanical systems, systems analysis, machine design, manufacturing, and design. This degree is intended for students presenting themselves as professional mechanical engineers, with academic backgrounds covering both the BSME and MSME curriculum. Students with an undergraduate degree in a discipline other than mechanical or aerospace engineering will need to make up deficiencies in undergraduate core areas in order to earn the MSME degree. If only a few deficiencies exist, these courses may be taken as part of the student's MSME program. If, however, the number of deficient courses is large (as many as ten courses can be required), the deficiencies will probably need to be made up before the student officially enters the graduate program. Non-ME courses presented to cover undergraduate deficiencies are evaluated by the department.

Master of Science in Engineering (MSE). Those students not wishing to make up undergraduate deficiencies may qualify for the MSE degree. The MSE degree has exactly the same degree requirements as the MSME, but does not require the core professional undergraduate ME courses. Instead, it requires only the standard entry-level math, physics, and chemistry courses, along with introductory engineering courses such as statics, dynamics, elementary materials, circuit theory, computer programming, *etc.* The admission requirements are detailed in Appendix 13.

Thus, the principal difference between the two degrees is the presence of the undergraduate coursework underlying the MSME. This degree is traditionally identified with the professional engineering practice associated with the BSME. The MSE degree has been primarily for students with non-engineering backgrounds who wish to work in research topics associated with mechanical engineering rather than mechanical engineering professional practice.

F3. Bachelor's Degrees

Goals and Objectives

Goals/Program Educational Objectives

1. *Preparation for the profession*. At the end of their education, students should possess a tool chest of skills and knowledge that positions them for success as (1) entry-level engineers in existing firms, or (2) graduate students in any program in the country. This does not preclude other activities, such as volunteerism, self-employment, or academic study in another discipline. Students succeed in this goal by being able to: Use fundamental science and engineering analysis to solve engineering problems; Successfully execute engineering designs, including effective use of project management tools; Perform effectively in teams through oral, written and graphical communication.

2. *Contribution to society*. Students succeed in this goal by being able to: Think critically, in the sense of broadly educated individuals; Perform independent,

informed analysis on issues inside and outside of technology; Continue lifelong learning.

This mission and the program and educational objectives are consistent with those of the College of Engineering and the university because they reflect the same concerns for professional training and development as well as for contributions to society outside the profession. The first focus is on preparing students to be entry-level engineers and graduate students. Most of our successful alumni started either at entry-level in existing firms or as graduate students. From this point the alumni branch in so many directions it is difficult (and probably counterproductive) to include specific training covering all the possible directions. This is part of the reason for the second objective, to acquire the capability to "self learn" the skills needed to move along one of the many possible career paths. The other goal of the second objective is to provide an informed individual who is a critical consumer of both technical and non-technical information. Meeting this goal is one difference between a broadly-based university education as opposed to technical training.

Assessment

Our principal assessment tools are as follows:

Standardized Exam: The Fundamentals in Engineering (FE) Examination administered by the National Council of Examiners for Engineering and Surveying (NCEES) is the first formal step toward registration as a Professional Engineer (PE). As such the FE exam represents an excellent evaluation of the technical ability of students from engineering programs from all over the state and nation. Examinees are tested in both General Engineering areas (*e.g.* chemistry, electrical circuits, ethics, engineering economics, mathematics, *etc*.) as well as chosen specialty topics, in this case Mechanical Engineering (*e.g.*, controls, design, fluid mechanics, stress analysis, thermodynamics, *etc*.).

In the Department of Mechanical Engineering, all students are encouraged to take the FE exam prior to graduation. Typically the FE exam is given in October (autumn quarter) and April (spring quarter) of each academic year. To prepare for the majority of students wishing to take the FE exam in April, in anticipation of graduation in spring quarter, the department offers a FE exam preparatory sequence in winter quarter preceding the FE exam.

Students taking the FE exam must enter the special code for the University of Washington, indicate that they are currently enrolled in school, and must also select both their major and afternoon (PM) portion of the FE examination as Mechanical Engineering (the morning (AM) portion of the FE exam is General Engineering). When the results for the examination are released (typically June for the April FE exam), each student is encouraged to submit a copy of the official passing exam result to the Department of Mechanical Engineering for use by the ABET subcommittee. The compiled FE exam results are forwarded to the COE by the State of Washington Board of Registration for Professional Engineers and Land Surveyors. The overall average results as well as individual subject matter can be compared for UW ME students (special code), with the state averages, and the national averages thus providing additional information for evaluating the performance the technical outcomes of the program.

Currently, about 20-25% of graduating students in each academic year voluntarily take the FE exam. (We have investigated various options for increasing participation. It turns out we are legally prohibited from requiring the exam as a condition of graduation, as it represents a control of a graduation requirement by an entity outside the university.) We do strongly encourage students to take the exam.

Surveys: All graduating seniors are surveyed by the university as to their level of customer satisfaction with their university experience. In addition, the University of Washington Engineering Alumni Association conducts periodic surveys of all College of Engineering alumni to assess their success in their profession. Surveys are also conducted by the College of Engineering Cooperative Education office to provide results from industrial employers of co-op students. These results are directly targeted to particular industries and to ME students and often address both how well students are prepared for an assignment when first entering the co-op program as well as how much they have changed when leaving the program. As part of its own assessment process, the department conducts surveys at graduation (zero year), one year after graduation and five years after graduation. These surveys are intended to probe how well students graduating from the program are utilizing the "tool chest" of skills acquired in the curriculum. The survey forms (for the year one survey) are included in Appendix 15. In particular, departmental surveys are intended to assess those areas not addressed in other assessment methods such as the standardized exams. So-called "soft" skills such as teamwork, oral communication, project management, *etc*. can be assessed via surveys. Results of these surveys are subject to interpretation although any "red flags" are the source of scrutiny for weakness in the curriculum. The rationale for surveying at three alumni "ages" is to see if there are changes in perception of the value of the various aspects of education as the student is exposed to engineering practice (*e.g.*, the value of a course might not be as apparent to a new student as to an alumnus who has needed it for work). Note that the survey forms were reviewed by our Visiting Committee, who suggested some broadening of the survey beyond just curriculum aspects.

Instructor Course Assessment: At the end of each academic year, the coordinator and all instructors for that year of each course meet to assess the degree of success of that course for that academic year. The coordinator completes a pre-formatted report and forwards it to the ABET subcommittee which reviews it and documents any corrective action. The coordinator then proposes corrective action. In general, this takes the form (1) of enforcing the inclusion of material that should have been present to meet an objective or outcome, or (2) of recognizing that the course naturally does not fulfill one of the listed ABET objectives or outcomes. In the latter case the action is to recommend to the ABET Subcommittee that the objective or outcome be removed for the subject course from the mapping table. This procedure has been found to provide an added benefit as a very effective means of "institutionalizing" course material so as to promote consistency and quality within courses with multiple instructors. It has also proven to be a very effective means of making the general faculty aware of ABET objectives and outcomes.

Technical Writing Assessment (TC): This assessment is coordinated by our Department of Technical Communication. They first form a committee of three Mechanical Engineering faculty to act as reviewers. They then identify courses that have a significant writing assignment

(senior level is best), and contact the instructor to make sure a copy of each of the papers is available. Generally the students are asked to turn in two copies of their papers.

TC then organizes two face-to-face meetings with the reviewers. At the first meeting, they review the evaluation forms and talk about the process. Each member then takes two sample papers to evaluate. At the second meeting everyone's evaluations are reviewed and discussed to "calibrate" the methods to be used for the rest of the papers.

At the second meeting the evaluators are given their papers to review. They can have about 3 weeks to complete these. Evaluations are returned to TC, who then prepares a summary report. The summary report from our last assessment (August 2006) is included as Appendix 1.

Visiting Committee (VC): The Visiting Committee is asked to undertake various reviews of the undergraduate program. These tend to be *ad hoc* rather than systematic, and are usually focused on areas that are perceived as problems or areas where their expertise is especially helpful. Four instances where such reviews were held are:

1) A review of the student/alumni surveys
2) Completion of a survey in which the members compared the attributes of our graduates in their employment against those from peer schools
3) A review of the capstone projects themselves

Center for Instructional Development and Research (CIDR): This campus group provides a service in which trained evaluators come to the classroom and engage the students in a series of questions. Often this is used to help evaluate/improve teaching, but in the present context it is used to evaluate the degree by which specific objectives and outcomes are addressed. The instructor is excused and the facilitator proceeds using a variety of surveys, focus group discussions, and consensus building.

The assessment materials are collected by the ABET Subcommittee, and disseminated back to the course coordinators or the faculty as the case may be for action. The committee keeps a log of each actionable item through to its implementation into the program. This log then forms the basis for evaluating the degree to which the change led to program improvement.

Efficiency Measures

In common with the other departments of the college, we reduced our graduation credit requirement to 180 credits a few years ago. This allows a student who plans well the ability to graduate in four years. If the student goes on Co-Op, then they cannot normally graduate in this time.

We previously offered all required courses every quarter, which allowed the student the flexibility design their own curriculum sequence. We have since reduced the number of offerings to two (except for the ME 373/374 sequence which is offered only once each year). This has resulted in two lockstep sequences for the required part of the program. To support this, we offer undergraduate admission only for autumn quarter entry. These steps have simplified

the course planning process and reduced the number of student mistakes that lead to delayed graduation. In practice, the choice of the two lockstep sequences is determined by which capstone project the students plan to perform. One sequence is for the SAE Car and sub projects, and the other is for the remaining projects. Both sequences are shown in the advising guide (Appendix 4).

Career Advising

Our faculty are heavily involved with our local and national employers via research/consulting, employer membership on our visiting committee, connections with alumni at companies, and our Leadership Seminar. While many students make use of the Career Center, many companies directly recruit by send their openings to us for dissemination over our BSME mail list. We survey our alumni to determine where they go (*e.g.,* the placement information contained in Appendix E). It was in this way that we have followed the changing employment picture for BSMEs, from large companies to small entrepreneurial firms. We are presently considering adding material on entrepreneurship to the curriculum to recognize this trend.

G. GRADUATE STUDENTS

G1. Recruitment and retention

As discussed in Section A, we view one major strength as our recruiting strategy, something that involves the participation of most of the faculty. The GPC initially reviews each applicant file for quality and compatibility with our program. A preliminary score is assigned based on a combination of the GPA for the last two years and the GRE score:

Score = GPA + GRE/1000

The GRE score is the sum of the verbal, quantitative, and writing scores. The writing score is transformed to an 800 maximum basis via equivalent percentiles. Thus, a perfect score is 6.4 (=4.0+2400/1000). While we make use of this composite score for initial screening, we have found the GPA (interpreted in terms of the quality of the school and the resistance of the school to grade inflation) to be the strongest indicator of success. Beyond the raw GPA, we look for trends up or down in grades, and unevenness in grades (good grades with one or two bad terms may indicate a capable student suffering from external issues). After GPA, we find the quantitative GRE score to be the next most useful indicator for success in our program. Specifically, a low GREQ score can indicate a problem with what otherwise is a good record, while the difference between an adequate and a perfect GREQ score generally does not correlate well with success. The personal statement can provide a indication of maturity and focus.

Those applicants of interest are assigned to a faculty member who shares the same research interest (and diversity background where appropriate) for an initial telephone interview. The main goals are (1) to evaluate the depth of the applicant's interest in our program, and (2) to show our interest in the applicant. The buy-in of the whole faculty to this process shows the applicant that we care about the applicant, something that has repeatedly come out of surveys of our students. In the past we made an open invitation for applicants to visit campus on their own

schedule, but last year we held our first Prospective Student Visitation Day, which was a complete success. We believe this one change was responsible for a 20% increase in our acceptance rate this last fall. One measure of success is our improving ability to draw students from all over the country (see Appendix 7).

We formulate our financial aid offers at the same time we consider admission. Appendix 5 shows the financial aid packages accepted for the autumn 2006 entering class. Note that the entering cohort numbers about 45, but those on the professional, terminal MSME track are normally not supported. The initial financial aid consists of a mix of fellowships, RA appointments and TA appointments. Most of the TAs convert to RAs during their first year. The department will support any PhD student whose RA support has run out through five years of PhD study. Most of continuing PhD students are supported on RAs. The support situation for autumn 2006 *continuing* students is given in Section G4 below.

Our approaches for outreach and recruiting for underrepresented groups are discussed in Section E above.

Our graduate program has very low attrition. Approximately only 1 or 2 of the ~50 students we admit each year do not finish their degrees.

An important factor in retaining our graduate students is understanding their perception of our program and its climate. The Advance program conducted a series of focus groups with our graduate students to identify areas of satisfaction and concern. The major findings are listed in Appendix 2. Appendix 2 also includes departmental action items taken in response to these issues.

G2. Advising, Mentoring and Professional Development

Much of the material here is covered in Section A7. The student's time here can be divided into two periods. The first is before the advisor is identified, when the advising office and GPC are the principal contact. The main steps are listed below:

- **Initial Enrollment.** Most students already have expressed an interest in one of the main graduate technical concentrations offered (*e.g.,* renewable energy, controls). Curriculum pathways for these are provided on the web, and by the advisors during the initial meeting with the student. For those who do not have an initial strong interest, a custom initial enrollment is designed to cover the multiple areas of interest expressed by the student.
- **Rules and Regulations.** Introduction to these is provided by (1) interview with the advisors and/or the GPC, (2) extensive materials available on the web (*e.g.,* see Appendices 10 and 11, and http://www.me.washington.edu/academic/advising/), and (3) an orientation presentation given by the GPC before the start of classes each fall.
- **Research Advisor Selection.** This admittedly is something the students find stressful. We do ask the students to be proactive in contacting and interviewing potential research supervisors. The GPC summarizes the process for the new students at orientation, and identifies appropriate faculty for the student where needed.

The second period begins after the advisor is selected. At that point the advisor takes prime responsibility for academic and career mentoring, and is the principal source of information on employment choices at graduation. The advising office performs graduation audit checks to ensure that students are on track to meet graduation requirements.

G3. Grievance Procedures

For Academic Student Employees (ASEs) there is a detailed procedure for grievances specified under the Union contract. The GPC generally acts as an advocate for students in disputes with advisors. We have had no formal grievances lodged in the last 10 years. The only issues along these lines involve disputes between faculty and students involving research workload expectations, and expected graduation dates. The GPC has advised students generally on how to approach their advisors on these issues, with most resulting in resolution. In two cases, the student moved to another advisor, with the GPC again acting in the role of an advocate for the student during this process.

G4. Graduate Student Service Appointees

The Department has three general pathways for graduate student appointees. The first is for those who are recruited with an offer of a service appointment. The second is for those who enter without an initial offer of support, but who are subsequently placed on a research assistantship by a faculty member who has grant support. The third are those unsupported students who become teaching assistants by competing for extra, open positions that are unfilled by those with guaranteed appointments.

Recruitment offers are made as part of the initial admission review process that is outlined above. The priority is for the highest quality applicants who we feel (via personal communication) have a reasonable chance of accepting an offer. We have generally found that a candidate who is most interested in other schools will generally not respond favorably to a superior financial offer if it is not backed up by successfully convincing the candidate that there is a superior educational reason for coming here. Thus, our focus is on the later, with the financial support itself generally not being the critical factor. The duration of the initial offer is a minimum of one year, with some being for two years. While most of these offers consist of TA support, some include one quarter of RA support, and around seven offers include cash support from fellowship endowments (generally about $9500) each in addition to the service appointment. Some custom packages are designed for minorities to take advantage of special fellowship endowments or GO-MAP resources. Almost all of these students who continue on for a PhD are converted over to RA support under research grants at some point during their initial TA support period.

In the second pathway, students receive an offer of a RA from a faculty member who has grant support. The department facilitates the interaction between the students and the faculty, but in the end it is the faculty member who extends the offer and the student who accepts it, completing the advisor/student contract. In general, the RA continues through the life of the grant (usually three years), and for any follow-on grants. The Department generally undertakes the support of any PhD student in good standing whose grant support has run out up to the end of the fifth year

from entry into the program. The goal is to guarantee support to all who have committed to the PhD program for at least five years.

The third pathway involves allocating departmental TA appointments that are in addition to our commitments. For most quarters, we do have additional open TA appointments. Approximately 6 weeks ahead of the start of the quarter an email goes to the graduate student body asking for self nominations for these open positions. These are then assigned based on the following priorities. First, those classes that require special skills (*e.g.,* computer graphics or machining) are staffed by students who have these skills. Second, senior PhD students who have run out of RA support have a high priority, as noted above. Third are MSME students who desire teaching experience. We generally try to spread the support resources around among these students (*e.g.,* if one student is supported in one quarter and another is not, the positions may be reversed in the following quarter). Support under this avenue is generally on a quarter-by-quarter basis.

Any PhD student who wishes to teach a lecture course is generally allowed to do so at least once during their program. Often this takes place during summer quarter.

The mix of funding sources for PhD students in autumn quarter 2005 (typical of our funding pattern) was as follows:

Total Students:	50
Under RA Support	28
Under Fellowship Support	5
Under TA Support	3
Partial Support	2
No Support*	12

*Most of these are (1) Boeing employees who are part-time PhD students, or (2) students who have accepted positions elsewhere and are finishing their dissertations away from campus. This total does not include MSME students who are on the PhD path. The support breakdown of these is approximately half TA, half RA.

Promotions and pay rates are set by the UW and the ASE Union contract. Six basic pay rates are in effect: pre-MS, PhD pre-candidate, and PhD post-candidate, with different rates in each of these categories for RA and TA. The RA rate is in excess of the standard UW rate, something negotiated by the department to ensure our offers are financially competitive.

In our Department, TAs always work under the supervision of the course instructor. In those few cases where the graduate student is acting as the course instructor, a faculty member (usually the course coordinator) is assigned as the supervisor. An evaluation form is completed for each TA at the end of the quarter by the instructor, who shares the evaluation in a conference with the student. RAs are supervised by the research advisor.

Because almost all the courses in our department are taught directly by faculty, the role of the TA is primarily one of support, e.g., grading, conducting lab sections, conducting recitation sections. Thus, the primary source of training is the instructor. All new TAs are required to

attend the two-day TA workshop conducted by CIDR in the fall. In addition, senior graduate students in our department have conducted a workshop on their own for new graduate students.

REQUIRED APPENDICES

Appendix A. Graduate Student Statistical Summary

See following page.

Mechanical Engineering

J**1997-98**	**1998-99**	**1999-00**	**2000-01**	**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**2006-07**	
Autumn Quarter Enrollment										
Enrollment History										
Total	178	158	152	150	138	147	136	141	147	152
Full-Time	117	100	99	97	95	110	92	100	101	103
Part-Time	61	58	53	53	43	37	44	41	46	49
Male	154	136	129	126	113	119	114	117	120	117
Female	24	22	23	24	25	28	22	24	27	35
Ethnic Minority	21	19	19	24	20	20	16	18	25	25
International	44	49	43	44	53	52	40	37	42	46
Wash. Resident	101	81	80	82	65	70	71	75	72	61
Non-Resident	77	77	72	68	73	77	65	66	75	91
New Student Enrollment	41	36	39	36	34	37	30	34	39	49
Continuing	135	119	112	113	101	107	106	107	108	103
Annual Applications (Sum-Spr qtrs)	233	192	193	165	173	229	207	143	165	
Autumn Quarter	190	151	152	131	126	177	171	117	132	170
Autumn Quarter Denials	58	46	39	31	23	62	76	26	15	32
Autumn Quarter Offers	112	76	98	77	78	94	88	74	95	113
Autumn Quarter Percentages										
% Denied (of Applications)	30.5%	30.5%	25.7%	23.7%	18.3%	35.0%	44.4%	22.2%	11.4%	18.8%
% Offers (of Applications)	58.9%	50.3%	64.5%	58.8%	61.9%	53.1%	51.5%	63.2%	72.0%	66.5%
% New Enrollees (of Apps)	21.6%	23.8%	25.7%	27.5%	27.0%	20.9%	17.5%	29.1%	29.5%	28.8%
% New Enrollees (of Offers)	36.6%	47.4%	39.8%	46.8%	43.6%	39.4%	34.1%	45.9%	41.1%	43.4%
Autumn Minority Admissions										
Application	13	16	11	13	19	17	16	18	24	25
Denials	1	8	0	2	6	5	2	5	3	1
Offers	12	6	11	10	13	12	12	12	19	19
Autumn International Admissions										
Application	87	73	78	74	62	79	67	36	39	56
Denials	44	32	38	23	15	48	56	13	9	28
Offers	35	20	30	31	25	19	10	7	14	21
Applicant Average GPA										
Denied	3.10	3.16	3.20	3.06	3.01	3.25	3.39	3.15	3.11	3.37
Accepted But Not Enrolled	3.51	3.51	3.51	3.50	3.60	3.53	3.52	3.49	3.57	3.58
Accepted and Enrolled	3.44	3.45	3.51	3.46	3.54	3.51	3.50	3.47	3.50	3.54
Applicant Average GRE										
Denied										
Verbal Score	477	391	432	470	383	548	519	480	519	477
Quantitative Score	740	703	755	721	733	761	761	755	754	771
Analytical Score	642	537	607	582	633	693	679	727	700	
Accepted But Not Enrolled										
Verbal Score	514	515	499	499	531	523	537	513	510	515
Quantitative Score	735	740	732	730	745	749	742	738	744	745
Analytical Score	655	663	650	636	699	693	684	676	602	650
Accepted and Enrolled										
Verbal Score	508	496	492	508	514	536	512	508	475	491
Quantitative Score	710	731	721	719	742	743	731	728	726	730
Analytical Score	652	649	624	625	683	692	644	700	574	557
Annual Degrees (Sum-Spr qtrs)										
Masters:	47	51	41	44	29	36	33	45	36	
Doctoral:	11	8	7	12	11	9	9	8	11	
Ph.D. Candidates:	6	13	10	6	14	4	10	12	4	
Autumn Quarter Financial Support										
Teaching	35	33	38	31	30	27	19	28	23	26
Research Assistants	46	47	34	37	35	45	47	43	47	40
Fellowship	0	1	5	4	4	4	5	5	4	2
Traineeships	1	0	1	1	0	0	0	0		0

Appendix B. Academic Unit Profile

MECHANICAL ENGINEERING
BI: 2005-2007 (07/01/2005-06/30/2007)
Financial Position at June 30, 2006

SOURCE OF FUNDS		Amount
GOF incl. temperary funding	06-1058	3,365,205
DOF -RCR Fixed	75-1158	348689.00
DOF -RCR CRISP	75-1190	18,646
DOF-LFA	74-1058	1,036,858
DOF -RCR Variable	75-1058	432,784
Self-Sustaining Accounts (3)	09-9358	469,414
Gift - Three accounts	65-4258	289,174
Research Supplus Account	65-2218	17,902
Mech Engr Royalty	65-9864	11,452
Subtotal Actual:		5,990,124
Projected Income		
DOF - RCR Variable		56,925
Self-Sustaining Accounts (3)	06-9358	41,218
Gift (3)	63-3750	62,093
Subtotal Projected:		160,236
TOTAL SOURCE OF FUNDS		6,150,360
USE OF FUNDS (Projected)		
Faculty/staff/TA/Hourly	06-1058	3,337,494
Operation		282,426
Course Fee Overrun		15,000
Committed Actual: Research Cost Sharing		191,651
Obligated Actual : Start-Up/Others		1,442,770
Committed but not Obligated : Research Matching		300,000
TOTAL USE OF FUNDS		5,569,341
RESERVE BALANCE as of 06/30/07 (Projected)		**581,019**
? Potential Increases in On-Going Expenses: Salaries/Wages		
Two New Faculty Hires: $80-150K/yr/person		160,000
Acade,oc Staff Support (web;shop;G&C):$45-$65K/yr/person		90,000
? Potential One-time Expenses:		
Lab Improvements (252,G045,G032,etc):		510,000
Start-up Packages 0 Two (2) New Hires:		400,000
TOTAL RESERVE BALANCE (Projected):		**?**

The following table shows our direct research expenditures (compared with the College) and the breakdown by major agency. Note that these do not include indirect expenditures, which increase all these totals by approximately 50%.

ME Research Expenditures

Total Direct Expenditures from External Support by Source of Support
(does not include fellowship and gifts)

		DHHS	*DOD*	*DOE*	*NSF*	*Other Fed.*
00-01	$	5,778	386,444	206,985	387,318	83,907
01-02		120,333	538,742	209,387	483,530	269,422
02-03		171,030	820,077	61,574	442,058	379,752
03-04		604,063	1,023,687	107,352	471,665	328,592
04-05		981,353	922,340	133,312	505,417	442,074

Total Exp.		***2001***	***2002***	***2003***	***2004***	***2,005***	**2,006**
ME	$	2,255,954	2,628,422	3,026,762	4,120,132	4,877,390	4,270,796
% Increase			16.51%	34.17%	82.63%	116.20%	89.31%
COE	$	42,560,587	49,798,075	53,132,951	58,102,506	62,948,748	
% Increase			17.01%	24.84%	36.52%	47.90%	

Appendix C. Special Pathways, Options, Certificates within Degree

None.

Appendix D. List of Faculty by Rank, Including Dissertation Committees for the Last Five years.

Name	Rank	Students			
Devasia	Professor	Clayton, Garrett	Hatano, Yuko	Iamratanakul, Dhanakorn	
		Leang, Kam	Tien, Szu-Chi	Zou, Qingze	
Emery	Professor	Bardot, Dawn	Valenti, Elisabetta		
Fabien	Professor	Kay, Joseph Dee	Leuschke, Rainer		
Ganter	Professor	Berkley, Jeffrey	Chen, Hao		
Gao	Professor	Chen, Hsiu-Hung			
Garbini	Professor	Chao, Shih-Hui	Goettsch, Ulix	Kriewall, Thomas	
Kramlich	Professor	Castiglone, Linda	Liu, Jun	Martin, Scott	Nadella, Krishna
Malte	Professor	Novosselov, Igor	Polagye, Brian		
Ramulu	Professor	Gururaja, Suhasini	Kim, Dae-Wook	Kunaporn, Sawalee	
		Pedersen, William	Pitt, Franna	Sanders, Daniel	
Reinhall	Professor	Einstein, Daniel	Hofbeck, Eric	Liu, Chao-Shih	
		Low, Lesley	Nichols-Pagel, Gerald		
Riley	Professor	Nichols, Joseph	Nichols-Pagel, Gerald	Mitarai, Satoshi	Wetchagarun, Saensuk
		Zhu, Yong			
Shen	Professor	Lee, Cheng-Chun	Kim, Hyun Chul	Heo, Baekho	Hsu, Yi-Chu
		Shen, Jr-Yi	Tseng, Chaw-Wu	Wu, Chia-Che	Yellin, Jessica
		Park, Jung Seo	Yoon, Jungkeun		
Taya	Professor	Almajid, Abdulhakim	Hudnut, Steven	Le Guilly, Marie	Liang, Yuanchang
		Park, Jong-Jin	Reyburn, Beth	Zhao, Ying	
Tuttle	Professor	Albers, Robert	Miyazono, Toshiya		
Fridley	Joint Professor	Krogstad, Finn Tryggve Ol	Liquori, Michael	Reutebuch, Stephen	Rhee, Hakjun
Hyman	Emeritus Professor	Hornbaker, Margaret Hall	Ozalp, Nesrin		
Kobayashi	Emeritus Professor	Jackson, John			
Kosaly	Emeritus Professor	Mitarai, Satoshi	Sripakagorn, Paiboon		
McCormick	Emeritus Professor	Sundman, Lydia			
Adee	Associate Professor	NONE			
Berg	Associate Professor	Jung, Tae Young	Pongpunwattana, Anawat		
Cooper	Associate Professor	Fitch, Peder			
Henry (Mescher	Associate Professor	Reeve, Hayden Matane	Zhu, Yong		
Kumar	Associate Professor	Nadella, Krishna	Wang, Xiaoxi		
Li, W.	Associate Professor	Wang, Hai	Wang, Xiaoxi	Xu, Jun	
Storti	Associate Professor	Green, Seth	Johnston, Scott	Sliger, David	
Ao, Ping	Research Associate Pro	NONE			
Ching	Research Associate Pro	Carter, Jarrod Wade	Dahl, Michael	Lim, Jae Bum	Mkandawire, Chimbaugor
		Nuckley, David	Yliniemi, Eno		
Dahl	Research Associate Pro	NONE			
Sandwith	Research Associate Pro	NONE			
Seibel	Research Associate Pro	Brown, Christopher	Katdare, Rahul	Soper, Timothy	Yoon, Woon Jong
Chung	Assistant Professor	NONE			
Li, J.	Assistant Professor	Du, Quangen	Ma, Yunfei		
Nuckley	Research Assistant Prof	Lim, Jae			
Wang	Research Assistant Prof	Ho, Joe Nhut	Huang, Cheng-Sheng		
Xu	Research Assistant Prof	NONE			

Appendix E. Placement of Graduates

The following table shows the placement of PhD graduates over the last three years.

PhD Graduate	Degree Awarded	Placement
HSU,YI-CHU	Spring 2003	Assistant Professor (tenure track), Southern Taiwan Institute of Technology, Taiwan
PARK,JUNG SEO	Spring 2003	Hitachi Global Storage Technologies
REEVE,HAYDEN MATANE	Spring 2003	United Technologies Research Center, East Hartford, CT
JANG,LING-SHENG	Summer 2003	Assistant Professor (tenure track), National Cheng-Kung University, Taiwan
MARTIN,SCOTT MONTGOMERY	Summer 2003	Center for Turbulence Research, Stanford University
SAFOUTIN,MICHAEL JOHN	Summer 2003	Villageware Corporation, Seattle
ZOU,QINGZE	Summer 2003	Assistant Professor (tenure track) Iowa State University
GREEN,SETH	Autumn 2003	Intel, Portland
LEUSCHKE,RAINER	Winter 2004	Post-Doc, EE Department, UW
MITARAI,SATOSHI	Winter 2004	Post-Doc, University of California, Santa Barbara
LE GUILLY,MARIE O	Spring 2004	Intel, Portland
PONGPUNWATTANA,ANAWAT	Spring 2004	Post-Doc, AA Department, UW
FITCH,PEDER ERIK	Summer 2004	Phillips, Inc., Lake Stevens, WA
HEO,BAEKHO	Summer 2004	Samsung Electronics, Korea
PARK,JONG-JIN	Summer 2004	
YELLIN,JESSICA MARIA	Summer 2004	Center for Engineering Learning and Teaching, UW, Seattle
KRIEWALL,THOMAS EDWARD	Autumn 2004	Intel, Portland
LEANG,KAM K	Autumn 2004	Assistant Professor (tenure track) Virginia Commonwealth University
PITT,FRANNA SUSAN	Winter 2005	Technical Fellow, The Boeing Company
JOHNSTON,SCOTT R	Spring 2005	Post-Doc, Georgia Institute of Technology
LIU,CHAO-SHIH	Summer 2005	Assistant Professor (tenure track), Taiwan Military Academy

YLINIEMI,ENO M	Summer 2005	Project Manager, Seattle Monorail Refurbrishing Project
NICHOLS,JOSEPH WILLIAM	Autumn 2005	Post-Doc, Ecole Polytechnique, Paris France
NICHOLS-PAGEL,GERALD ALEXANDER	Autumn 2005	CTA, Inc. (Architecture & Engineering), Boseman, MT
OZALP,NESRIN	Autumn 2005	Assistant Professor (tenure track), Ege University, Izmir, Turkey
HAKIM,AMMAR H	Winter 2006	
HSU,CHIA-HSIEN	Winter 2006	
NOVOSSELOV,IGOR V	Winter 2006	Enertechnix Inc, Maple Valley, WA
ZHAO,YING	Winter 2006	B&D, New Jersey Research and Development Center
WU,CHIA-CHE	Spring 2006	Assistant Professor (tenure track), National Chung-Hsing University, Taiwan
XU,JUN	Spring 2006	Genie Industries, Redmond, WA

We do not keep individual statistics on BSME and MSME graduates, but we do track general employment statistics. For those BSME graduates finishing during the 5 quarters starting autumn 2003 through autumn 2004 (consisting of 128 graduates) we were able to track the initial post graduation positions of 93.

- Graduate school (27): e.g., Coventry University (England), Duke University, UC Berkeley, Columbia, Michigan, Wisconsin, USC, UW, WSU
- Large manufacturers (8): Boeing, Chrysler, Kenworth, HP, Intel, Lockheed-Martin, Honeywell
- Government (3): Naval Undersea Warfare Center, Puget Sound Naval Shipyard, US Air Force
- Small/Entrepreneurial/Startup (36): ACCO, Applied Precision, ATS Automation, Canflex, Coffman Engineers, East West Industries, Eldec, Engineering Arts, Forest Concepts, Hargis Engineering, Herrick Co, Isothermal Systems, Jensen Maritime Consulants, Marine Jet Technology, Medical Instrument Co, Micro encoder, MicroEnergy Tech, Mid-Columbia Engineering, Northern Power Systems, Parametrix, Pentar Avionics, Puget Sound Energy, Red dot Corp, Seatac Manufacturing, Sunstream Corp, Swift Engineering, Taylor Aerospace, Tracedetect, Trinity Glass International, Underground co, Vought Aircraft Inc.
- Part time (5)
- Other (travel, not in field, looking) (14)

In general the MSME initial employment trends are similar to those for the BSME.

Appendix F. Academic Unit's Mission Statement

Our mission is to advance the well-being of society through excellence in teaching, research and service that exploits the rapidly changing technical diversity of mechanical engineering. We achieve this within a collaborative environment that stimulates faculty, staff and students to reach their highest potential through life-long learning.

Appendix G. Faculty Biosketches

ALBERTO ALISEDA

Department of Mechanical Engineering
University of Washington Box 352600
Seattle, WA. 98195-2600
Phone: 206 543 4910, Fax: 206 685 6047, Email: aaliseda@u.washington.edu

EMPLOYMENT:

2006-	Assistant Professor. Department of Mechanical Engineering. University of Washington.
2004-	Visiting Professor. Department of Fluid Mechanics and Thermal Sciences. Universidad Carlos III de Madrid.
2004-2006	Postdoctoral Researcher. Department of MAE. UCSD.
1999-2004	Research Assistant. Department of MAE. UCSD.
1998-1999	2nd Lieutenant Spanish Air Force Corp of Engineers.
1997	GMV.SA, Tres Cantos, Madrid.

EDUCATION:

May 2004	Ph.D. in Engineering Sciences (Mechanical Engineering). University of California, San Diego. Thesis Advisor: Prof. Juan C. Lasheras.
Sep. 2000	M.S. in Engineering Sciences (Mechanical Engineering). University of California, San Diego.
Sep. 1998	BS./MS. Aerospace Engineering. Escuela Tecnica Superior Ingenieros Aeronauticos, Universidad Politecnica de Madrid.

AWARDS:

June 2002	Outstanding Research Assistant award. MAE Department. UCSD.
June 2001	Best Teaching Assistant annual award. MAE Department. UCSD.
1999-2001	La Caixa Foundation Graduate Fellowship.
1998	National Outstanding End-of-Studies Award in Aeronautical Engineering, 3rd prize. Spain.
1997	National Research Fellowship for last year undergraduate students.

PUBLICATIONS:

1. A physics-based model for air-blast atomization of viscous and non-Newtonian liquids. *Aliseda, A., Hopfinger, E., Lasheras, J.C. submitted to* ***Atomization and Sprays.***
2. The mechanism of air entrainment in a deep water hydraulic jump. *Rodriguez-Rodriguez, F.J., Aliseda, A., Lasheras, J.C. submitted to the* ***Journal of Fluid Mechanics.***
3. Rising velocity of microbubbles in a homogeneous isotropic turbulent flow. *Aliseda, A., Lasheras, J.C submitted to the* ***Physics of Fluids.***
4. Effect of buoyancy on the dynamics of a turbulent boundary layer laden with microbubbles. *Aliseda, A., Lasheras, J.C.* ***Journal of Fluid Mechanics,*** *(2006*), vol 559, pp 307-334.
5. Tailored fuel injection for Pulsed Detonation Engines via feedback control. *Aliseda A., Ariyur K.B., Sarrazin O., Lasheras J.C., Krstic M.* ***Journal of Propulsion and Power*** *(2003)*, vol 19, 5, pp 917-921.
6. Effect of preferential concentration on the settling velocity of heavy particles in homogeneous isotropic turbulence. *Aliseda A., Cartellier A., Hainaux F., Lasheras J.C.* ***Journal of Fluid Mechanics*** *(2002*), vol 468, pp 77-105.

RESEARCH AND TEACHING INTERESTS:

- **Turbulent Multiphase Flows:**

  - Particles and droplets in atmospheric turbulence, specifically the formation and growth of rain drops in clouds.

  - Experimental investigation of bubble transport, entrainment and break-up in industrial processes and the ocean, with particular attention to the effect on the gas exchange between the atmosphere and the ocean.

  - Atomization and Sprays, with an emphasis on feedback control for tailored atomization processes and atomization of fluids with complex rheological properties.

- **Medical and Biological Flows:**
  - Fluid mechanics of the human circulation. Hemodynamics in healthy and diseased large vessels. In vivo and in vitro flow measurements and imaging. Dynamics of microbubble Ultrasound Contrast Agents in the human circulation.
  - Flow effects on cell dynamics, mechanotransduction and cell motion.

FUNDING: Pfizer Pharmaceutical R&D, Office Of Naval Research.

Name and Rank: Ping Ao, Research Associate Professor in Mechanical Engineering
Adjunct Associate Professor in Physics

Education: BS Physics, Peking University, Beijing, China (1983)
MS Physics, University of Illinois, Urbana-Champaign (1985)
PhD Physics, University of Illinois, Urbana-Champaign (1990)

Professional Employment (Post PhD):

1990-94, Postdoctoral research associate, University of Washington
1994-97 Assistant professor, Department of Theoretical Physics, Umeå University, Umeå, SWEDEN
1997-2000 Associate Professor, Department of Theoretical Physics, Umeå University Umeå, SWEDE
2000-03 Senior Research Scientist and Visiting Associate Member, Institute for Systems Biology, Seattle
2003 Visiting Professor, Keck Graduate Institute, Claremont
2003-presnt Research associate professor, Department of Mechanical Engineering, University of Washington

Teaching Interests: Computational/theoretical/systems biology, Thermodynamics, Statistical mechanics, Fluid dynamics including turbulence, Control theory.

Research: Two main research areas.

The major focus is in theoretical/computational biology, particularly on quantitative and integrative systems biology, evolution theory, gene regulatory dynamics, dynamics of metabolic pathways, cancer dynamics.

The minor focus is in theoretical condensed matter physics, particularly on vortex dynamics in superconductors, superfluids, quantum atomic liquids, microscopic origin(s) of dissipation in quantum and classical turbulences.

Research Support (since 2000):

Institute for Systems Biology
National Institutes of Health, USA (so far total $1.2m).

Graduate Students Supervised (Graduated since 2000)

MS: John Olson

Training postdoctoral research associates (since 2000):

Dr. B.H. Lin PhD University of Chicago
Dr. L.W. Lee, PhD University of California, Santa Cruz

Service Highlights:

External: Editor for Journal of Biological Systems
Referee for Nature: Genetics; Review of Modern Physics; Nature (Deutch); Physical Review Letters; Physical Review B; Physics Letter A; Physica C; Physica Scripta; Journal of Low Temperature Physics; Journal of Physics-condensed matter physics; Sensors and Actuators B; Journal of Theoretical Biology; Journal of Biological Systems; Biophysical Journal.

1) Three major contributions to systems biology since 2000

Robustness, Stability and Efficiency of Phage λ Regulatory Network: Dynamical Structure analysis,
X.-M. Zhu, L. Yin, L. Hood, and P. Ao, J Bioinf. Biocomput. **2** (2004) 785.

In this paper with Dr. Zhu, Dr. Yin, Prof. Hood I solved one of outstanding problems in the robustness and stability of gene regulatory networks. Quantitative agreement between mathematical calculation and biological data was obtained, which has been extremely rare in the mathematically modeling of biology. Along with the solution, a new method to treat stochastic differential equations emerged, a dynamical structure theory of complex networks, to analyze and predict the properties of the complex network dynamics. The study of the gene regulatory networks in biology has been regarded as one of the logical following-up problems after the completion of Human Genome Project.

Mathematically, this is a prototype problem of how to use stochastic differential equations to model one of most important stochastic processes in molecular biology: the switching between two stable states.

Laws of Darwinian Evolutionary Theory, P. Ao, Physics of Life Reviews **2** (2005) 117.

In this paper the mathematical problems on two most fundamental concepts in evolutionary biology, Fisher's fundamental theorem of natural selection and Wright's adaptive landscape, have been solved. The Darwinian dynamics for the first time has been put into a set of equations whose components have direct biological meanings. The key ingredient to formulate the Darwinian dynamics is my introducing of a transverse matrix into evolutionary dynamics.

It should be pointed that one of the well known biologists, E.O. Wislon, has done the same classification in his 2006 book: There exists general laws in biology, and those laws can be classified into two categories: dynamical part and structure part. My paper is the first consistent formulation of the dynamical laws on quantitative side.

Existence and Construction of Dynamical Potential in Nonequilibrium Processes without Detailed Balance,
L. Yin and P. Ao, J. Phys. **A39** (2006) 8593.

From my genetic switch study I believe I had discovered another stochastic integration method which directly connects to the symplectic structure in theoretical physics.
This method also suggests a way of construction of potential function in a generic class of stochastic processes in the absence of detailed balance, via a generalized Einstein relation. A consistent exposure of this method from a theoretical point of view is given.

The method here implies a generic construction of Lyapunov function in whole state space, therefore would have interesting implication for control theory.

2) Publication Summary

Among my **73 refereed publications**, 16 are Physical Review Letters (impact factor 7.489, immediacy index 1.572), and 12 are biological papers or biology motivated. There are total 940 citations to my work according to Science Citation Index. Among them, one of my publications has 154 citations.

Since moving into ME in 2003, I have published **15 referred journal papers**. Both graduate and undergraduate students have been involved in my research.

Name and Rank: Martin C. Berg, Associate Professor

Education: BS, Mechanical Engineering, University of Washington, (1975)
PhD, Mechanical Engineering, University of Washington, (1978)
PhD, Mechanical Engineering, Stanford University, (1986)

Professional Employment:
2/78-12/80: Senior Engineer, Flight Controls Research Group, Boeing Commercial Airplane Company. 3/86-9/93: Assistant Professor, Mechanical Engineering Department, University of Washington. 9/93-present: Associate Professor, Mechanical Engineering Department, University of Washington.

Teaching Emphasis: Dynamic systems modeling and analysis and control system design. At the undergraduate level, teaching emphasis during the last five years has been in courses that are part of our mechatronics thread. At the graduate level, teaching emphasis during the past five years has been with control system design related courses, e.g., a nonlinear controls systems course and a discrete event systems course.

Research: Applications of discrete-time and discrete-event control system design methodologies to the likes of industrial robots and laboratory automation systems.

Research Support (since 2000): National Science Foundation, National Institutes of Health.

Graduate Students Supervised (Graduated since 2000):
PhD: Vatchara Lertpiriyasuwat, David Rathbun
MS: Greg Wood, Andrew Neeld

Service Highlights:
Internal: Systems and Dynamics Interest Group Leader. Site coordinator for the College of Engineering's Robotics, Controls and Mechatronics web site.
External: Program Committee for the 2007 American Control Conference

Awards:
College of Engineering Outstanding Faculty Award for 1996–97

Publications:

1. M. C. Berg, N. Amit, and J. D. Powell, "Multirate Digital Control System Design," IEEE Transactions on Automatic Control, Vol. 33, No. 12, pp. 1139-1150, 1988.
2. G. S. Mason and M. C. Berg, "Reduced Order Multirate Compensator Synthesis," AIAA Journal of Guidance, Control and Dynamics, Vol. 15, No. 3, pp. 700-706, 1992.
3. M. C. Berg, G. S. Mason, and G. S. Yang, "A New Multirate Sampled-Data Control Law Structure and Synthesis Algorithm," AIAA Journal of Guidance, Control and Dynamics, Vol. 15, No. 5, pp. 1183-1191, 1992.

4. C. Ha, U. L. Ly, and M. C. Berg, “Optimal Discrete-Time Dynamic Output Feedback: A w-Domain Approach,” AIAA Journal of Guidance, Control and Dynamics, Vol. 16, No. 3, pp. 534-540, 1993.
5. G. S. Mason and M. C. Berg, “Robustness Analysis of a Multirate Flutter Suppression System,” AIAA Journal of Guidance, Control and Dynamics , Vol. 16, No. 5, pp. 992-926, 1993.
6. G. S. Mason and M. C. Berg, “Multirate Flutter Suppression System Design for a Model Wing,” AIAA Journal of Guidance, Control and Dynamics, Vol. 17, No. 6, pp. 1267-74, 1994.
7. M. C. Berg, “Introduction to a Special Coordinate Basis for Multivariable Linear Systems,” IEE Proceedings on Control Theory and Applications, Vol. 145, No. 3, pp. 204-210, 1998.
8. V. Lertpiriyasuwat, M. C. Berg and K. W. Buffington, “Extended Kalman Filtering Applied to a Two-Axis Robotic Arm with Flexible Links,” International Journal of Robotics Research , Vol. 19, No. 3, pp. 254-270, 2000.
9. G. Mason, A. Pongpunwattana and M. C. Berg, “A Flexible Test Bed for Control System Analysis and Verification,” Mechatronics, Elsevier Science, Ltd., Vol. 12, pp. 891-904, 2002.
10. G. S. Mason and M. C. Berg, “Linear Time-Invariant Milling Models Applicable to Chatter Suppression System Design,” System Analysis, Modeling and Simulation, Taylor and Francis Group, London, Vol. 12, No. 7, pp 891-904, 2002.
11. H. Yang and M. C. Berg, “Tracking Control of Mechanical Systems with a Partially Known Friction Model,” ICASE Transactions on Control, Automation and Systems Engineering, Korea, Vol. 4, No. 4, pp. 311-318, 2002.
12. D. B. Rathbun, M. C. Berg and K. W. Buffington, “Pulse Width Control for Precise Positioning of Structurally Flexible Systems Subject to Stiction and Coulomb Friction,” ASME Journal of Dynamic Systems, Measurement, and Control, Vol. 126, No. 1, pp. 131-138, 2004.
13. D. B. Rathbun, M. C. Berg and K. W. Buffington, “Piecewise-Linear-Gain Pulse Width Control for Precise Positioning of Structurally Flexible Systems Subject to Stiction and Coulomb Friction,” ASME Journal of Dynamic Systems, Measurement, and Control , Vol. 126, No. 1, pp. 139-143, 2004.
14. V. Lertpiriyasuwat and M. C. Berg, “Adaptive Real-Time Estimation of End-Effector Position and Orientation using Precise Measurements of End-Effector Position,” IEEE/ASME Transactions on Mechatronics, Vol. 11, No. 3, pp. 304-319, 2006.

Name and Rank: **Randal P. Ching**, Reserarch Associate Professor

Education:

Ph.D. Mechanical Engineering, Department of Mechanical Engineering
University of Washington, Seattle, WA, 1992

M.S. Mechanical Engineering, Department of Mechanical Engineering
University of Washington, Seattle, WA, 1988

B.S. Mechanical Engineering, Department of Mechanical Engineering
University of Hawaii, Honolulu, HI, 1980

Professional Employment (Post PhD):

- *Research Associate Professor and Director, Applied Biomechanics Laboratory*, 2002 — Present

University of Washington, Department of Mechanical Engineering, Seattle, WA

- *Adjunct Research Associate Professor*, 2002 — Present

University of Washington, Departments of Bioengineering & Orthopaedics, Seattle, WA

- *Associate Professor*, 2001 — 2002; *Assistant Professor*, 1998 — 2001

University of Washington, Department of Orthopaedics, Seattle, WA

- *Adjunct Associate Professor*, 2001 — 2002; *Adjunct Assistant Professor*, 2000 — 2001

University of Washington, Department of Mechanical Engineering, Seattle, WA

- *Adjunct Associate Professor*, 2001 — 2002; *Adjunct Assistant Professor*, 1998 — 2001

University of Washington, Department of Bioengineering, Seattle, WA

- *Research Assistant Professor*, 1997 — 1998; *Research Associate*, 1992 — 1997

University of Washington, Department of Orthopaedics, Seattle, WA

- *Research/Teaching Assistant, and Instructor*, 1986 — 1992

University of Washington, Department of Mechanical Engineering, Seattle, WA

- *Mechanical Engineer*, 1984 — 1986

SRI International (Stanford Research Institute), Radio-Physics Laboratory, Menlo Park, CA

- *Mechanical and Nuclear Engineer*, 1981 — 1984

Pearl Harbor Naval Shipyard, Nuclear & Production Engineering Departments, Pearl Harbor, HI

Teaching Emphasis: Computational Methods in Biomechanics, Biomaterials & Biocompatibility

Research: Biomechanics and Prosthetic Implant

Research Support (since 2000):

CDC (National Center for Injury Prevention and Control) 09/30/02 - 09/29/06
Grant No. R49/CCR021734-02 $623,000 (Total) Title:Effect of Loading Rate on Child Neck Injury Mechanics Role: Principal Investigator

US DOT/National Highway Traffic Safety Administration 09/30/99 - 04/28/06
Cooperative Agreement No. DTNH-22-99-27000 $968,000 (Total) Title:Neck Mechanics and Injury Tolerance as a Function of Developmental Age Role: Principal Investigator

Veterans Administration 10/01/97 - 09/30/07
Rehab. Research & Development Center Grant A0806-C $3,750,000 (Total) Title:Center for Limb Loss Prevention and Prosthetic Engineering Role: Investigator/Consultant (P.I. - B.J. Sangeorzan)

Archus Orthopedics, Inc.. 01/15/04 - 01/15/08
Title:Evaluation of Facet Arthroplasty Devices and Methods $185,000 (Total) Role: Principal Investigator

US DOD/Air Force Research Laboratory 09/01/00 - 04/20/04 (Subcontracted through General Dynamics) $100,000 (Total) Title:Human Tensile Neck Injury Tolerance Role: Principal Investigator

CDC (National Center for Injury Prevention and Control) 09/30/99 - 09/29/03
Grant No. R49/CCR016818-03 $439,000 (Total) Title:Age-Related Cervical Spine Mechanics and Injury Tolerance Role: Principal Investigator

Spinal Dynamics Corp. 05/01/98 - 07/25/03 Title:Functional Intervertebral Disc Space Prosthesis Development $40,000 (Total) Role: Principal Investigator

DePuy Orthopaedics, Inc. 07/01/00 - 6/30/02 Title:THA Range of Motion Study $31,000 (Total) Role: Principal Investigator

US DOT/National Highway Traffic Safety Administration 03/01/99 - 02/28/02 Cooperative Agreement No. DTNH22-99-H-07086 $300,000 (Total) Title:Age-Dependent Properties of the Spine Role: Principal Investigator

US DOD/Air Force Research Laboratory (AFRL/HESA) 05/01/98 - 04/30/00 Cooperative Research and Development Agreement: No. 98-138-HE-01 Facilities/Data Exch. Title:Multi-Axis, Neck-Injury-Threshold Criteria Role: Principal Investigator

Graduate Students Supervised (Graduated since 2000):

- Eno M. Yliniemi, Mechanical Engineering, Ph.D. (2005) [Chair/Advisor]
- Zachary R. Ashwell, Mechanical Engineering, M.S. (2005) [Co-Chair/Co-Advisor]
- Michael C. Dahl, Mechanical Engineering, M.S. (2003) [Chair/Advisor]
- Chimbaugona Mkandawire, Bioengineering, Ph.D. (2002) [Chair/Advisor]
- David J. Nuckley, Bioengineering, Ph.D. (2002) [Chair/Advisor]
- Jarrod W. Carter, Bioengineering, Ph.D. (2002) [Chair/Advisor]
- Geoffery C. Raynak, Bioengineering, Ph.D. (2000) [Chair/Advisor]
- Ruth S. Ochia, Bioengineering, Ph.D. (2000) [Chair/Advisor]

Service Highlights:

- Chaired CDC Grant Review Panels
  - Research Grants to Describe Traumatic Brain Injury Consequences, #06003 (2006)
  - Research Grants to Prevent Unintentional Injuries, #05022 (2005)
  - Traumatic Injury Biomechanics Research, #04047 (2004)
  - Traumatic Injury Biomechanics Research, #03028 (2003)
- CDC Initial Review Group Research Committee (4-Year Appointment: 2002-2006)
- NIH Center for Scientific Review Special Emphasis (Grant Review) Panel (1998-2000)

Awards:

- University of Washington College of Engineering, *UW Engineering in the Desert Keynote Address:* "Medicine + ENGINEERING = Improved Healthcare: Advancing Joint Replacement Systems", Palm Desert, CA, February 16, 2006
- Margaret H. Hines Award (Best Paper): The Ohio State University Injury Biomechanics Symposium, 2005
- Orthopaedic Research and Education Foundation (OREF) Clinical Research Award, 2001
- Pearl Harbor Naval Shipyard Superior Accomplishment Award, 1983
- HOWC Undergraduate Scholarship, 1976

Name and Rank: Jae-Hyun Chung, Assistant Professor

Education: BS Machine Design, Sungkyunkwan University, Seoul, Korea (1995)
MS Mechanical Design, Sungkyunkwan University, Seoul, Korea (1997)
PhD, Northwestern University, (2004)

Professional Employment (Post PhD):
2004-2005: Postdoctoral Fellow, Mechanical Eng. at Northwestern University
2005-present: Assistant Professor in Mechanical Engineering, University of Washington

Teaching Emphasis: Machine element design, design and manufacture of nano-devices, hands-on experience course in nanodevices.

Research: Nanomanufacturing issues associated with shadow edge lithography, microfabrication, nanoscale massive production. Nanofluidics applicable to biochips and biosensors. Biomimetic actuator for bio-mixers and sensors. Process for hybrid nanofibrils and composite.

Research Support (since 2005): National Science Foundation

Graduate Students Supervised (Graduated since 2005):
MS: Kie-Seok Oh
Current grad students: Kie-Seok Oh, Cheng-Ling Chang, Woon Hong Yeo

Service Highlights: Undergraduate Education Committee

Awards: Samsung Electronics Humantech Thesis Award (2004)

Research Interests:
Dr. Chung is interested in MEMS/Nanotechnology area, and in particular of the manufacturing of micro/nano structures. Examples of the research area are electric field guided molecular assembly and nanoscale structure fabrication using the shadow effect. He is also interested in the applications of such micro/nano structures. The applications include bio/chemical sensors using nanochannels, nanofibrils, and nanowires.

Selected Journals:

1. Y. Liu, W. K. Liu, N. Patankar, T. Belytschko, A. To, J. Chung,"Immersed Electrokinetic Finite Element Method", International Journal for Numerical Methods in Engineering, (in press)
2. Y. Liu, J. Chung, W. K. Liu, and R. S. Ruoff, "Dielectrophoretic Assembly of Nanowires", Journal of Physical Chemistry B, 10 (2006) pp 14098-14106.
3. J. Chung, X. Chen, E. J. Zimney, and R. S. Ruoff, "Fabrication of Nanopores in a 100-nm Thick Si_3N_4 Membrane", J. Nanosci. Nanotechnol. 6 (2006) pp. 2175–2181.
4. S. Lu, J. Chung, and R. S. Ruoff, "Controlled deposition of nanotubes on opposing electrodes", Nanotechnology 16 (2005) 1765–1770.
5. J. Chung, K.-H. Lee, J. Lee, D. Troya, and G. C. Schatz, "Multi-Walled Carbon Nanotubes

Experiencing Electrical Breakdown as Gas Sensors", Nanotechnology, vol. 15, pp. 1596-1602, 2004
6. J. Chung, K.-H. Lee, J. Lee, and R. S. Ruoff, "Toward Large Scale Integration of Carbon Nanotubes", Langmuir, vol. 20, pp. 3011-3017, 2004.
7. J. Chung and J. Lee, "Nanoscale Gap Fabrication and Integration of Carbon Nanotubes by Micromachining", Sensors & Actuators: A. Physical, vol. 104(3), pp. 229–235, 2003.
8. J. Chung, K.-H. Lee, J. Lee, "Nanoscale Gap Fabrication by Carbon Nanotube Extracted Lithography (CEL)", Nano Letters, vol. 3(8), pp. 1029-1031, 2003.

Selected Conference Proceedings

1. J. Chung, K.-H. Lee, J. Lee, R. Ruoff, "Electric Field Driven Fluid Flow Around Nano Particles", ASME conference, IMECE2004-62247, Anaheim, CA, November, 2004.
2. R. Rodriguez, J. Chung, K.-H. Lee, J. Lee, "Bio/Chemical Sensing By Thin Membrane Transducers", ASME conference, IMECE2004-62250, Anaheim, CA, November, 2004.
3. S. Lu, J. Chung, D. Dikin, J. Lee, R. Ruoff, "An integrated MEMS system for in-situ mechanical testing of nanostructures", extended abstract, ASME 3rd Annual Integrated Nanosystems: Design, Synthesis & Applications Conference, Pasadena, CA, Sept. 22-24, 2004.
4. S. Lu, J. Chung, J. Lee, R. S. Ruoff, "Integration of Freely Suspended Nanotubes on 3-Dimensional MEMS Structures", IEEE/NDSI, Miami, Florida, February, 2004.
5. J. Chung, K.-H. Lee, J. Lee, "Microfabricated Glucose Sensor Based on Single-Walled Carbon Nanotubes", IEEE-MEMS conference, pp.617-620, Maastricht, The Netherlands, January 25-29, 2004.
6. J. Chung, K.-H. Lee, J. Lee, "CNT-Extracted Lithography (CEL)", ASME conference, IMECE2003-41549, Washington, D. C., November, 2003
7. K.-H. Lee, J. Chung, J. Lee, "Amplicon Shuttled Nucleic Acid Amplification", MircoTAS, pp. 163-166, Squaw Valley, CA, October, 2003.
8. J. Chung, K.-H. Lee, J. Lee, "Fabrication of Single Multi-Walled Carbon Nanotube Array with a Composite Electric Field Guided Assembly Method", IEEE NANO, San Francisco, CA, August, 2003.
9. K.-H. Lee, J. Chung, J. Lee, "Superimposed ac- and dc Electric Field Guided Deposition of a Single DNA Molecule along a Microfabricated Gap", IEEE NANO, San Francisco, CA, August, 2003.
10. J. Chung, K.-H. Lee, J. Lee, "Multi-Walled Carbon Nanotube Sensors", IEEE transducers, pp. 718-712, Boston, MA, June 8-12 2003.

Name and Rank: Joyce S. Cooper, Associate Professor

Education: BS Mechanical Engineering, Rensselaer (1987)
MS Environmental Engineering, Duke University (1992)
PhD Environmental Engineering, Duke University (1996)

Professional Employment

General Electric Company (Schenectady, NY) Cooperative Education Intern, 1985; Delco Products, General Motors Corporation (Rochester, NY) Cooperative Education Intern, 1986; Polaroid Corporation (Waltham, MA) Quality Engineer, 1987-1988; E-Systems (Falls Church, VA) Design Engineer, 1988-1991; Research Triangle Institute (Research Triangle Park, NC) Research Scientist, 1992, 1996; Office of Waste Reduction, Department of Environment, Health, and Natural Resources, Graduate Student Intern, 1993-1995; University of Tennessee Center for Clean Products (Knoxville, TN) Project Manager, 1996-1997; Battelle Memorial Institute (Columbus, OH & Seattle, WA) Senior Research Scientist, 1997-1999

Teaching Emphasis: Design for Environment, Life Cycle Assessment, and Mechanical Engineering Design. Focus for the last five years on graduate-level and senior undergraduate courses.

Research: Environmental issues associated with emerging technology systems. Modeling of fuels production (conventional and biomass-based); polymer exchange membrane fuel cell, solid oxide fuel cell, biomass to electricity power plants; regional industrial materials exchange and electronics recycling.

Research Support (since 2000): Department of Energy, National Science Foundation, US Forest Service, Boeing, Ford Motor Company, Plug Power

Graduate Students Supervised (Graduated since 2000 unless noted):

PhD: Peder Fitch (2004), Seung-Jin Lee (expected 2008), Faith Pardue (expected 2009)
MS: Kristen Rounds, John Crawford, Kimberly Kelsey, Viral Mehta, Veronica Henzi, Daniel Wick, Ethan Jennerich, Christine Godwin, Nathaniel Coates, Robert Trujillo, Liila Woods, Gus Takala (expected 2007)

Service Highlights:

Internal: Mechanical Engineering Graduate Education Committee (2000-2005, Chair 2002-2005); select Mechanical Engineering and Civil and Environmental Engineering Department search committees; College Commencement Marshal (2000, 2001, 2003-2006)

External: Technical and review committees for IEEE, SAE, SETAC; founding editorial board for SETAC's *Integrated Environmental Assessment and Management*

Awards: US Department of Education Fellowship: Areas of National Needs Program, 1991; Sigma Xi, The Scientific Research Society, 1994; Morris K. Udall US Congressional Fellowship: Office of Technology Assessment, 1995; University of Washington Presidential Faculty Development Fellowship, 2001; Fulbright-VTT Award in Civil Engineering, 2007

Since joining the UW, I have sought to develop research with lasting technical impact that advances engineering technology development. The **goals** of my research program are (1) To develop a leading research center in Life Cycle Assessment (LCA) of emerging technologies and (2) To provide financial support and outstanding educational experiences to students in LCA of emerging technologies.

To achieve these goals, the **direction** of my research program focuses on the investigation of how design and manufacturing options for emerging technologies dictate how, where, and in what form energy and materials are used and wasted throughout the technology life cycle. Here, the "technology life cycle" refers to the extraction and processing of raw materials and technology manufacturing, use, maintenance, and retirement. LCA, although still a developing research methodology, provides a protocol for understanding the environmental impacts (such as resource depletion, contribution to global warming, and human health effects) of material and energy use and waste throughout the life cycle.

My choice to study LCA as applied to emerging technologies stems from the fact that environmental impacts are dictated by design: the materials and processes used to make a technology dictate impacts over its life cycle. Given that emerging technologies such as fuel cells, nanostructured and other advanced materials are not yet widely produced, the design, production methods, and performance characteristics are far from finalized. As a result, the exact materials and energy use and waste throughout the life cycle are uncertain. Because of this, the few LCAs that do exist for emerging technologies are based on select configurations (like a specific sample or prototype) with little consideration of design and manufacturing alternatives. The use of fundamental principles of mechanical and environmental engineering to understand performance issues for design and manufacturing is the basis for making the UWME Design for Environment Laboratory a leading research laboratory in LCA of emerging technologies.

Highlights of my record to date include (1) having one of my publications* still listed as one of the top most downloaded articles in the *Journal of Power Sources* (with an impact factor of 2.77) and cited 14 times in the first year and (2) my work as a founding Executive Committee member of the *American Center for Life Cycle Assessment*, a professional organization with a mission to build capacity and knowledge of LCA.

* Mehta, V., J.S. Cooper, "Review and analysis of PEM fuel cell design and manufacturing," *Journal of Power Sources*, **114** (1) 32-53 (2003) [this article remains in the top 25 articles within this journal, see http://top25.sciencedirect.com/?journal_id=03787753]

Name and Rank: Peter H. Dahl, Research Associate Professor and Principal Engineer, Applied Physics Laboratory

Education: BS University of Washington (1976)
MS University of Washington (1982)
PhD Ocean Engineering, Massachusetts Institute of Technology (1989)

Professional Employment (Post PhD):
1989-present: Applied Physics Laboratory
Senior Engineer (1996), Principal Engineer (2000)
1991-present: University of Washington, Department of Mechanical Engineering
Research Assistant Professor (1991), Research Assistant Professor (2000), and

Teaching Emphasis: Acoustics. Developed jointly with Prof. Per Reinhall, *Applied Acoustics* (ME525) is a graduate-level introduction to acoustics involving its various applications, such as medical ultrasound, underwater sound, noise control and vibrations. ME525 serves as a core course for BioEngineering students involved in medical ultrasound. I also developed a short course for the Freshman Discovery Seminar program entitled *What is Sound*?

Research: Underwater acoustics, acoustic remote sensing, impact issues related to ambient noise in air and underwater environments, applications of ultrasound

Research Support (since 2000): Office of Naval Research, Washington Sea Grant, Alaska Department of Fish and Game, Naval Research Laboratory

Graduate Students Supervised (Graduated since 2000):
PhD: George Kapodistrias
MS: Brian Strully

Service Highlights:
Internal: Chair, Graduate Education Committee
External:

- National Chair, Underwater Acoustics Committee of the Acoustical Society of America (2003-2006)
- Associate Editor for the IEEE *J. Oceanic Engineering* (1997-2003)
- Guest Editor for *J. Oceanic Engineering* Special Issue on Asian Marginal Seas (2003-2004)
- Short lecture series on sound for 2003 UW *Gear Up Summer Program* for high school students

Awards:

Fellow, Acoustical Society of America (2001)

In 2000, I was selected by ONR to be the Chief U.S. Scientist for the Asian Seas International Acoustics Experiment (ASIAEX), conducted in the East China Sea in 2001, involving the U.S., China, and Korea. This leadership role continued into the data analysis phase, launched by an international ASIAEX workshop I organized and hosted at APL (January 2000) and the ASIAEX symposium in Chengdu, China (October 2002) for which I was on the steering committee. These meetings were the genesis of a series of ASIAEX journal papers that have been published as compendium issue of the IEEE *J. Oceanic Eng*. (October 2004), for which I was a Guest Editor. More recently, I co-founded and am the co-organizer of the first Pacific Rim Underwater Acoustics Conference, involving China, Korea, Japan, the U.S. and Canada, to be held in Vancouver B.C., in October 2007.

Highest Impact papers:

Dahl, P. H. and J. W. Choi, "Precursor arrivals in the Yellow Sea, their distinction from first-order head waves, and their geoacoustic inversion," *J. Acoust. Soc. Am*., 120 (6), 3525-3533, December 2006.

Dahl, P. H., "Forward scattering from the sea surface and the van Cittert-Zernike Theorem," *J. Acoust. Soc. Am.* 115 (2), 589-599 Feb. 2004.

Dahl, P.H., "On bistatic sea surface scattering: Field measurements and modeling," by P. H. Dahl, *J. Acoust. Soc. Am.* 105 (4), 2155-2169, April 1999.

P. H. Dahl, "Underwater Ultrasound," In: *Encyclopedia of Electrical and Electronics Engineering* pp. 10-27, Ed. John Webster, John Wiley & Sons, New York, March 1999.

Name and Rank: Santosh Devasia, Professor

Education:

- Bachelor of Technology (June 1988)
  Mechanical Engineering, Indian Institute of Technology, Kharagpur, India
- Master of Science (December 1990)
  Mechanical Engineering, University of California, Santa Barbara
- Doctor of Philosophy (December 1993)
  Mechanical Engineering, University of California, Santa Barbara (UCSB)

Professional Employment (Post PhD):

- Professor, Mech. Eng. Dept., U of Washington (2005 onwards)
- Associate Professor, Mech. Eng. Dept., U of Washington (2000-2005)
- Associate Professor, Mech. Eng. Dept., U of Utah (2000)
- Assistant Professor, Mechanical Eng. Dept., U of Utah (1994 - 2000)
- Post-Graduate Researcher, Mechanical Eng. Dept., UCSB (Dec. 1993-July 1994)

Teaching Emphasis: I regularly teach courses in Controls and Mechatronics areas.

- Undergraduate courses include Dynamics (ME230), Instrumentation (ME 473), Controls (ME471), Embedded Systems (ME477) and Capstone Design Class (ME495M).
- Graduate courses include Digital Control (ME581, ME582) and a new course that I developed on Feedforward Control (ME593). Graduate courses are co-listed in AA and EE depts.

Research:

- Bio-Imaging (AFM Imaging of Cell Migration)
- Nanotechnology (High Speed AFM and STM)
- Inversion-based Feedforward Control
- Distributed Air Traffic Management Systems
- Control of Dual-Stage Disk Drive Systems

Research Support (since 2000): External funding as **Principal Investigator (PI)**

Grant Number	Agency	Dates	Amount $
CMS 0196214	NSF	9/1/00-8/31/02	88,100
NAG 2-1450	NASA	1/1/01-12/31/03	101,766
CMS 0301787	NSF	7/1/03-6/30/07	201,929
GM68103-01	NIH	5/1/03-4/30/05	201,600
CMS 0336221 REU	NSF	7/1/03-6/30/07	6,000
Research Gift	INSIC	1/1/04-12/30/06	92,000
NNA04C131G	NASA	4/15/04-4/14/05	55,000
CMII 0624597	NSF	8/1/06-7/31/09	340,000
		Total	1,086,395

Graduate Students Supervised (Graduated since 2000):

• Hector Perez	Ph. D., May 2002, U. of Utah, Mechanical Engineering (Was a visiting student at U. of Washington for a year.) Joined as Research Professor (2003) Universidad Pontificia Bolivariana, Bucaramanga, Colombia
• Qingze Zou	Ph. D., July 2003, U. of Washington, Mechanical Engineering Joined as Assistant Professor (Tenure Track, 2004) Mechanical Eng Department, Iowa State University, Ames, Iowa
• Kam K. Leang	Ph. D., Sept. 2004, U. of Washington, Mechanical Engineering Joined as Assistant Professor (Tenure Track, 2005) Mechanical Eng Dept., Virginia Commonwealth U., Richmond, Virgina
• Vegard Lund	M.S., August 2000, U. of Utah, Mechanical Engineering "Automated Conflict Resolution for Air Traffic Management."
• Clint Vander Giessen	M.S., December 2002, U. of Washington, Mechanical Engineering "Inversion-Based Dynamic Compensation of Inertial Reaction Devices"
• Eric B. Howell	M.S., Spring 2004, U. of Washington, Mechanical Engineering "Design of Shock Absorbing Transtibial Prosthesis with a Controls Approach," G. Klute (VA Rehab R&D Center, Seattle) was Co-Chair
• Benjamin B. Jordan	M.S., Spring 2005, U. of Washington, Mechanical Engineering "Fast Positioning of Disk Drives with Dual Stage Systems"

Service Highlights:

• Associate Editor, Journal of Dynamic Systems Measurement and Control by ASME, since 1/1/03

• Associate Editor, Transactions on Control Systems Technology by the IEEE, since 1/1/03

• Guest Editor, Special Issue on "Dynamics and Control of Micro- and Nano-scale Systems." Transactions on Control Systems Technology by the IEEE, To appear in 2007.

• EE Dept Chair Search Committee: (2003-2005: Two Years) College committee member with eight others to search for a new Chairperson, Electrical Eng. Department, U. of Washington.

• U. of Washington, Faculty Council on Instructional Quality (Member), October 2001-2004. The committee is involved in university-wide instructional quality issues.

• U. of Washington, Faculty Council on University Facilities and Services (Member), September 2002-2005. The committee is involved in issues related to university-wide facilities.

• UW Department Review Committee (Member), 2006-07. Review of the Dept. of Construction Management, the College of Architecture and Urban Planning at UW.

Awards:

• U. of Utah's Early Career Teaching Award (for excellence in teaching), 1999-2000

• Professor of the Year Award from Mechanical Engineering Students, U of Utah, 97-98

• Dean's List of Top Instructors in the College of Engineering, U. of Utah (Six times)
Autumn '96, Winter '97, Winter '98, Spring '98, Spring '99, and Spring '00

Publications:

• Journal: 37 published; 1 in press; 3 accepted; and 3 submitted.

• Conferences: 49 published; and 1 submitted

Name and Rank: Ashley F. Emery

Education: BS Mechanical Engineering, University of California, Berkley (1956)
Mechanical Engineering, University of California, Berkley (1958)
PhD, Mechanical Engineering, University of California, Berkley (1961)

Professional Employment (Post PhD):
1961-Present: University of Washington, Seattle, WA

Teaching Emphasis: Heat Transfer, Fluid Mechanics, Architectural Heat Transfer, Thermal Stresses, Experiment Design, Classical Thermodynamics, Statistical Thermodynamics, Inverse Problems.

Research: Validation of large computer codes, Statistical analysis, Bayesian inference, Design of experiments, Optical Fibers.

Research Support (since 2000): National Science Foundation, Washington Technology Center, Sandia National Laboratories

Graduate Students Supervised (Graduated since 2000):
PhD: Dawn Bardot, Elisabetta Valenti, Walter Dauksher
MS: Kendra Anderson, MingHang Wong, David Reddy

Service Highlights:
Internal: Vice Chair, Chair of Faculty Senate, Chair Senate Council on Planning and Budgeting, Member of UW Tower Advisory Committee, Member of City of Seattle – University Community Advisory Committee.

External: Member of ASME Max Jakob Award Committee, Chair, Editorial Board, ASME Applied Mechanics Review, Chair, ASME K-12 committee. Executive Committee member, 2006 International Heat Transfer Conference, 2007 IPDE conference, 2007 ICIPE conference.

Awards:
Mechanical Engineering Teaching Award (2001-2002)
Fellow, ASME
Puget Sound Engineer of the Year
Outstanding Reviewer, ASME J. Heat Transfer, 1992-1995
Best Paper Award, ASME J. Heat Transfer, 1993
Recipient of the 2000 ASME Heat Transfer Memorial Award
Best Paper Award, ASME J. Heat Transfer, 2004

Publications:

A Long Term Study of Residential Home Heating Consumption and the Effect of Occupant Behavior on Homes in the Pacific Northwest Constructed According to Improved Thermal Standards, ***Energy***, Volume 31, No. 5, pp 551-744, 2006

The Concept of Retained Strength as Applied to Thermal Shocks, to be presented at the ***2006 ASME Pressure Vessels and Piping Division Conference, Paper PVP2006-ICPVT11-93825***, Vancouver, BC, Jul 23-27, 2006

The Determination of the Sensitivity of Heat Transfer Systems Using Global Sensitivity and Gaussian Processes (with D. Bardot), ***Proc. 2005 Summer Heat Transfer Conference, Paper HT2005-72287***, San Francisco, CA to be published ***ASME J. Heat Transfer*****,** March, 2006

Temperature Distribution in a Radiating Fin with Stochastic Properties and Environment, to be published ***ASME J. Heat Transfer***, 2007

The Design of a Thermal Protection System (with D. Bardot) **Proceedings** ***13th International Heat Transfer Conference, 13*** - 18 August 2006, Sydney, Australia

Effects of Cross-Draft and Hood Face Velocity on Exposure to a Manikin at the Face of an Industrial Bench-top Hood (with S. E. Guffey, H. B. Rafnsdottir), accepted for publication ***AIHAJ***,

The Use of Kriging and Nuisance Variables in Parameter Estimation, submitted to ***Inverse Problems in Science and Engineering***

Acounting for Heat Losses In a Calorimeter Using Bayesian Inference, **Proceedings 2006 IMECE**, Chicago, Ill, November 2006

Measured and Predicted Thermal Performance of a Residential Basement (with D. R. Heerwagen, C. J. Kippenhan and D. E. Steele), **ASHRAE HVAC&R Research, Vol 13, No 1,** January 2007

Book Chapters

Thermal Comfort, in ***The Ergonomic Payoff,*** R. Lueder, ed., Holt Rinehart and Winston of Canada, 1986

Thermal Science for Physical Medicine (with K. M. Sekins), ***Therapeutic Heat and Cold,*** 4th edit, J. F. Lehmann, ed., Williams and Wilkins, 1990

Computer Modeling of Thermotherapy (with K. M. Sekins), ***Therapeutic Heat and Cold,*** 4th edit, J. F. Lehmann, ed., Williams and Wilkins, 1990

Supercomputing in Heat Transfer (with D. W. Pepper), ***Annual Review of Heat Transfer*****,** C. L. Tien, ed., CRC Press, February 1994

The Effect of Uncertainties and Correlations on the Efficiency of Estimating and the Precision of Estimated Parameters, in ***Inverse Engineering Handbook*** (K. Woodbury, ed.), CRC Press, 2002

Name and Rank: **Mark A. Ganter,** Professor

Education:

- University of Wisconsin Ph.D. in Mechanical Engineering 1985

Dynamic Collision Detection using Kinematics and Solid Modeling Techniques, w/J.J. Uicker, Jr.

- University of Wisconsin M.S. in Mechanical Engineering 1981

Techniques for Converting Wire-Frame to Solid-Geometric Data Representations, w/J.J. Uicker, Jr.

- University of Wisconsin B.S. in Mechanical Engineering, Magna Cum Laude 1979

Professional Employment (Post PhD):

2000-current	University of Washington, Seattle, WA Professor of Mechanical Engineering
1993–2000	University of Washington, Seattle, WA Associate Professor of Mechanical Engineering
1986-1993	University of Washington, Seattle, WA Assistant Professor of Mechanical Engineering
1985-1986	University of Wisconsin, Madison, WI Visiting Assistant Professor of Mechanical Engineering

Teaching Emphasis: Design, Kinematics and Linkage Design, Micro-computer Graphics for CAD

Research: development of implicit solids for design, development of implicit solids for layered manufacturing, extension of techniques for skeleton generation for implicit solid modeling, refinement of previously developed surface-surface intersection algorithms, and fusion of multi-spectral vision images for improved machine vision and recognition.

Research Support (since 2000):

- Sulzberger Institute for Dermatologic Education, D. Berg, G. Raugi, J. Berkley, H. Gladstone, S. Weghorst, M. Ganter, "Virtual Reality Skin Surgery II", $25,000 (9/00 – 9/01) $2,500 (10%) for Ganter.
- Intel Equipment Grant Program , (M. Ganter, w/COE) "Intel Computer Equipment Proposal for Support of Cluster Computing," $128,00-250,000 (6/2001-current).
- Modeling of Thermal Post-processing for Electronic-based Manufacturing via Three Dimensional Printing, PI - Duane Storti, Major Participants - Rhonda Anderson and Mark Ganter,8/17/2004 - 8/18/2005, $60,000 funded by ExtrudeHone Corp (extension of subcontract of ONR funding).
- Advanced Materials for Rapid Manufacturing, - Duane Storti, Major Participants - Rhonda Anderson and Mark Ganter, 7/1/2003 - 4/30/2004, $27,997 funded by ExtrudeHone Corporation as sub-contract of U.S. Navy STTR Phase I.
- Pacific Northwest Regional Collaboratory PI – Jim Fridley, Co-PI – Dennis Lettenmaier, Major Participants– Hans-Erik Andersen, Bruce Bare, Mark Ganter, Bruce Lippke, Gerard Schreuder, Duane Storti, Nate Van Rheenan, ~$170K annually via PNNL and Raytheon (approved).
- 3D Printing of a complex ceramic part, M. Ganter, R. Anderson, and D. Storti, Powerex Corp, May-August 2006, $60,000.
- Rapid Modeling of Thermal Post-processing for Electronic-based Manufacturing via Three Dimensional Printing: Sintering to Full Densification, PI - Duane Storti, Major Participants -

Rhonda Anderson and Mark Ganter,Summer 2005- Summer 2006, $60,000 approved for funding by ExOne Corp (extension of subcontract of ONR funding).

Graduate Students Supervised (Graduated since 2000):

- Chang, J. (w/D. Storti): Interval Arithmetic Solid Modeling 2000
  (Dr. Chang was a post-doctoral researcher in the UW Civil Engineering Department, 2001)
  (Dr. Chang is currently working at Pittsburgh Supercomputing Center @ CMU)
- Berkely, J., (w/ G. Turkiyyah): Haptic Rendering of Deformable Bodies using Real-Time Finite Element Analysis: An Application to Surgical Simulation 2002
- LaFond, II, C. Design of a Large-Scale Styrofoam-based Rapid Prototyping Machine 2002
- Katdare, R. 3-D Implicit Object Reconstruction From Sliced Point Data Sets Using Java 2002
- Wahlborg, J. Heterogenous Implicit Solid Modelling 2003
- Mehta, F. (w/D. Storti): Applications of Level Set Methods to Lidar & EOS Data 2004
- Blanch, Ian (w/D.Storti): An Exploration of Powder Based Manufacturing Processes 2005

Service Highlights:

- American Society of Mechanical Engineers (ASME):
  -Committee Chair for ASME Design Automation Group - 2000
  -Paper Review Coordinator - ASME Design Automation Group – 2002-2005
- Associate Editor ASME Journal of Mechanical Design - 1998 - current (ending 2002)

Awards:

- American Foundry Society (AFS) Best Paper Award 1991 in Pattern and Foundry Tooling Division for M.A. Ganter and P.A. Skoglund, "Computer Assisted Pattern Core Development"
- Pattern Recognition Journal – Editiorial Board Honor 1999 – "3D Object Identification with Color and Curvature Signatures"

Selected Publications:

- H. Gladstone, G. Raugi, D. Berg , J.Berkley, M. Ganter, , S. Weghorst, "Virtual Reality of Dermatological Surgery: Virtually a Reality in the Twenty-First Century", J. Amer. Academy of Dermatology , 1999.
- R. Blanding, G. M. Turkiyyah, D. W. Storti, and M. A. Ganter, "Three Dimensional Geometric Morphing", Computational Geometry: Vol. 15, pp. 129-148, 2000.
- Brooking, C., Ganter, M. Storti,` D., Turkiyyah, G.,"Deformable Solid Modeling Through Implicit Skeletal Construction, J. Math. Modelling and Scientific Comp, Principia Scientia, Volume 10, 2000.
- J.Berkley, G. Turkiyyah, D. Berg , M. Ganter, S. Weghorst, " Real-Time Finite Element Modeling for Graphical and Haptic Rendering: An Application to Surgical Simulation", IEEE Trans. in Vis. And Comp. Graphics,v 10, n3, May/June, 2004, p 314-325.

Name and Rank: Dayong Gao, Professor

Education: BS, Mechanical Engineering, University of Science and Technology of China, Hefei, Chian (1982)
PhD, Mechanical Engineering, Concordia University, Montreal, Canada (1991)

Professional Employment (Post PhD):
1991-97: Methodist Hospital Medical Research Institute, Cryobiology Research Institute, Center for Transplantation Immunology and Reproductive Biology, Indianapolis, IN, NIH Postdoctoral Research Fellow (1991), Senior Scientist (1993); 1998-2004: Department of Mechanical Engineering, University of Kentucky, Lexington, KY, Professor and Baxter Healthcare Corp Chair of Engineering; 2004-present: University of Washington, Department of Mechanical Engineering, Professor.

Teaching Emphasis: Thermodynamics, advanced energy conversion, combustion, heat transfer. fluid Mechanics, advanced thermodynamics, bio-heat-mass transfer, cryobiology fundamentals, and bioengineering

Research: Fundamental cryobiology, mechanisms of cryoinjury and cryoprotection of living cells and tissues, cryopreservation and banking, MEMS, nano-technology, artificial kidney and livers, bio-instrument and sensors.

Research Support (since 2000): NIH, DoD, NSF, Whitaker Foundation, American Cancer Society, American Heart Association, Washington Research Foundation, Fred Hutchison Cancer Research Center, Baxter Heathcare Corp, Analytical Control Systems, Inc, Methodist Research Funds…

Graduate Students Supervised (Graduated since 2000):
PhD (12): Zhongping Huang, Zhijie Liao, Gang Zhao, Aili Zhang, Dawei Luo, Junfeng Lu, Xu Han, Jiangping Yu, Xiaodong Luo, Peitao Wang, Zhiqun Shu
MS (8): Sulaiman Mustaklem, Haifeng Zhang, Bao Zhang, Kegang Hua, Churn Poh, LipKean Moey, Dong Yifeng, Jester Purttmen

Service Highlights:
Internal: Research Resource Committee
External: Committee member of National Institutes of Health Federal Advisory Committee, NCRR, NIH (2003-present); Governor Board of Society for Cryobiology (1999-2007), Treasurer of Society for Cryobiology (2000-2002), Editor of Preservation Engineering, Journal of Cell Preservation Technology (2003-present), Chairman of International Conference of Cryo-Medicine and Cryobiology (CRYO'2004), Member of Advanced Bio-Heat-transfer Technology Committee, ASME (1998-present).

Awards: American Cancer Society Young Investigator Award (2000), University of Kentucky Alumni Professorship (2002-2003), Baxter Healthcare Chair (2004), Whitaker Young Investigator Award (2000), American Heart Association Investigator Award (1998), Chang-Jiang Scholar and Chair Professor (Chinese Education Ministry) (2000-2004)

Publications:

(A) In Books (Since 2006)

1. Gao, D.Y. , J.P. Yu, and D. Luo, Chapter 12 "Thermal Instruments and Devices in Cryobiological Research and Applications", In: **Advances in Biopreservation (book)**, edited by John Baust, CRC, Taylor & Francis, New York, pp. 321-358, 2006.
2. Zhongping Huang, Jeffrey J. Letteri, Claudio Ronco, Gao, D.Y., William R. Clark, Chapter "Solute and Water Transport Across Artificial Membranes in Conventional Hemodialysis", In **Critical Care Nephrology (book) 2nd Edition**, edited by C. Ronco, J. Kellum, R. Bellomon, (In press), 2007.
3. Zhongping Huang, Jeffrey J. Letteri, Claudio Ronco, Gao, D.Y., William R. Clark, Chapter "Pre- and Post-Dilution Reinfusion Techniques", In **Critical Care Nephrology (book) 2nd Edition**, edited by C. Ronco, J. Kellum, R. Bellomon, (In press), 2007.
4. Zhongping Huang, Jeffrey J. Letteri, Claudio Ronco, Gao, D.Y., William R. Clark, Chapter "Solute and Water Kinetics in Continuous Therapies", In **Critical Care Nephrology (book) 2nd Edition**, edited by C. Ronco, J. Kellum, R. Bellomon, (In press), 2007.

(B) In Journals (Selected Refereed Full Manuscripts Since 2006)

1. Gang Zhao, Da-Wei Luo, Gao, D.Y. Universal Model for Intracellular Ice Formation and Its Growth. AIChE Journal 52: 2596-2606, 2006.
2. Gang Zhao, Bai, Xue-Fei; Luo, Da-Wei; Gao, D.Y. Modeling the heat transfer problem for the novel combined cryosurgery and hyperthermia system: a finite element framework. Cryoletters 27: 115-126, 2006.
3. Dawei Luo, Chun Yu, Liqun He, Caicheng Lu, Gao, D.Y. Development of a Single Mode Electromagnetic Resonant Cavity for Rewarming of Cryopreserved Biomaterials. Cryobiology 53: 288-293 , 2006.
4. W. Ding, Gao, D.Y. Theoretical estimation of shell-side mass transfer coefficient in randomly packed hollow fiber modules with polydisperse hollow fiber outer radii, Journal of Membrane Science 284: 95-101, 2006.
5. Pu LLQ, Cui XD, Fink BF, Gao, D.Y, and Vasconez HC. Adipose aspirates as a source for human processed lipoaspirate cells after optimal cryopreservation. Plast Reconstr Surg 117:1845-1850, 2006.
6. Z. Huang, W. Zhang, Gao, D.Y. Development of novel ceramic membranes with nano-pores for use in artificial kidney. Journal of Biomedical Devices, ASME, (Accepted and in press), 2007
7. Pu LLQ, Cui XD, Li JH, Fink BF, and Gao, D.Y. The fate of cryopreserved adipose aspirates after in vivo transplantation. Aesthetic Surg Journal 26: 653-661, 2006.
8. W. Ding, J. Yu, X.G. Zhang, E. Words, S. Heimfeld, Gao, D.Y. Simulation of removing permeable cryoprotective agents from cryopreserved blood with hollow fiber modules. Journal of Membrane Science (Accepted and in press), 2007.
9. G. Zhao, Q. Luo, S.X. Cheng, and Gao, D.Y. Comparative study of the cryosurgical process with two different cryosurgical systems: the Endocare Cryoprobe System versus the novel combined cryosurgery and hyperthermia system. Heat and Mass Transfer of Latin American Applied Research Journal, (Accepted and in press), 2007
10. Z. Huang, J. Letteri, W. Clark, W. Zhang, Gao, D.Y. Ultrafiltration rate as a dose surrogate in pre-dilution hemofiltration. Journal of Artificial Organs (Accepted and in press), 2007
11. Gang Zhao, D.W. Luo, Gao, D.Y. Effect of blood flow and metabolism on the multi-dimentional heat transfer during cryosurgery. Medical Engineering & Physics (accepted, in press 2007)

Name and Rank: **Joseph L. Garbini**, Professor

Education:

1973 - 1977 Ph.D. at the University of Washington. Major Field of study: Mechanical Engineering. Dissertation topic: Theoretical and experimental aspects of the measurement of fluid turbulence with ultrasound.
1971 - 1973 Master of Science in Mechanical Engineering, University of Washington.
1967 - 1971 Bachelor of Science in Mechanical Engineering. Elected to Tau Beta

Professional Employment (Post PhD):

1991 - present Professor of Mechanical Engineering, University of Washington.
1985 - 1991 Associate Professor of Mechanical Engineering, University of Washington
1979 - 1985 Assistant Professor of Mechanical Engineering, University of Washington
1978 - 1979 Systems Engineer, Weyerhaeuser Co., Tacoma, WA

Teaching Emphasis: Manufacturing Optimization, Systems Analysis, Automatic Control, Realtime computing, Mechanical Dynamics, Advanced Engineering Mathematics.

Research: Instrumentation and controls. Engineering systems research and design. Extensive training in systems analysis and control, dynamics and instrumentation. Background includes electromechanical analysis, computer control systems and magnetic resonance microscopy.

Research Support (since 2000):

• The Accelerated Development of MRFM (PI w/John Sidles)	$431,000	2001	DARPA
• Direct 3D Imaging of Molecular Structure: Quantum • Sensing and Control (PI w/John Sidles)	$400,000	2001	NSF
• System Control for Magnetic Resonance Force Microscopy (PI w/John Sidles)	$ 866,000	2002	IBM / DARPA
• Achieving Molecular Observation in Four Years (w/John Sidles PI)	$ 1,000,000	2002-3	DARPA
• Achieving Single Nuclear Spin Detection (w/John Sidles PI.)Teamed with Cornell and U. Michigan (70% to UW) Review after 3 years	$ 5,000,000	2005-10	DARPA / MURI

Graduate Students Supervised (Graduated since 2000):

Masters

• Morrell, Melissa Adaptive Control of MRFM Using van der Waals Feedback 2001
• Salisbury, Curt Control of a Piezoelectric Sample Scanner for MRFM 2003
• Church, Matthew Two-Color Interferometry for MRFM Sample Scanner 2003
• Peeples, Mark Three-Axis Control for MRFM Sample Scanner 2004

Ph.D.

• Chao, S. H. 3D Imaging by Magnetic Resonance Force Microscopy 2002
• Kriewall, Thomas Heterodyne Control, Estimation and Identification for MRFM 2004

Service Highlights:

• Chairman. Technical Panel on Instrumentation and Components of the Dynamic Systems and Control Division 1989 - 1992
• Fluke Chair Search Committee (1991)
• Ford Foundation Fellowship Committee (1994-1996)
• Vice-chairman of the College Council (1995-1996)
• Chairman of COE College Council (1996-1997)
• Ad-Hoc Committee on COE Restructuring (1996-1997)
• Alternate ME Representative to COE Promotion and Tenure Committee (1994-1999)
• ME Representative to COE Promotion and Tenure Committee (1998-1999)
• Alternate ME Representative to COE Promotion and Tenure Committee (1999-2000)
• COE Shop Restructuring Committee (1999-2000)
• AA Department Chair Review Committee (2004)

Awards:

• Society of Manufacturing Engineers 1984 Outstanding Young Manufacturing Engineer Award, presented at the SME Automatic Factory Conference & Exposition (AUTOFACT 6) held October 1-4, 1984, in Anaheim California.
• 1990-1991 College of Engineering Burlington Resources Foundation Faculty Achievement Award for Outstanding Teaching.
• 2005 - 2010 Professor James B. Morrison Endowed Chair in Mechanical Engineering

Selected Publications:

• Dougherty, W. M., K. J.Bruland, S. H. Chao, J. L. Garbini, S. E. Jensen, and J. A. Sidles. "The Bloch Equations in High-Gradient Magnetic Resonance Force Microscopy: Theory and Experiment." *Journal of Magnetic Resonance*, 143, 106-119, 2000.
• Mitchell, S. B., Sanders, J. E. , Garbini, J, L., and Schuessler, P. K. "A Device To Biaxially Strain Biomaterials In Culture." *IEEE Transactions on Biomedical Engineering*, Vol. 48, No. 2, 2000.
• Holl, M., Garbini, J., Kumar, V. and Murray, W., "Asteady-State Balance Model of the Polycarbonate-CO2 System Reveals a Self-Regulating Cell Gropwth Mechanism in the Solid-State Microcellular Process," *Journal of Polymer Science Part B: Polymer Physics*. Vol 39, No. 8, April 2001.
• Sidles, J. A., Garbini, J. L., Dougherty, W. M., Chao, S. H. "The classical and quantum theory of thermal magnetic noise, with applications in spintronics and quantum microscopy." *Proceedings of the IEEE, Special Issue on Spintronics*, Vol. 91, No. 5, pp. 799-816, 2003.
Chao, S.H., Dougherty, W. M., Garbini, J. L., Sidles, J. A. "Nanometer-scale magnetic
• Q. Zou, C. Vander Giessen, J. Garbini, and S. Devasia, "Precision Tracking of Driving Waveforms for Inertial Reaction Devices," *Review of Scientific Instruments*. 2005, 76, 23701-9.
• Kriewall, T. "Heterodyne Digital Control of Magnetic Resonance Force Microscopy." *Journal of Dynamic Systems, Measurement, and Control*. (Accepted for Publication) Chao, S.H., Garbini, J. L., Dougherty, W. M. , Sidles, J. A. "The design and control of a three dimensional piezoceramic tube scanner with an inertial slider," *Review of Scientific Instruments*

Name and Rank: John C. Kramlich, Professor and Associate Chair

Education: BS Chemical Engineering, Washington State University (1973)
MS Environmental Engineering, Washington State University (1975)
PhD, Washington State University, (1980)

Professional Employment (Post PhD):
1980-91: Energy and Environmental Research Corporation, Irvine CA; Research Engineer, Group Leader, Division Director, Vice President. Contract research and development in control of pollutants from combustion-based energy sources.
1991-present: University of Washington, Department of Mechanical Engineering as Associate Professor (1991), Professor (1997), and Associate Chair (2004).

Teaching Emphasis: Thermodynamics, advanced energy conversion, combustion, heat transfer. Formerly coordinator for the college-wide freshman design course. Focus for the last five years on graduate-level and senior undergraduate courses.

Research: Environmental issues associated with energy conversion. Transformations and control of mercury in coal combustion, performance modeling of solid oxide fuel cells, mineral transformation in biomass combustion, modeling of turbulence/chemistry interactions in flames.

Research Support (since 2000): Department of Energy, National Science Foundation, NASA, Office of Naval Research, Washington Technology Center, Environmental Protection Agency, Weyerhaeuser (last 10 years)

Graduate Students Supervised (Graduated since 2000):
PhD: Rebecca Sliger, Chong Cha, Scott Martin
MS: Margaret Wheeler, Joseph Klover, Luke Hovee, Aaron Harris, Marc Brune

Service Highlights:
Internal: Graduate Program Coordinator, Associate Chair for Academics
External: Member/alternate, Executive Committee, Western States Section/The Combustion Institute

Awards:
College of Engineering Outstanding Educator of the Year (2002)
Mechanical Engineering Undergraduate Teaching Award (1999-2000)
Environmental Protection Agency Scientific and Technological Achievement Award: Awarded by the external Science Advisory Board for Outstanding Paper in the Review Category (1996)

Selected Higher Impact Publications

KRAMLICH, J. C., AND P. C. MALTE: Modeling and measurement of sample probe effects on pollutant gases drawn from flame zones. *Combustion Science and Technology* **18,** 91-104 (1978).

COLE, J. A., J. C. KRAMLICH, W. R. SEEKER, AND M. P. HEAP: Activation and reactivity of calcareous sorbents toward sulfur dioxide. *Environmental Science and Technology* **19,** 1065-1072 (1985).

KRAMLICH, J. C., M. P. HEAP, W. R. SEEKER, AND G. S. SAMUELSEN: Flame-mode destruction of hazardous waste compounds. *Proceedings of the Combustion Institute* **20,** 1991-1999 (1985).

HEAP, M. P., S. L. CHEN, J. M. MCCARTHY, J. C. KRAMLICH, AND D. W. PERSHING: An advanced selective reduction process for NO_x control. *Nature* **335,** 620-622 (1988).

MUZIO, L. J., AND J. C. KRAMLICH: An artifact in the measurement of N_2O from combustion sources. *Geophysical Research Letters* **15,** 1369-1372 (1988).

LYON, R. K., J. C. KRAMLICH, AND J. A. COLE: Nitrous oxide: Sources, sampling, and science policy. *Environmental Science and Technology* **23,** 392-393 (1989).

KRAMLICH, J. C.: Observations on waste destruction in liquid injection incinerators. *Combustion Science and Technology* **74,** 17-30 (1990).

KRAMLICH, J. C., AND G. H. NEWTON: Influence of coal properties and pretreatment on ash aerosol yield. *Fuel* **73,** 455-462 (1994).

KRAMLICH, J. C., AND W. P. LINAK: Nitrous oxide behavior in the atmosphere, and in combustion and industrial systems. *Progress in Energy and Combustion Science* **20,** 149-202 (1994).

CHA, C., J. C. KRAMLICH, AND G. KOSÁLY: Finite-rate mixing effects in reburning. *Proceedings of the Combustion Institute* **27,** 1427-1434 (1998).

CHENEVERT, B. C., J. C. KRAMLICH, AND K. M. NICHOLS: Ash characteristics of high alkali sawdust and sanderdust biomass fuels. *Proceedings of the Combustion Institute* **27,** 1719-1725 (1998).

CHA, C. M., AND J. C. KRAMLICH: Modeling finite-rate mixing effects in reburning using a simple mixing model. *Combustion and Flame* **122,** 151-164 (2000).

SLIGER, R. N., J. C. KRAMLICH, AND N. M. MARINOV: Towards the development of a chemical kinetic model for the homogeneous oxidation of mercury by chlorine species. *Fuel Processing Technology* **65,** 423-438 (2000).

BOND, T. C., D. S. COVERT, J. C. KRAMLICH, T. V. LARSON, AND R. J. CHARLSON: Primary particle emissions from residential coal burning: optical properties and size distributions. *Journal of Geophysical Research-Atmospheres* 107 (D21), 189-202 (2002).

MARTIN, S. M., J. C. KRAMLICH, G. KOSÁLY, AND J. J. RILEY: The premixed conditional moment closure method applied to idealized lean premixed gas turbine combustors. *Transactions of the ASME: Journal of Engineering for Gas Turbines and Power* **125(4),** 895-900 (2003).

RAMULU M. AND J. C. KRAMLICH: Machining of fiber reinforced composites: review of environmental and health effects. *International Journal of Environmentally Conscious Design and Manufacturing* **11(4),** 1-19 (2003).

Name and Rank: Vipin Kumar, Associate Professor

Education: BS Mechanical Engineering, Indian Institute of Technology, Kanpur, India (1970)
MS Mechanical Engineering, University of Rhode Island (1972)
MBA University of Rhode Island (1974)
PhD, Mechanical Engineering, Massachusetts Institute of Technology (1988)

Professional Employment (Post PhD):
1988- present: Department of Mechanical Engineering, University of Washington as Assistant Professor (1988) and as Associate Professor (1994)

Teaching Emphasis:
Undergraduate teaching in Design and Manufacturing. Graduate teaching in Design Methodology and research-based course in cellular polymers. Developed industry-sponsored senior capstone design projects over the past four years.

Research: Synthesis, processing, and characterization of structure and properties of microcellular polymers: plastics with a very large number of very small bubbles. Development of Manufacturing Technology for microcellular polymers applications. Nanofoams and nanocomposites.

Research Support (since 2000): National Science Foundation, Washington Technology Center, various industries.

Graduate Students Supervised (since 2000):

Greg Branch, MS 2001 " A laboratory–scale machine for semi-continuous production of soild-state foams"; Peter Wallingford, MS 2001 (Flinn, MSE, co-chair), "Effect of CO_2 Sorption and Desorption on Mechanical Properties of Polycarbonate"; Krishna Nadella, MS 2002 " Extrusion of Microcellular PVC "; Jeff Kirkham, (Wei Li, co-chair) MS, 2003 "Improving Productivity of the Recycled Plastic Lumber Production Process"; Sravani Pakala, (Wei Li, Co-chair) MS 2003 "Measurement of Permeability of microcellular foams"; Michael Waggoner, MS 2005 "Manufacture of deep-draw foamed articles in the gas-impregnated thermoforming process"; John Erik Benson, MS 2006 "Gas-Impregnated Deformation of Solid-State Foams"; Dustin Miller, MS in progress, "PEI Nanofoams"; Stephen Probert, (Per Reinhall, Co-Chair) MS in progress "Sound absorption in Microcellular Foams"; Xiaoxi Wang, PhD in progress (Wei Li, Co-Chair), " Porous Polymers for Tissue Engineering"; Krishna Nadella, PhD in progress, " Microcellular panels for load-bearing applications".

Service Highlights:
Internal: Chaired ME Undergraduate Education Committee and the College Council for Educational Policy
External: Past Chair, Thermoplastic Materials and Foams Devision, Society of Plastics Engineers; Past Chair, Polymer Committee, ASME Materials Division.

Awards:
Elected Fellow of the Society of Plastics Engineers, May 2002**.**
Boeing-Welliver Faculty Fellow, 1997.
Received the Best Paper Award from the Thermoplastic Materials and Foams Division of the Society of Plastics Engineers in 1991 and 1995

Teaching innovations and their Impact

We have presented a paper on each of the following developments at an ASEE conference to disseminate our results.

- New course, " **Product Dissection**" provides an opportunity to disassemble common products such as bicycles, drills, lawnmower engines, etc. and learn their principles of operation. *The ENGR 100 "Introduction to Design" course has adopted the lawnmower dissection module, where hundreds of freshmen experience it every quarter.*
- **Product Dissection Laboratory**. Housed in the College of Engineering Integrated Learning Factory, this laboratory is *used every quarter by the ENGR 100 students.*
- **Sterling Engine** project for 'hands-on', quarter long lab experience in our Introduction to Manufacturing Processes course. *This project has been institutionalized, and now every year, about 100 ME undergraduates experience the joy of fabricating something that is expected to work.*
- Introduced several new **'hands-on' laboratories** in ME 356 (Machine Design).
- At the 2002 ASEE meeting in Montreal, Prof. Eberhardt of UW A&A, a 1998 Welliver Fellow, and I presented a present a paper entitled "**the long-term impact of the Welliver Program**." In which we reviewed how this program has impacted our approach to teaching.

Undergraduate Student Supervision

I have had 2-3 undergraduate research assistants every year in my lab for the past fifteen plus years. Students since 2000 include Lakhwant Singh, Jeff Bickel, Steve Probert, Mike Trumbore, Lee Kroeger, Matthew Olson, Michael Kristian, Lianne Lyn, Shawn Caughlan, Kirk Lennstrom , and Alex Harbell. In addition to involving undergraduates in research, I have supervised a number of student teams for industry-sponsored capstone design projects. I run the credit-for-co-op program in our department, under which students can earn up to four academic credits for a six-month industrial internship. Approximately 20 students participate in this program every year.

Impact of research

We have made significant contributions to the understanding of bubble nucleation and growth in gas-polymer systems, especially in solid-state systems. A major thrust of our program has been to transfer technology to industry so that the dream of serving a wide spectrum of applications could be realized. Our laboratory has developed a number of manufacturing processes that help conserve natural resources and that are environmentally friendly, replacing, for example, harmful chemical blowing agents detrimental to the ozone layer with a benign gas such as nitrogen or carbon dioxide. In 2002 a startup company, MicroGreen Polymers Inc. was launched by two of my graduate students to commercialize the solid-state foam technology. The company has licensed the patents from UW and has raised 2.5M in venture capital funds in 2006.

Recent Publications

Singh, L., Vipin Kumar, and Buddy D. Ratner, (2004) "Generation of Porous Microcellular 85/15 Poly(DL-lactide-co-glycolide) Foams for Biomedical Applications", *Biomaterials*, V 25, No. 13, June 2004, 2611-2617

Kumar, V., (2005) "Phenomenology of bubble nucleation in the solid-state nitrogen-polystyrene system", *Colloids and Surfaces, A: Physiochem. And Eng. Asp. 263 (2005) 336-340.*

Nadella, K., Kumar, V., and Li, W., (2005), "Constrained Solid-State Foaming of Microcellular Panels," , *Cellular Polymers*, Vol. 24, No. 2, 71-90

Sarno, E., Kumar, V., and Li, W., (2005) "A Hybrid Methodology for Enhancing Reliability of Large Systems in Conceptual Design and its Application to the Design of a Multiphase Flow Station", *Research in Engineering Design*, Vol. 16, 27-41.

Pasricha, Arun, Gregory Wing, Vipin Kumar, and Mark Tuttle, (2005) "The Effect of CO_2 on the Creep Response of Polycarbonate", *Poly.Eng.and Sc.*, Vol. 45 No. 12 , 1639-1644.

JIANGYU LI

Professional Preparation

Tsinghua University, *Materials Science and Engineering*, B.E., 1994
University of Colorado-Boulder, *Mechanical Engineering*, M.S., 1996
University of Colorado-Boulder, *Electrical Engineering*, M.S., 1998
University of Colorado-Boulder, *Mechanical Engineering*, Ph.D., 1998
University of California-San Diego, *Active Materials*, Postdoc, 1998-1999
California Institute of Technology, *Active Materials*, Postdoc, 1999-2001

Appointments

Assistant Professor, University of Washington, 2006 - present
Assistant Professor, University of Nebraska-Lincoln, 2001 - 2005
Postdoctoral Scholar, California Institute of Technology, 1999 - 2001
Postgraduate Researcher, University of California-San Diego, 1998-1999
Graduate Assistant, University of Colorado-Boulder, 1994-1998

Award and Honor

1. Faculty Fellow, College of Engineering, University of Nebraska-Lincoln, 2005
2. Adaptive Structures and Material Systems Best Paper Award, ASME, 2004
3. Research Award, Dept. of Engineering Mechanics, University of Nebraska-Lincoln, 2003
4. William Mong Visiting Research Fellowship, University of Hong Kong, 2003

Teaching Emphasis

Mechanics of materials, micro- and nano-mechanics, active materials

Research

Multifunctional materials and structures, active materials, micromechanics, ferroelectrics

Research Support

NSF, AFOSR, ONR, NASA, ACS PRF, UW RRF, NRI, UNL

Selected Publications (42 Journal Articles)

1. Li, J.Y., Luo, Y., Bai, M.J., Ducharme, S., 2005, "Nanomesa and Nanowell Formation in Langmuir-Boldgett Polyvinylidene Fluoride Trifluoroethelyne Copolymer Films," *Applied Physics Letters* **87**, article number 213116.
2. Huang, C., Zhang, Q. M., Li, J. Y., and Rabeony, M., 2005, "Colossal Dielectric and Electromechanical Responses in Self-Assembled Polymeric Nanocomposites," *Applied Physics Letters* **87**, article number 182901.
3. Li, J.Y., Huang, C., and Zhang, Q.M., 2004, "Enhanced Electromechanical Properties in All-Polymer Percolative Composites," *Applied Physics Letters* **84**, 3124.
4. Li, J.Y and Rao, N., 2004, "Micromechanics of Ferroelectric Polymer Based Electrostrictive Composites," *Journal of the Mechanics and Physics of Solids* **52**, 591.
5. Li, J.Y., 2003, "Exchange Coupling in a P(VDF-TrFE) based All-Organic Composite with Giant Electrostriction," *Physical Review Letters* **90**, article no. 217601.
6. Li, J. Y., Rogan, R. C., Ustundag, E. and Bhattacharya, K. 2005, "Domain Switching in Polycrystalline Ferroelectric Ceramics," *Nature Materials* **4**, 776.

7. Srinivas, S. and Li, J. Y., 2005, "The Effective Magnetoelectric Coefficients of Polycrystalline Multiferroic Composites," *Acta Materialia* **53**, 4135.
8. Li, J.Y. and Liu, D., 2004, "On Ferroelectric Crystals with Engineered Domain Configurations," *Journal of the Mechanics and Physics of Solids* **52**, 1719.
9. Qu, H.L. and Li, J.Y., 2003 "The Remanence Enhancement in Magnetically Interacting Particles," *Physical Review B*. **68**, article number 212402.
10. Nemat-Nasser, S. and Li, J.Y., 2000, "Electromechanical Response of Ionic Polymer Metal Composite," *Journal of Applied Physics* **87**, 3321.

Synergistic Activities

1. Advised four undergraduate students on research experiences through Undergraduate Creative Activities and Research Experience (UCARE) program and Undergraduate Honor Thesis program at University of Nebraska-Lincoln
2. Served as Guest Editor for *Mechanics of Materials* Special Issue on Active Materials, 2004; Organized and Chaired symposiums/sessions in professional conferences, including **Organizer** of Minisymposium on Active Materials, 2004 SIAM Conference on Mathematical Aspects of Materials Science; **Organizer** of Active Materials Symposium, 41th Annual Technical Meeting of Society of Engineering Science
3. Delivered invited lectures in professional conferences, including **Keynote Speaker** in the Mini Symposium on Mechanics of Soft Actuators and Sensors, the 14th U.S. National Congress of Theoretical and Applied Mechanics, and **Invited Speaker** in ASME/ASCE Joint Summer Meeting, SES Annual Technical Meeting, MRS Fall Meeting, and International Materials Research Congress
4. Served as **Reviewer** for numerous journals, presses, societies, and funding agencies, including *Acta Materialia, Advanced Functional Materials, Advanced Materials, Applied Physics Letters, Chemical Physics Letters, Journal of Applied Physics, Journal of the Mechanics and Physics of Solids, Macromolecules, Materials Science and Engineering A, Smart Materials and Structures*, SPIE Press, WIT Press, MRS, ASME, NSF, South African National Research Foundation, American Chemical Society Petroleum Research Fund, US-Israel Binational Science Foundation, National Natural Science Foundation of China, and Hong Kong Research Grants Council
5. Developed an *Active Materials* course, taught at both undergraduate and graduate levels

Student Advising

M.S. students graduated (5): D. Liu (Univ. of Colorado-Boulder), H.L. Qu (Univ. of Nebraska-Lincoln), N. Rao (Univ. of Utah), Shashidhar Srinivas (industry), and Y. Luo (Univ. of Nebraska-Lincoln)

Current graduate students (**4**): Q.G. Du (Ph.D.), Y.F. Ma (Ph.D.), L.J. Li (Ph.D.), and Brian Walson (MS/Ph.D.)

Undergraduate Students (6): Sam Gooch, Rahul Marwah, Jon Hahn, Justin Hasner, Andy Malone, and Scott Kratzer

Name and Rank: Wei Li, Associate Professor

Education: BS, Precision Instrument and Mechanology, Tsinghua University, China, (1990)
MEng, Manufacturing Systems, Asian Institute of Technology, Thailand, (1993)
MS, Industrial Engineering, Florida A&M University, (1995)
PhD, Mechanical Engineering, University of Michigan, (1999)

Professional Employment (Post PhD):
1999-2000: University of Michigan, Research Fellow.
2000-present: University of Washington, Department of Mechanical Engineering, Assistant Professor (2000-06), Associate Professor (2006-present).

Teaching Emphasis: Manufacturing processes, computer numerical control and computer aided manufacturing, dynamic system analysis, mechanical measurements.

Research: Material behaviors in manufacturing processes, modeling of coupled thermal-mechanical-electrical processes, monitoring and diagnosis, design of experiment, fabrication of porous materials, tissue engineering scaffolds, and 3D cell culture devices.

Research Support (since 2000): National Science Foundation, Washington Technology Center, Boeing Company, DaimlerChrylser, Genie Industries.

Graduate Students Supervised (Graduated since 2000):
PhD: Jun Xu (2006), Xiaoxi Wang (w/ Kumar, expected 2007), Hai Wang (expected 2007)
MS: Juntae Lee, Maxwell V. Chor, Tarun Khosla, Jeffery Kirkham (w/ Kumar), Srivani Pakala (w/ Kumar), Nick Kaltsas (expected 2007)

Service Highlights:
Internal: Undergraduate Education Committee, Faculty Senate
External: ASME/MED Newsletter Editor

Awards:
Presidential Early Career Award for Scientists and Engineers (PECASE), 2005
Finalist, NAMRI/SME Outstanding Paper Award, 2005
National Science Foundation (NSF) CAREER Award, 2004
SME Outstanding Young Manufacturing Engineer Award, 2002

Major Contributions

I have developed on-line monitoring and diagnosis algorithms for detecting process abnormalities and estimating product quality without destructive testing. I extended design of experiment methodology for parameter interdependency (not only interaction). My graduate student and I have developed a novel *dynamic thermal tensioning* approach for real time welding distortion control. The method is now used in industry and has resulted in significant scrape rate reduction. I have also developed a selective ultrasonic foaming process to fabricate porous polymeric materials for biomedical applications.

Selected Publications:

- Xu, J. and Li, W., "The Nonlinear Time-varying Response of Dynamic Thermal Tensioning for Welding-Induced Distortion Control," *ASME Transaction Journal of Manufacturing Science and Engineering*, **in-press**.
- Xu, J. and Li, W., "A Finite Element Model for Welding Induced Distortion Control," *Journal of Engineering Manufacture,* **in-press**.
- Li, W., "Manufacturing Process Diagnosis using Functional Regression," *Journal of Materials Processing Technology*, **in-press.**
- Xu, J., Kim, D., and Li, W., "Force Characteristics of Self-piercing Riveting," *Journal of Engineering Manufacture*, **in-press**.
- Chor, M. and Li, W., 2007, "Permeability Measurement of Tissue Engineering Scaffold," *Journal of Measurement Science and Technology,* Vol. 18, pp. 208-216.
- Wang, X., Li, W., and Kumar, V., 2006, "A method for solvent-free fabrication of porous polymer using solid-state foaming and ultrasound for tissue engineering applications," *Journal of Biomaterials*, Vol. 27, pp. 1924-1929.
- Xu, J. and Li, W., 2005, "Welding Induced Distortion Control using Dynamic Thermal Tensioning," *Transaction of North American Manufacturing Research Institution of SME*, Vol. 33, pp. 273-280. **(*Finalist, NAMRI/SME Outstanding Paper Award*)**
- Li, W., Cerjanec, D., and Grzadzinski, G.A., 2005, "A Comparative Study of Single AC and Multiphase DC Resistance Spot Welding," *ASME Transaction Journal of Manufacturing Science and Engineering,* Vol. 127, No. 3, pp. 583-589.
- Li, W., 2005, "Modeling and On-line Estimation of Electrode Wear in Resistance Spot Welding," *ASME Transaction Journal of Manufacturing Science and Engineering,* Vol. 127, No. 4, pp. 709-717.
- Sarno, E., Kumar, V., and Li, W., 2005, "A Hybrid Methodology for Enhancing Reliability in Conceptual Design of Complex Systems and Its Application in the Design of A Multiphase Flow Station," *Journal of Research in Engineering Design*, Vol. 16, No. 1-2, pp. 27-41.
- Nadella, K., Kumar, V., and Li, W., 2005, "Constrained Solid-State Foaming of Microcellular Panels," *Journal of Cellular Polymers*, Vol. 24, No. 2, pp. 71-90.
- Li, W., Li, D., and Ni, J., 2003, "Diagnosis of Tapping using Spindle Motor Current," *International Journal of Machine Tools and Manufacture*, Vol. 43, No.1, pp. 73-79.
- Li, W., Nadella, K., and Kumar, V., 2003, "Manufacturing of Micro-scale Open-cell Polymeric Foams using the Solid-State Foaming Process," *Transaction of North American Manufacturing Research Institution of SME*, Vol. 31, pp. 371-378.
- Li, W., Cheng, S.-W., Hu, S.J., 2002, "Robust Design and Analysis for Manufacturing Processes with Parameter Interdependency," *Journal of Manufacturing System*, Vol. 21, No. 2, pp. 93-100.
- Li, W., Cheng, S.-W., Hu, S.J., and Shriver, J., 2001, "Statistical Investigation on Resistance Spot Welding Quality using a Two-stage, Sliding-level Experiment," *ASME Transaction Journal of Manufacturing Science and Engineering*, Vol. 123, pp. 513-520.

Philip C. Malte, Professor of Mechanical Engineering

Department of Mechanical Engineering
University of Washington
Seattle, WA 98195
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Phone: (206) 685-2171
FAX: (206) 685-8047
E-mail: malte@u.washington.edu

Education

The University of Michigan	Aero Engr	BS, 1964
The University of Michigan	Engr Math	BS, 1964
The University of Michigan	Aero Engr	MS, 1966
The University of Michigan	Aero Engr	PhD, 1971

Appointments

1983-present	Professor, Mechanical Engineering, University of Washington
1983-1994	Graduate Program Director, Mech Engr, Univ of Washington
1979-1983	Associate Professor, Mech Engr, University of Washington
1977-1979	Associate Professor, Mech Engr, Washington State Univ
1977-(6 months)	Faculty Rotator, US Dept of Energy, Washington, DC
1973-1977	Assistant Professor, Mech Engr, Washington State Univ
1971-1972	Senior Engineer, Rohr Industries, San Diego, CA
1967-1968	Engineer, Martin Marietta Corp, Denver, CO

Honors

Fellow, American Society of Mechanical Engineers
Chair, Board of Governors University of Washington Program on the Environment
Chair, International Gas Turbine Institute Combustion and Fuels Committee
Chair, Combustion Institute Western States Section

Editorship

Associate Editor, *ASME Transactions, Journal of Engineering for Gas Turbines and Power*

Research

Professor Malte has over 30 years experience conducting and managing experimental research and managing computational research. Until 10 years ago, Professor Malte's research was focused predominantly on combustion, especially on the formation and control of pollutants in high intensity combustion systems, such as those used in advanced power generation gas turbines. Professor Malte is internationally known for his research on oxides of nitrogen (NO_x) in high intensity combustion. Over the past 10 years, Professor Malte has divided his research attention between renewable energy and combustion technologies. Recently, the Energy and Environmental Combustion Laboratory, which Professor Malte founded and directs, conducted analysis, evaluation, applications engineering and system-level design on low wind speed turbines, micro-hydroelectric, solar PV, and biofuels from forest residues. Currently, the Laboratory is performing PhD level research on the impart of tidal turbines on the estuary flow and on one another in a farm of tidal turbines, as well PhD level research on gaseous fuel interchangeability using both experiments and fluids and chemical kinetic computational modeling.

Publications since 1995

with D.G. Nicol, R.C. Steele, and N.M. Marinov: "The Importance of the Nitrous Oxide Pathway to NOx in Lean-Premixed Combustion," *Transactions of the ASME, Journal of Engineering for Gas Turbines and Power*, Vol. 117, pp. 100-111 (1995).

with R.C. Steele, D.G. Nicol, and J.C. Kramlich: "NO_x and N_2O in Lean-Premixed Jet-Stirred Flames," *Combustion and Flame*, Vol. 100, pp.440-449 (1995).

with N.M. Marinov: "Ethylene Oxidation in a Well-Stirred Reactor," *International Journal of Chemical Kinetics*, Vol. 27, pp. 957-986 (1995).

with W. Polifke, K. Dobbeling, T. Sattelmayer, and D.G. Nicol: "An NO_x Prediction Scheme for Lean-Premixed Gas Turbine Combustion Based on Detailed Chemical Kinetics," *Transactions of the ASME, Journal of Engineering for Gas Turbines and Power*, Vol. 118, pp. 765-772 (1996).

with T. Rutar, J.C. Kramlich, and P. Glarborg: "Nitrous Oxide Emissions Control by Reburning," *Combustion and Flame*, Vol. 107, pp.453-463 (1996).

with R.C. Steele, A.C. Jarrett, J.H. Tonouchi, and D.G. Nicol: "Variables Affecting NOx Formation in Lean-Premixed Combustion," *Transactions of the ASME, Journal of Engineering for Gas Turbines and Power*, Vol. 119, pp. 102-107 (1997).

with R.C. Steele, J.H. Tonouchi, D.G. Nicol, and D.T. Pratt: "Characterization of NO_X, N_2O, and CO for Lean-Premixed Combustion in a High-Pressure Jet-Stirred Reactor," *Transactions of the ASME, Journal of Engineering for Gas Turbines and Power*, Vol. 120, pp. 303-310 (1998).

with K.M. Nichols: "Evaluation of NO_x Production from Black Liquor Gasification-Gas Turbine Combustion Systems," Paper No. 12-5, *Proceedings of the 1998 International Chemical Recovery Conference*, Tampa, FL (1998).

with D.G. Nicol, A.J. Hamer, R.J. Roby, and R.C. Steele: "Development of a Five-Step Global Methane Oxidation-NO Formation Mechanism for Lean-Premixed Gas Turbine Combustion," *Transactions of the ASME, Journal of Engineering for Gas Turbines and Power*, Vol. 121, pp. 272-280 (1999).

with T. Rutar and J.C. Kramlich: "Investigation of NO_x and CO Formation in Lean-Premixed, Methane/Air, High-Intensity, Confined Flames at Elevated Pressures," *Proceedings of the Twenty-eighth Symposium (International) on Combustion*, pp. 2435-2441, The Combustion Institute, Pittsburgh (2000).

with T. Rutar: "NO_x Formation in High-Intensity Jet-Stirred Reactors with Significance to Lean-Premixed Combustion Turbines," *ASME Journal of Engineering for Gas Turbines and Power*, Vol. 124, pp. 776-783 (2002).

with J.C.Y. Lee and M.A. Benjamin: "Low NO_x Combustion for Liquid Fuels: Atmospheric Pressure Experiments Using a Staged Prevaporizer- Premixer," *Transactions of the ASME, Journal of Engineering for Gas Turbines and Power*, Vol. 125, pp. 861-871 (2003)

with B. Polagye and K. Hodgson: "An Economic Analysis of Bio-Energy Options Using Thinnings from Overstocked Forests," *Biomass and Bioenergy,* Vol. 31, pp 105-125 (2007).

with I. Novosselov: "Development and Application of an Eight-Step Global Mechanism for CFD and CRN Simulations of Lean-Premixed Combustors," paper accepted for ASME Turbo-Expo, Montreal, Canada, and *ASME Journal of Engineering for Gas Turbines and Power.* (2007).

Name and Rank: Ann M. Mescher, Associate Professor

Education: BS Engineering Physics, Ohio State University (1988)

PhD Mechanical Engineering, Ohio State University (1995)

Professional Employment (Post PhD):

1995-96: University of Massachusetts Lowell, Department of Mechanical Engineering, Assistant Professor
1996-present: University of Washington, Department of Mechanical Engineering as Assistant Professor (1996), and Associate Professor (2003).

Teaching Emphasis: Heat transfer, fluid mechanics, thermodynamics, design.

Research: Study of mass and energy transport phenomena in advanced manufacturing processes for polymer optical fiber, development of manufacturing processes for non-linear organic material devices, including photonic bandgap fiber.

Research Support (since 2000):

National Science Foundation, Washington Technology Center, Air Force Office of Scientific Research.

Graduate Students Supervised (Graduated since 2000):

PhD: Hayden Reeve
MS: Andrew Eidinger, Anil Ogale, Brian Ratliff, Adrian Staff, Charles Firkins, Jeremy Dixon, Hayden Reeve, Shawn Williams, Curtis Ebersold, Shiqiang Wu

Service Highlights:

Internal: Organized the 1st and 2nd annual University of Washington Mechanical Engineering Design Fairs; Award Selection Committee: University of Washington *Alumnus Summa Laude Dignatus*; Co-organized the 1st and 2nd "Hands-On FutureTech" workshop series which highlighted graduate research opportunities through hands-on activities for Latino, Native American and African American students.
External: International Standing Committee for Polymer Optical Fiber, Technical Program Chair for the 12th International Polymer Optical Fiber Conference.

Awards:

Puget Sound Engineering Council's Academic Engineer of the Year (2007)
Best Paper Award: ASME Summer Heat Transfer Conference (2003)

REPRESENTATIVE PUBLICATIONS

1. Reeve, H., A. Mescher, A. Emery, "Investigation of Steady State Drawing Force and Heat Transfer in Polymer Optical Fiber Manufacturing," *Journal of Heat Transfer,* Vol. 126, No. 2, pp. 236-243, 2004.
2. Reeve, H., A. Mescher, A. Emery, "Unsteady Natural Convection of Air in a Tall Axi-symmetric Non-isothermal Annulus," *Numerical Heat Transfer: Part A*, Vol. 45, No. 7, pp. 625 – 648, 2004.
3. Reeve, H. M., A. M. Mescher and A. F. Emery, "Investigation of Convective Heating in a Polymer Fiber Drawing Process," *Polymer Composites*, Vol. 24, No. 2, pp. 279-290, 2003.
4. Reeve, H. M., and A. M. Mescher, "Effect of Unsteady Natural Convection on the Diameter of Drawn Polymer Optical Fiber," *Optics Express*, Vol. 11, No. 15, pp. 1770-1779, 2003.
5. Reeve, H., A.M. Mescher, A. Emery, "Experimental and Numerical Investigation of Polymer Preform Heating," *Journal of Materials Processing and Manufacturing Science*, Vol. 9, No. 4, April 2001, pp. 285-301.
6. Mescher, A.M. and H. Reeve, "A Study on Transient Heating of Polymer Fiber Preforms," *Journal of Materials Processing and Manufacturing Science,* Vol. 8, October 1999, pp. 94-105.
7. Sarikaya, M., H. Fong, N. Sunderland, B. Flinn, G. Mayer, A. Mescher, E. Gaino, "A Biomimetic Model of a Sponge-Spicular Optical Fiber – Mechanical Properties and Structure," *Journal of Materials Research*, Vol. 16, No. 5, pp. 1420-1428, May 2001.
8. Minaie, B., Y. F. Chen, and A.M. Mescher, "A Methodology to Obtain a Desired Filling Pattern During Resin Transfer Molding," *Journal of Composite Materials,* Vol. 36, No. 14, pp. 1677-1692, 2002.
9. Hailey, M., J. Jorgensen, A. Mescher and J. Fridley, "Undergraduate Collaborative Capstone Design Projects Using the Web," Proceedings of the 2001 American Society for Engineering Education Conference & Exposition, 2001.
10. Essenhigh, R.H. and A. Mescher, "Mechanism of Carbon Combustion: Relative Influence of Adsorption, Desorption, and Boundary Layer Diffusion as a Function of Pressure," *Combustion and Flame*, 111, pp. 350-352, 1997.

REPRESENTATIVE INVITED LECTURES

1. "Photonic Crystal Fiber: Its Application and Fabrication Challenges," Norfolk State University, VA, 28 April, 2006.
2. "Transport Phenomena in Polymer Fiber Manufacturing," International Polymer Optical Fiber Conference, 8 September, 2000.
3. "Research Program in Polymer Optics and Processing at the University of Washington," National Industrial Research Institute of Nagoya, Japan, 15 March, 2000.
4. "Process Control Strategy for Advanced Polymer Composite Molding," U.S. Army Tank-Automotive Research, Development and Engineering Center, 15 December, 1998.
5. "Transport Phenomena During Manufacture of Polymer Optical Fiber," Bell Labs, Innovations for Lucent Technologies, 30 September, 1998.
6. "Outcomes of Industrial Involvement in Mechanical Engineering Senior Design Course," University of Washington, ECSEL, 6 April, 1998.

Name and Rank: David J. Nuckley, Research Assistant Professor

Education: BS Bioengineering, Syracuse University (1995)
Ph.D. Bioengineering, University of Washington (2002)

Professional Employment (Post PhD):
2002-present: University of Washington, Department of Mechanical Engineering
Research Assistant Professor

Teaching Emphasis:
Biomechanics, instrumentation, biology for engineers.

Research:
Biomechanics of pediatric cervical spine injuries for the prevention of injuries and the development of interventions (air bag de-powering, helmet design, booster seat design). Investigating the biomechanical and biological changes in intervertebral disc tissues to understand the etiology of lumbar disc degeneration and low back pain. Development of computational models of the pediatric cervical spine and neck to examine injury mechanics parametrically.

Research Support (since 2000):
Center for Injury Prevention and Control, CDC, Orthopaedic Research and Education Fund, Cervical Spine Research Society, College of Engineering (Infrastructure), and Royalty Research Fund

Graduate Students Supervised (Graduated since 2000):
MS: Amy Vincent

Service Highlights:
Internal: Undergraduate Admissions/Scholarship Committee Member
External: SEM Technical Division Board, Host Northwest Biomechanics Symposium 2005

Awards:
Margaret H. Hines Award for Outstanding Paper, Injury Biomechanics Symposium (2006)
GAANN Fellow (1998)
Syracuse Scholar (1995)

Publications:

Nuckley DJ, Van Nausdle J, and Ching R. Neural Space and Biomechanical Integrity of the Developing Cervical Spine in Compression. (2006) *Spine* In Press (accepted 8/30/06).

Linders DR and Nuckley DJ. Deduction of Spinal Loading from Vertebral Body Surface Strain Measurements. (2006) *Experimental Mechanics* In Press (accepted 8/14/06).

Elias P, Nuckley DJ, and Ching RP. Effect of Loading Rate on the Compressive Mechanics of the Immature Baboon Cervical Spine. (2006) *Journal of Biomechanical Engineering* 128 (1):18-23.

Nuckley DJ and Ching RP. Developmental biomechanics of the cervical spine: Tension and compression. (2006) *Journal of Biomechanics* 39:3045-54.

Nuckley DJ, Hertsted S, Eck M, and Ching R. Effect of Displacement Rate on the Tensile Mechanics of Pediatric Cervical Functional Spinal Units. (2005) *Journal of Biomechanics* 38 (11):2266-75.

Nuckley DJ, Konodi MA, Raynak GC, Ching RP, Chapman JR, and Mirza SK. Neural Space Integrity of the Lower Cervical Spine: Effect of Anterior Lesions. (2004) *Spine* 29 (6):642-9.

Nuckley DJ, Eck M, Carter J, and Ching R. Spinal Maturation Affects Vertebral Compressive Mechanics and vBMD with Sex Dependence. (2004) *Bone* 35:720-8.

Nuckley DJ, Van Nausdle J, Raynak G, Eck M, Harrington R, and Ching R. Examining the Relationship Between Whiplash Kinematics and a Direct Neurologic Injury Mechanism. (2003) *International Journal of Vehicle Design* 32 (1 / 2):68-83.

Nuckley DJ, Hertsted S, Ku G, Eck M, and Ching R. Compressive Tolerance of the Maturing Cervical Spine. (2002) *Stapp Car Crash Journal* 46:431-40.

Name and Rank: **MAMIDALA RAMULU**, Professor

Education:

- PhD in Mechanical Engineering, University of Washington, March 1982
- M Tech in Production Engineering, Indian Institute of Technology, June 1976
- BE in Mechanical Engineering with Distinction, Osmania University, India, 1974

Professional Employment (Post PhD):

1994 Sept-present Professor, Dept of Mechanical Engineering, UW.
1995 Sept -1996 March Visiting Scientist, Defense Metallurgical Research Laboratories, Kanchanbagh, Hyderabad, India.
1990 Sept-1994 Aug Associate Professor, Dept. of Mechanical Engineering, UW
1985 Sept-1990 Aug Assistant Professor, Dept. of Mechanical Engineering, UW
1982 Sept-1985 AugResearch Assistant Professor, Dept. of Mechanical Engineering, UW
1982 March-1982 Aug Post Doctoral Research Technologist II, Dept. of Mechanical Engineering, Univ. of Washington
1981 Jan-1982 March Pre-Doctoral Research Associate II, Dept. of Mechanical Engineering, Univ. of Washington
1978 Sept-1980 June Teaching Assistant, Dept. of Mechanical Engineering, Univ. of Washington
1976 Jan-1977 Dec Research Scholar, Indian Institute of Technology, New Delhi
1972 Jan-1974 April Lecturer (part-time) in Math and Physics, Rao's College, India

Teaching Emphasis: mechanics of materials, fracture mechanics, fatigue, and advanced manufacturing processes.

Research: solid and fracture mechanics

Research Support (since 2000):

- High pressure water jets Co-PI Boeing 2002-2003 **$35,000** (PI: J. Kramlich)
- Development of Certification-Co-PI Boeing 2001-2002 **$35,000** (PI: M. Campion)
- Development of Certification-Co-PI Boeing 2002-2003 **$35,000 (**PI: M. Campion)
- Crack Growth in SPF titaniumPI Boeing 2002(year) **$32,000**
- Web based UHP Waterjet PI WTC 2003 (year) **$29,800**
- AWJ Lightout automation PI OMAX 2003(year) **$7,500**
- Modeling and Evaluation of Mechanical Properties in FSW and SPF titanium alloy sheet joints, **Phase-1**. PI, Boeing 2004Oct- June 2005, $50,000
- Modeling and Evaluation of Mechanical Properties in FSW and SPF titanium alloy sheet joints, **Phase-2**. PI, Boeing 2004Oct- December 2005, $50,000
- Modeling and Evaluation of Mechanical Properties in FSW and SPF titanium alloy sheet joints,**Phase-2 renewal**, PI, Boeing December2005- Dec2006, $120,536
- Edge Geometry Effect on Fatigue Life, Co-PI Boeing May 2006- April 2007, $102,595 **(PI is B. Finn 50%)**

Graduate Students Supervised (Graduated since 2000): PhD

- Patrick Stickler (August 2001)
Experimental and Numerical Investigation of Transeversly Stitched T-joint
Associate Tech Fellow, The Boeing Company, seattle
- Kunaporn Sawalee (August 2002) An Experimental and Numerical Analysis of Waterjet Peening Of 7075-T6 Aluminum Alloy
Lecturer, Institute of Engineering and Resources Technology ,Walailuk University, Thailand
- Dave Wook Kim (Dec 2002) Machining And Drilling Of Hybrid Composites
Assistant Professor, Washington State University, Vancoure

• W.Pedersen (March 2003) Machinability of Functionally Gradient Al/SiC Metal Matrix Composite Assistant Professor, University of Minnesota, Deluth

Service Highlights:

ASME

1993- 1996, *Executive Member*, Western Washington Section

1992-1995 *Chairman*, ASME Materials Processing Committee

1989-1991 *Vice Chairman*, ASME Materials Processing Committee, Materials Division.

1989-1992 ASME Materials Division *Liaison* to Production Engineering Division

1986-present *Member* Manufacturing Engineering & Materials Divisions

Awards:

2004 *R1edu Award*, which recognizes excellence in online teaching and innovation. R1edu is a consortium of 34 of the leading American universities coordinated by the University of Washington

2000 *Professional Service Recognition*, Knowledge Management Group, Boeing Company

1999 *Professional Achievement Award*, Sheared Services Group, Boeing Company

1999 *Fellow*, ASM International

1999 *Best Research Paper Award*, American Waterjet Technolgy Association

1998 *Fellow*, Society for Experimental Mechanics (SEM)

1997 *The Ed Wells Summer Faculty Fellow*, Boeing Company, Seattle

1996 ASME Manufacturing Engineering Division's Service Award for contributions to "Machining and Finishing Processes of Advanced Materials: Current and Future," at the 1996 International Mechanical Engineering Congress and Exhibition

1995 *Fellow*, American Society of Mechanical Engineers (ASME)

1993 *Elected member* to North American Manufacturing Institute of SME

1991 *Faculty Excellence Award*, Minority Science and Engineering Program, University of Washington, Jan. 25, 1991

1989 *Presidential Young Investigator Award*

1989 *AT&T Foundation Award*, American Society for Engineering Education

1987 *Ralph R. Teetor Award*, Society of Automotive Engineers

Selected Publications:

• M.K.Han and M. Ramulu, " Mixed Mode Fatigue Crack Propagation in 7075-T6 Aluminum Sheet Material" *Key Engineering Materials,* Vol.297-300*,* 2005, pp.743-749

• M.K.Han and M. Ramulu, " Fatigue life Prediction of Ship Welded Material" *Key Engineering Materials,* Vol.297-300*,* 2005, pp.1565-1571

• T.Honda, M. Ramulu and A.S. Kobayashi, "Shot Peening and Fatigue Crack Growth in 7075-T7351 Aluminum", *Key Engineering Materials,* Vol.297, 2005, pp.72-77

• D. Kim, M. Ramulu, and W. Pedersen "Machinability of Titanium/Graphite Hybrid Composite Drilling" ", *Transactions of NAMRI/SME*, Vol. 33, 2005, pp.445-452

• W.E. Pedersen and M. Ramulu, "Proposed Tool Wear Model for Machining Particle Reinforced Metal Matrix Composites" *Transactions of NAMRI/SME*, Vol. 33, 2005, pp.549-556

• Spitsen, R., Kim, D., Flinn, B., Ramulu, M., and Easterbrook, E.T.,"The Effects of Post-Weld Cold Working Processes on the Fatigue Strength of Low Carbon Steel Resistance Spot Welds," ASME *Journal of Manufacturing Science and Engineering,* Vol. 127,N. 4, 2005, pp.718-723

• W. Pedersen and M. Ramulu, "Facing SiCp/Mg Metal Matrix Composites with Carbide Tools" *Journal of Materials Processing Technology*, Vol.172, No. 3, 2006, pp.417-423

Name and Rank : Per G. Reinhall, Professor

Education and Academic Experience:

Ph.D. in applied Mechanics, California Institute of Technology, 1982
MS in Applied Mechanics, California Institute of Technology, 1978
BS in Mechanical Engineering, University of Washington, 1977

Professional Employment:

2001- Present	Professor, Mechanical Engineering, University of Washington
2001- Present	Adjunct Professor, Mechanical Engineering, University of Washington
1988-2001	Associate Professor, Mechanical Engineering, University of Washington
1982-88	Assistant Professor, Mechanical Engineering, University of Washington

Teaching Emphasis:

Vibrations, System Dynamics, Finite Element Analysis, Design, Nonlinear Dynamics

Research:

Nonlinear dynamics, vibrations, and acoustics. Current research focuses on biomedical devices and sensors, computational biomechanics, heart valve dynamics, structural mechanics and design, fuel cell technology, microfabrication, and coupled nonlinear systems

Research Support (since 2000):

National Institutes of Health, AFSOR, National Research Council

Graduate Students Supported (since 2000):

PhD: Astrid Schreuder, Peter Huang, Lesley Low, Daniel Einstein, Jessica Yellin, Chao-Shih Liu, Gerald Pagel, Matthew Kundrat, Eric Hofbeck,, Jong Yoon

MS: Ben Venema, Leonard Kandt, Chris Brown, Paula Beardsley, Tiana Pavlic, Chris Brown, Terje Dehli, Mathew Pagel, Matthew Kundrat, Stephen Probert

Service Highlights:

University: College Council (2004 – present), Graduate School Council (2006 – present), Promotion Advisory Committee (chair, 2004 – present), Faculty Affairs Committee (2003 - present, chair: 2004-2006)

Outside University: Board Member, Seattle Mathematics, Engineering, and Science Achievement (MESA), Board Member, Seattle Institute for Cardiac Research, 1998 - present

Awards:

Best Instructor of the Year Nomination, 1987
Outstanding Faculty Award, 1991
University Distinguished Teaching Award Nomination, 1997
College of Engineering Teaching Award Nomination, 1997
ASME J-DSMC Best Journal Paper Award 2004 for "A Nonlinear State Space Model of a Resonating Single Fiber Scanner for Tracking Control Theory and Experiment", ASME Journal of Dynamic Systems, Measurement, and Control, Vol. 126, 2004, 88-101

Selected Journal Publications (since 2000):

Kandt LD, Reinhall PG, Scheibe RR, "Determination of Air Brake Adjustment from Air Pressure Data", Journal of Automobile Engineering, Part D, Vol. 215, 2001, 21-26.

Constantine WLB, Reinhall PG, "Wavelet Based In-band Denoising Technique for Chaotic Sequences", Journal of Bifurcation and Chaos, 11 (2), 2001, 483-495

Grande KJ, Cochran RP, Reinhall PG, and Kunzelman KS, "Simulation of Aortic Valve-Sparing: Influence of Graft Shape and Stiffness", IEEE Transactions in Biomedical Engineering, Vol. 48(6), 2001, 647-659

Huang YH, Reinhall PG, Shen IY, Yellin JM, "Thickness Deformation of Constrained Layer Damping: An Experimental Evaluation", Journal of Vibration and Acoustics, Vol. 123(2), 2001, 213-221

Huang YH, Reinhall PG, Shen IY,"A Comment on Boundary Conditions in the Modeling of Beams with Constrained Layer Damping Treatments" Journal of Vibration and Acoustics, Vol. 123(2), 2001, 280-284

Grande KJ, Cochran RP, Reinhall PG, Kunzelman KS, "Mechanisms of Aortic Valve Incompetence: Finite Element Modeling of Marfan Syndrome, Journal of Thoracic and Cardiovascular Surgery, 2001, 122(5), 946-954

Huang YH, Reinhall PG, Shen IY, Kumar V, "Utilization of Microcellular Foam Materials in Constrained Layer Damping Treatments", Journal of Cellular Polymers, Vol. 20(2), 2001, 101-114

Constantine W,. Percival DB,. Reinhall PG, `Inertial Range Determination for Aerothermal Turbulence Using Fractionally Differenced Processes and Wavelets,' Phys Review E, 64, 2001, 036301

Wang WC, Fauer M, Ho JN, Seibel EJ, Reinhall PG, "Micro-machined Optical Waveguide as a Resonant Optical Scanner", Sensors and Actuators A: Physical, Volume 102, Issues 1-2, 1 Dec, 2002, 165-175

Low LA, Reinhall PG, Storti DW, "A Numerical Investigation of Phase-Locked and Chaotic Behavior of Coupled van der Pol Oscillators", Journal of Vibration and Acoustics, Vol. 125, No. 2, 2003, 162-169

Einstein DR, Reinhall PG, Nicosia M, Cochran RP, Kunzelman K, "Dynamic Finite Element Implementation of Nonlinear, Anisotropic Hyperelastic Biological Membranes", Computer Methods in Biomechanics and Biomedical Engineering, Vol. 6, No.1, 2003, 33-44,

Smithwick Q, Reinhall PG, Seibel EJ, Vagner J, "A Nonlinear State Space Model of a Resonating Single Fiber Scanner for Tracking Control Theory and Experiment", ASME Journal of Dynamic Systems, Measurement, and Control, Vol. 126, 2004, 88-101 Awarded ASME- J-DSMC Best Journal Paper 2004.

Einstein DR, Kunzelman K, Reinhall PG, Nicosia M, Cochran RP, "Haemodynamic Determinants of the Mitral Valve Closure Sound: a Finite Element Study", IEEE Medical & Biological Engineering & Computing, 2004, 42(6), 832-46

Bardy GH, Lee KL , the SCD-HeFT Investigators, "Amiodarone or an Implantable Cardioverter-Defibrillator for Congestive Heart Failure", The New England Journal of Medicine, Vol. 352, No. 3, 2005, 225-237

Einstein DR, Kunzelman K, Reinhall PG, Nicosia M, Cochran RP, "The Relationship of Normal and Abnormal Microstructural Proliferation to The Mitral Valve Closure Sound.", Journal of Biomechanical Engineering, Vol. 127, Issue 1, 2005, 134-147

Wang W-C, Dee J, Ledoux W, Sangeorzan B, Reinhall PG, " A Shear and Plantar Pressure Sensor Based on Fiber Optic Bend Loss", Journal of Rehabilitation Research and Development, Vol.42, No.3, 2005, 315-326

Einstein DR, Kunzelman K, Reinhall PG, Nicosia M, Cochran RP, "Nonlinear Fluid-Coupled Computational Model of the Mitral Valve" Journal of Heart Valve Disease Vol. 14, Number 3, May 2005

Wang W-C, Ho JN, Reinhall PG, "A Novel Double-Sided Micromachining Process for Silicon Cantilever Using A Parallel Capacitively Coupled Plasma", Journal of Microlithography, Mcrofabrication, and Microsystems, 4, 013010 (2005)

Low L, Goldman EB, Reinhall PG, Storti DW, "Coupled van der Pol oscillators as a simplified model for generation of neural patterns for jellyfish locomotion", Structural Control and Health Monitoring "Vol.13, Issue 1, 2006, 417-429

Brown C, Reinhall PG, Seibel EJ, "Optomechanical Design and Fabrication of a Scanning Fiber Endoscope", Journal of Optical Design, Vol 45, Issue 4, 2006

Smithwick Q, Vagner J, Reinhall PG, Seibel EJ, "An Error Space Controller of a Resonating Fiber Scanner: Simulation and Implementation", ASME Journal of Dynamic Systems, Measurement, and Control, Vol 128(4), 2006, 899 -913

Yoon WJ, Reinhall PG, Seibel EJ, "Analysis of Electro Active Polymer Bending: A Component in a Low Cost Ultrathin Scanning Endoscope", Sensors & Actuators: A. Physical, accepted, 2006

Pagel GA, Reinhall PG, Percival DB, "Should Second-order Structure Functions be Used for Estimation of Inertial Range behavior in Measured Turbulence? A comparative Study" Phys Review E, accepted, 2006.

Patents

1. US Patent 4,121,967, Reinhall PG, Screw Conveyer in Pulp Making Equipment, 1979. (Patent granted in all major industrial countries)
2. US Patent 5,335,463, Reinhall PG, Composition for Vibration Damping, 1994.
3. US Patent 5,336,742, Reinhall PG, Composition for Vibration Damping, 1995.
4. US Patent 5,892,437, Reinhall PG and Scheibe RR, On-Board Brake Warning Device For Air Brake Equipped Vehicles, 1999.
5. US Patent 6,856,712, Fauver, Seibel, Reinhall, Brown, Smithwick, Micro-Optical Fabricated System for Imaging or Display using Pulled and/or Etched Optical Fibers, 2005.
6. Patent Pending and Provisional Patent 60/548965, Reinhall, Wang, Polymer Based Distributive Waveguide Sensor for Pressure and Shear Measurement, 2005.
7. Patent Pending, OTT # 2341-3247, Wang, Reinhall, Fauer, Seibel, Microfabricated Optical Waveguide Scanning Cantilever as a Micro Display Device
8. Patent Pending, OTT # 2341-3520DL, Wang, Reinhall, Integrated Optical Scanning Image Acquisition and Sensing Device
9. Patent Pending, Wang, Reinhall, A distributed shear stress and pressure sensor for a prosthetic liner.

Name and Rank: James J. Riley, Professor

Education: PhD, Fluid Mechanics, The Johns Hopkins University (1972)
BA, Physics, Rockhurst College (1965)

Professional Employment (Post PhD):
1971-72: Post-Doctoral Visiting Scientist, National Center for Atmospheric Research
1972-73: Research Physicist, Naval Research Laboratory
1973-75: Research Scientist, Flow Industries, Inc.
1975-83: Senior Research Scientist, Flow Industries, Inc.
1977-83: Department and Program Manager, Flow Industries, Inc.
1983-85: Associate Professor, University of Washington
1985-present: Professor, Mechanical Engineering, University of Washington
1985-present: Adjunct Professor, Applied Mathematics, University of Washington
1997-99: Acting Chair, Mechanical Engineering, University of Washington

Teaching Emphasis:
Fluid Mechanics, Hydrodynamic Stability, Turbulence, Dynamics, Applied Mathematics, Thermodynamics.

Research: Various problems in fluid mechanics, including turbulent dispersion, two-phase flows, boundary layer transition, free shear flows, chemically-reacting flows, geophysical flows, flow of ferrofluids, and direct numerical simulation and large-eddy simulation of turbulent flows.

Research Support (since 2000):
National Science Foundation, NASA

Graduate Students Supervised (Graduated since 2000):
PhD: Satoshi Mitarai, Joseph Nichols, Gerald Pagel
MSME: Michael Flores, Gerald Pagel, Joseph Nichols, Saensuk Wetchagarun, Patrick Dean, Adel Alshayji

Additional Supervision (since 2000):
Post-doctoral fellows: Stephen deBruynKops, Marco Belan

Service Highlights: (since 2000)
Internal: Chair, Applied Physics Laboratory Review Committee; Chair, Civil & Environmental Chair Search Committee; Chair, Mechanical Engineering Faculty Search Committee (twice); Member, Mechanical Engineering Chair Search Committee; Member, UW Faculty Committee on Faculty Affairs

External: Chair, Annual Meeting of the Division of Fluid Dynamics of the American Physical Society; Associate Editor, *Journal of Fluid Mechanics*; Associate Editor, *Journal of Turbulence*; Guest Editor, *Annual Review of Fluid Mechanics*; Member, Highline Community College Engineering Advisor Committee; Member, Highline Community College Foundation

Awards: PACCAR Professorship; Fellow, American Physical Society; Fellow, American Society of Mechanical Engineers; Fellow, (British) Institute of Physics; Chair, Division of Fluid Dynamics, American Physical Society; Senior Scientific Fellow, Battelle Pacific Northwest Laboratories

Recent Research Highlights:

Developed one of the first subgrid models for large-eddy simulation of turbulent combustion, an approach which has great potential in future applications. Riley, J.J. 2006. "Review of large-eddy simulation of non-premixed turbulent combustion", *J. Fluids Engin.-Transact. of the ASME*, 128(2):209-215.

Developed a new model for extinction and reignition in combustion. Mitarai, S., Kosaly, G., Riley, JJ. 2005. "A new Lagrangian flamelet model for local flame extinction and reignition", *Comb. Flame,* 137(3): 306-319.

Developed important new concepts regarding the behavior of strongly, stably-stratified flows. Riley, J.J, deBruynKops, S.M. 2003. "Dynamics of turbulence strongly influenced by buoyancy", *Phys. Fluids*, 15(7): 2047-2059.

Eric J. Seibel

Research Associate Professor — Jan 25, 2007
Mechanical Engineering Department
Adjunct, Department of Bioengineering — Voice: (206) 616-1486
Human Photonics Laboratory, Box 352600 — Fax: (206) 543-5380
215 Fluke Hall, University of Washington — www.me.washington.edu/people/faculty/Seibel/
Seattle, WA 98195-2600 — eseibel@u.washington.edu

Education

Ph.D. in Bioengineering (March, 1996) University of Washington, Seattle, WA
Dissertation: *Development of a Near-field Scanning Optical Microscope for Imaging Biological Samples in Physiological Buffer*

M.S. in Mechanical Engineering (Dec. 1984) University of California, Berkeley, CA
Thesis: *Construction of a Laser-induced Fluorescence Spectroscopy Experiment for Studying OH in Flames*

B.S. in Mechanical Engineering (May 1983) Cornell University, Ithaca, NY

Professional Experience (including teaching experience)

07/06 – Present	Research Associate Professor, Mechanical Engineering, Member of the UW Graduate Faculty, Adjunct in Bioengineering, Faculty in the UW Center for Nanotechnology (CNT), Human Interface Technology Laboratory (HIT Lab)
12/97 – 6/06	Research Scientist and Research Assistant Professor Mechanical Engineering and the Human Interface Technology Laboratory, University of Washington, Seattle, WA
3/96 – 11/97	Senior Fellow and Instructor Department of Bioengineering, University of Washington, Seattle, WA. Spring quarters ('96- 97), initiated and taught a 4-credit graduate lecture & lab, BIOEN 561, Biomedical Optics.
1988 – '96	Pre-Doctoral Trainee in Molecular Biophysics & Cardiovascular Bioengineering
1984 – '88	Metrologist III (Quality Research Engineer) CooperVision Ophthalmic Products Div., Cooper Companies, Inc., San Jose, CA. Developed new measurement techniques to evaluate and improve quality of ophthalmic devices, especially soft contact lenses. Worked on FDA-regulated studies for new product approval and internal studies for setting and tightening manufacturing tolerances.

Awards and Honors

#1 University of Washington investigator with the most filed innovations in 2001-2003 and within the top 4 in 2004-2006, UW Technology Transfer Fiscal Reports.

BEST CONFERENCE PAPER AWARD for a co-authored, peer-reviewed conference publication at the IEEE Virtual Reality VR2002 conference, Orlando, FL, March 27, 2002, (Chinthammit et al., 2002).

NSF and UW College National Press Release (Office of Legislative and Public affairs) on the Wearable Low Vision Aid Project (NSF grant #9978888, see web site released in May 2004: http://www.nsf.gov/news/news_summ.jsp?cntn_id=100390&org=NSF&from=news).

2004 BEST JOURNAL PAPER AWARD for Smithwick, Q.Y.J., Reinhall, P.G., Vagners, J., Seibel, E.J. (2004) A nonlinear state space model of the resonating single fiber scanner for tracking control: theory and experiment. ASME Journal of Dynamic Systems, Measurement, and Control, vol. 126: 88-101.

Selected Journal and Conference Publications (student authors are underlined)

Kleweno, C. P., Seibel, E. J., Viirre, E. S., Kelly, J. P., and Furness, T. A. III. (2001) The Virtual Retinal Display as an alternative low vision computer interface: pilot study, **Journal of Rehabilitation Research and Development. Vol. 38** (4)**:** 431-442.

Seibel, E.J. and Smithwick, Q. Y. L (2002). Unique features of optical scanning, single fiber endoscopy. – *Featured article on the journal cover.* **Lasers in Surgery and Medicine. 30**(3): 177-183.

Wang, W-C, Fauver, M., Ho, J.N., Seibel, E.J., Reinhall, P.G. (2002) Micromachined optical waveguide cantilever as a resonant optical scanner. **Sensors and Actuators A (Physical) 102**(1-2): 165-175.

Chinthammit, W., Seibel, E.J., Furness, T.A. III (2003) Shared-aperture tracking display for Augmented Reality. **PRESENCE 12**(1):1-18.

McQuaide, S.C., Seibel, E.J., Kelly, J.P., Schowengerdt, B.T., Furness, T.A. III (2003) A retinal scanning display system that produces multiple focal planes with a deformable membrane mirror. **Displays, 24**(2): 65-72.

Hoffman, H.G., Richards, T.L., Magula, J., Seibel, E.J., Hayes, C., Mathis, M., Sharar, S.R., Maravilla, K. (2003) A magnet-friendly virtual reality fiberoptic image delivery system. **CyberPsychology and Behavior**, **6**(6): 645-648.

Smithwick, Q.Y.J., Reinhall, P.G., Vagners, J., Seibel, E.J. (2004) A nonlinear state space model of the resonating single fiber scanner for tracking control: theory and experiment. **ASME Journal of Dynamic Systems, Measurement, and Control,** vol. 126: 88-101.

Bryant, R.C., Seibel, E.J., Lee, C.M., Schroder, K.E. (2004) Low-cost wearable low vision aid using a handmade retinal light scanning microdisplay. **Journal of the SID (Society for Information Display) 12**(4): 397-404.

Schowengerdt, B.T. & Seibel, E.J. (2004) True 3D displays that allow viewers to dynamically shift accommodation, bringing objects displayed at different viewing distances into and out of focus. **CyberPsychology and Behavior 7**(6): 610-620.

Fauver, M., Seibel, E.J., Rahn, J.R., Meyer, M.G., Patten, F.W., Neumann, T., and Nelson, A.C. (2005) Three-dimensional imaging of single isolated cell nuclei using optical projection tomography. **OSA Optics Express 13**(11): 4210-4223. Note, the cover figure for this peer-reviewed multimedia web journal is from our article.

Barhoum, E.S., Johnston, R.S., and Seibel, E.J. (2005) Optical modeling of an ultrathin scanning fiber endoscope, a preliminary study of confocal versus non-confocal detection. **OSA Optics Express 13**(19): 7548-7562.

Brown, C.M., Reinhall, P.G., Karasawa, S., and Seibel, E.J. (2006) Optomechanical design and fabrication of resonant microscanners for a scanning fiber endoscope, **SPIE Optical Engineering**, 45(4): 040101 (10 pages).

Hoffman, HG, Richards, T., Bills, AR, Van Oostrom, T., Magula, J., Seibel, EJ, Sharar, S. (2006) Using fMRI to study the neural correlates of virtual reality analgesia. **CNS Spectrums: The International Journal of NeuroPsychiatric Medicine**, 11(1): 45-51.

Seibel, E.J., Johnston, R.S., and Melville, C.D. (2006) A full-color scanning fiber endoscope, Optical Fibers and Sensors for Medical Diagnostics and Treatment Applications VI, Ed., I. Gannot, Proc. SPIE, vol 6083: 9-16.

Tuttle, B.W. and Seibel, E.J. (2006) Application of therapeutic laser light using singlemode fiber delivery in a scanning fiber endoscope. Optical Fibers and Sensors for Medical Diagnostics and Treatment Applications VI, ed. I. Gannot, Proc. SPIE 6083: 36-47.

Schowengerdt, B.T. and Seibel, E.J., (2006) True 3D scanned voxel displays using single and multiple light sources, **Journal of the Society for Information Display**, 14(2): 135-143.

Hoffman, H.G., Seibel, E.J., Richards, T.L., Furness, T.A., Patterson, D.R., and Sharar, S.R. (2006) Virtual reality helmet display quality influences the magnitude of virtual reality analgesia. **The Journal of Pain** 7(11):843-850.

Smithwick, Q. Y. L., Vagners, J., Seibel, E.J., and Reinhall, P.G. (2006) An Error Space Controller of a Resonating Fiber Scanner: Simulation and Implementation **ASME Journal of Dynamic Systems, Measurement, and Control** 128: 899-913.

Yoon, W.J., Reinhall, P.G, and Seibel, E.J. (in press and on-line 2006) Analysis of electro active polymer bending: a component in a low cost ultrathin scanning endoscope. **Sensors and Actuators A**.

Name and Rank: I-Yeu (Steve) Shen, Professor

Education: BS Mechanical Engineering, National Taiwan University, Taiwan (1981)
MS Mechanical Engineering, National Taiwan University, Taiwan (1986)
PhD, University of California, Berkeley, California, USA (1991)

Professional Employment (Post PhD):
1991-93: University of Nebraska, Lincoln, Nebraska; Assistant Professor of Department of Engineering Mechanics.
1993-present: University of Washington, Department of Mechanical Engineering as Assistant Professor (1993), Associate Professor (1996), and Professor (2002).

Teaching Emphasis: Undergraduate and graduate courses in systems and dynamics (ME 230, ME 373, ME 374, ME 469), vibrations (ME 470, ME 588, ME 589, ME 590), mechanical design (ME 495), and applied mathematics (ME 564, ME 565).

Research: Major research areas include disk drive dynamics (spindle motors, disk media, glide heads, and suspension systems), vibration of rotating machines, PZT thin-film micro-sensors and actuators, medical applications (e.g., hearing implants and hearing aids), damping technology (passive, active, and hybrid damping, isolation), linear and nonlinear vibration.

Research Support (since 2000): National Science Foundation, Army Research Office, IBM, Western Digital Corp., Panasonic (Japan), Hitachi (Japan), IDEMA, Electro-Mechanic Technology Advancing Foundation (Japan), University of Washington.

Graduate Students Supervised (Graduated since 2000):
PhD: Thitima Jintanawan, Yao-Hsing (Peter) Huang, Jr-Yi Shen, Chaw-Wu Tseng, Jung Seo Park, Yi-Chu Hsu, Jessica Yellin, Baekho Heo, Chia-Che Wu
MS: Seungman (Paul) Chang, Richard Kent, Hyunchul Kim

Service Highlights:
Internal: Chair of Undergraduate Education Committee (Mechanical Engineering), Member of Councils of Education Policy (College of Engineering)
External: Conference Chair, 2006 ASME/ISPS-JSME/IIP Joint Conference on Micromechantronic Intelligent and Precision Equipment (San Jose, CA., USA); Guest Editor and Editorial Board of *Journal of Microsystem Technologies, MEMS, Systems for Information Storage & Processing*; Associate Editor of ASME *Journal of Vibration and Acoustics*, Vice Chair (7/06-6/07) and Executive committee member (7/00 to present) of ASME Information Storage and Processing System (ISPS) Division.

Awards:
Mechanical Engineering Outstanding Faculty of the Year Award (1998, 2003, 2004)

My research efforts in the past have lead me to be the international leader of spindle dynamics of hard disk drives. There are many facts to support this statement. All literature and disk drive companies now use the terminology that we created as far as disk drive spindle research is concerned. Our paper on spindle dynamics has been cited very frequently. Oversea researchers are repeating our research with similar approaches. I have been invited to give keynote speech in international conferences on disk drive technologies. US and Japanese disk drive companies now regularly invite me to give seminars and short courses on disk drive spindle dynamics. We receive research funding from major US and Japanese disk drive companies, such as IBM, Seagate, Western Digital, Hitachi, and Panasonic. Visiting scholars from foreign countries now come to UW to collaborate with me on disk drive spindle dynamics. Some disk drives companies (e.g., Hitachi and Samsung) have licensed the software that we developed. I was invited to chair an international conference and to serve on the editor board of a journal related to disk drive technologies.

1. B. Heo, I. Y. Shen, and J. J. Riley, 2000: Reducing Disk Flutter by Improving Aerodynamic Design of Base Castings, *IEEE Transaction on Magnetics*, Vol. 36, No. 5, pp. 2222-2224.
2. I. Y. Shen, 2000: Recent Vibration Issues in Computer Hard Disk Drives, *Journal of Magnetism and Magnetic Materials*, Vol. 209, pp. 6-9.
3. T. Jintanawan and I. Y. Shen, 2000: Free Vibration of a Rotating Disk Pack and Spindle Motor System with Rotating Shaft Design, *Journal of Information Storage and Processing Systems*, Vol. 2, pp. 129-139.
4. T. Jintanawa, I. Y. Shen, and K. Tanaka, 2001: Vibration Analysis of Fluid Bearing Spindles with Rotating-Shaft Design, *IEEE Transaction on Magnetics*, Vol. 37, No. 2, pp. 799-804.
5. J. S. Park, I. Y. Shen, and C. –P. R. Ku, 2002: A Parametric Study on Rocking Vibration of Rotating Disk/Spindle Systems with Hydrodynamic Bearings: Rotating-Shaft Design. *Journal of Microsystem Technologies*, Vol. 8, pp. 427-434.
6. C. W. Tseng, J. Y. Shen, and I. Y. Shen, 2003: Vibration of Rotating-Shaft HDD Spindle Motors with Flexible Stationary Parts. *IEEE Transaction on Magnetics*, Vol. 39, No. 2, pp. 794-799.
7. J. S. Park and I. Y. Shen, 2004: Aerodynamically and Structurally Coupled Vibration of Multiple Co-Rotating Disks. ASME *Journal of Vibration and Acoustics*, Vol. 126, pp. 220-228.
8. J. Yoon and I. Y. Shen, 2005: A Numerical Study on Rotating-Shaft Spindles with Nonlinear Fluid-Dynamic Bearings. IEEE *Transactions on Magnetics*, Vol. 41, No. 2, pp. 756-762.
9. B. Heo and I. Y. Shen, 2005, A Parametric Study on Rocking Vibration of Hard Disk Drive Spindle Motors with Fluid-Dynamic Bearings and Rotating-Shaft Design. *Microsystem Technologies: Micro- & Nanosystems and Information Storage and Processing Systems*, Vol. 11, Number 11, pp. 1204-1213.
10. Tsung-Liang Wu, I. Y. Shen, F. Okamoto, and T. Asada, 2006: Vibration of 1.8-in HDD Spindle Motors at Various Ambient Temperatures, *IEEE Transaction of Magnetics*, (under review).

Name and Rank: **Minoru Taya**, Professor

Education:

BS	University of Tokyo	1968
MS	Northwestern University	1973
PhD	Northwestern University	1977

Professional Employment (Post PhD):

1989, Sept.-present Professor, Department of Mechanical Engineering, University of Washington
1989 - 1991 Professor of Materials Processing, Tohoku University, Sendai, Japan
1986 - 1989, Sept. Associate Professor, Department of Mechanical Engineering, UW
1983 - 1985 Associate Professor, Department of Mechanical and Aerospace Engineering, University of Delaware
1978 - 1983 Assistant Professor, Department of Mechanical and Aerospace Engineering, University of Delaware
1977 - 1978 Post Doctoral Fellow, Northwestern University

Teaching Emphasis: Mechanics, Materials

Research: intelligent materials and systems including shape memory alloys(SMA), ferromagnetic SMA(FSMA), piezo-composites, electro- and photo-active polymers, and actuators based on these materials, including compact ferromagnetic SMA spring actuators, which provides a large stroke and reasonably large force.

Selected Research Support (since 2005):

- "Design of Carbon Electrodes" Hitachi Power Metals $130,000 (Gift); 5/01/02 12/31/2005
- "Design of SPR-DW System for Diagnosis of Cancer" The Biomembrane Institute / Noactic Foundation, $300,000, 10/01/03-9/30/06, PI is Taya and Co-PI is Xu
- "Characterization of TiNi-A*l* Metal Matrix Composites", Newaz Technology, $100,000, 3/01/04-2/28/06
- "Plasma Spark Sintering of Nano-structured Smart Materials", AFOSR, $250,000, 4/01/04-8/31/05
- "Characterization of Spray Cast TiNi and TiNiPd", MRi, $160K, 10/2004-10/2006
- "Design of Active Nano-Composites", AFOSR, $312K, 4/2005-4/2007
- "Design of Active Polymer Antenna", Subcontract to NSF grant to Prof. Kuga, $105K, 9/2004-9/2007
- "Mass Production Scheme of Large Sized Electrochromic Windows", Toyokohan, $240K, PI is Taya, and CO-PI is Xu
- "Boeing Pennell Professorship Endowment", University of Washington, $245K, 3/2005-3/2010
- "Smart Structures for MEMS Packaging and Shape Memory Alloy", Phase 1., Noveltek, $23,000, 1/16/2006-5/16/2006
- MURI "Design of Energy Harvesting and Storage Materials", AFOSR, $6M, 5/1/2006-4/30/2011, Taya is the PI, while Co-PIs are C. Xu, G. Cao , Y. Kuga and A. Jenekhe

Graduate Students Supervised (Graduated since 2000): PhD

2001 S. Popovic, "Design of Electroactive Polymer Gels as actuator material" Trinity College, CT.
2002 A. Almajid, "Design of high performance piezo composite actuators" King Saud University.
2002 R. Y. Liang, "Design Principle of actuators based on ferromagnetic shape memory alloys", University of Washington, (Research Associate).
2004 M. LeGuily, "Design of Arrayed Nafion® Actuators", Intel. Coadvised by Prof. C. Xu
2004 J. J. Park, "Design of a New Arrayed Temperature Sensor Systems and Thermal Interface Materials".
2005 Y. Zhao, "Design of Energy Absorbing Materials Based on Porous TiNi", University of Washington (Research Associate).

Service Highlights:

- Associate Editor, *ASME Journal of Engineering Materials and Technology*, 1988-1993
- Associate Editor, *Mater. Sci. Eng.*, 1989-2000
- Associate Editor, *ASME Journal of Applied Mechanics*, 1994-2000
- Editorial Board, Mechanical Properties of Metallic Composites, Marcel Dekker, Inc., 1990-2000
- Editorial Board, Mechanics of Materials, 1999-
- Editorial Board, JSME International Transaction 2002-
- Editorial Board, J. Comp. Mater. 2001-
- Editorial Board, J. Japan Soc. Comp. Materials 2001-
- Editorial Board, Intl. J. Eng. Sci. Tech. 2002-
- Associate Editor, Mechanics of Materials, 2005-
- Editorial Board, Journal of Mechanics , Materials and Processing, 2006-

Awards:

Boeing-Pennell Professor of Engineering, effective on March 17, 2005.

Selected Publications:

- Liang, Y., Taya, M., and Kato, H., 2006, "3D Phase Transformation Diagram of Ferromagnetic Shape Memory Alloys", Mech. of Materials, vol.38, pp.564-570.
- Lee, J.K., and Taya, M., 2004, "Strengthening Mechanism of Shape Memory Alloy Reinforced Metal Matrix Composite", Scripta Mater, 51, 443-447.
- Zhao, Y., Taya, M., Kang, Y., and Kawasaki, A., 2004, "Compression Behavior of Porous TiNi Shape Memory Alloy", Act. Mater, 53, 337-343.
- Xu, C., Liu, L., Legenski, S., Ning, D. and Taya, M., 2004, "Switchable Window Based on Electrochromic Polymers", J. Materials Research, Vol.19, No.7, 2072-2080.
- Yamamoto, T., Taya, M., Sutou, Y., Liang, Y., Wada, T. and Sorensen, L., 2004, "Magnetic Field-Induced Reversible Variant Rearangement in Fe-Pd Single Crystals", Acta. Mater, 52, 5083-5091.
- Toi, Y., Lee, J.B. and Taya, M., 2004,"Finite Element Analysis of Superelastic, Large Deformation Behavior of Shape Memory Alloy Helical Springs", Computers and Structures, vol. 82, 1685-1693.
- Park, J.J. and Taya, M., 2004, "Micro-temperature sensor with thin-film thermocouples", Electronic Letters, vol.40, no.10, pp. 599-600.
- Kuga, Y., S.W. Lee, Almajid, A., Taya, M. and Watanabe, R., 2004, "Experimental and numerical studies of microwave properties of $BaTiO_3$-platinum composites", IEEE Trans Dielectrics and Insulation, vol.12, No.4, August 2005, pp.827-834
- Nemat-Nasser, S., Choic, J.Y., Guo, W.G., Isaacs, J.B, and Taya, M., 2005, "High Strain-Rate, Small-Strain Response of a TiNi Shape Memory Alloy", J. Eng. Mater. Tech., Jan., vol. 127, 83-89
- F. Su, Suzuki, H., Xu., C., Taya, M., Handa, K. and Hakomori, S., 2005, "Development of a surface plasmon biosensor", Mech of Materials, a Special Issue, in honor of Prof. L Keer 70th Birthday, in press.
- Zhao, Y., Taya, M., and Izui, H., 2006, "Study on Energy Absorbing Composite Structure Made of Concentric TiNi Spring and Porous TiNi", , International J Solids & Structures, vol.43, pp.2497-2512
- Liang, Y., Kuga, Y. and Taya, M., 2006, "Design of Membrane Actuator Based on Ferromagnetic Shape Memory Alloy Composite for Synthetic Jet Applications", Actuator and Sensors: A 125, pp.512-518.

Name and Rank: Mark E. Tuttle, Professor and Chair

Education: BS Mechanical Engineering, Michigan Technological University (1975)
MS Engineering Mechanics, Michigan Technological University (1978)
PhD, Engineering Mechanics, Virginia Polytechnic Institute and State University (1984)

Professional Employment (Post PhD):
1984-85: Visiting Scientist, Risö National Laboratories (Denmark). Conducted research involving characterization and manufacturing of composite structures.
1985-present: University of Washington, Department of Mechanical Engineering as Assistant Professor (1985), Associate Professor (1990), Professor (1995), and Chair (2004). Also Adjunct Professor, Industrial Engineering (2000-present)

Teaching Emphasis: Undergraduate and graduate courses in solid mechanics, including strength of materials and machine design (ME 354, 356), manufacturing processes (ME355), composite materials (ME 450, ME599), adhesion mechanics (ME 553), and experimental stress analysis (ME 556, 557). Note: my teaching activities have been minimal since becoming Chair in August 2004.

Research: Polymer-matrix composite materials and structures; buckling response of composite laminates; impact of fire on polymeric composites; optimal design of composite structures; measurement/prediction of long-term creep behavior.

Research Support (since 2000): National Science Foundation, NASA, Office of Naval Research, Federal Aviation Administration, DoE/Fermilab, Boeing, Ford, NSE Composites, Intek, Hartford Engineering

Graduate Students Supervised (Graduated since 2000):
PhD: Vesna Savic, Mark Potocki, Pairod Singhatanadgid, Toshiya Miyazono
MS: Loern Halverson, Brice Johnson, Tim Lee

Service Highlights:
Internal: Department Chair
External: Society for Experimental Mechanics (involved in many ways, including society President, 1995-96)

Awards:

2005 Fellow, Society for Experimental Mechanics
1998 Distinguished Speaker Award, University of Nebraska
1995 President, Society for Experimental Mechanics
1984 Sigma Xi "Ph.D Research Award" for dissertation study
1982 Harting “Best Paper” Award, Society for Experimental Mechanics

Major Recent Contributions:

My most recent contribution to the research mission of the ME Department has been serving as Director of the FAA-sponsored Center on Advanced Materials in Transport Aircraft Structures (AMTAS), which I helped establish in December 2003. The University of Washington is the lead institution of AMTAS, which also involves Washington State University, Oregon State University, and Edmonds Community College. Within the UW faculty, staff, and students from the departments of Mechanical Engineering, Aeronautics, and Astronautics, and Materials Science and Engineering participate in and receive funding from AMTAS.

Name and Rank: **Chunye Xu**, Research Assistant Professor

Education:

Ph.D. (Sc.D.) in Polymer, March 1998, Nara Women's University, Japan
M.S. in Engineering, March 1990, Xi'an Institute of Engineering Science and Technology, China
B.S. in Engineering, August 1987, Xi'an Institute of Engineering Science and Technology, China

Professional Employment (Post PhD):

Research Assistant Professor, Dept. of Mechanical Engineering, UW, 05/2002 — present
Research Associate, Dept. of Mechanical Engineering, UW, 05/2000 — 04/2002
Postdoctoral fellow, Japan Society for the Promotion of Science (JSPS), Nara Women's University, Japan, 04/1998 — 04/2000
Lecturer, Xi'an Institute of Engineering Science and Technology, China, 01/1993 — 10/1994
Assistant Professor, Xi'an Institute of Engineering Science and Technology, 04/1990 — 12/1992

Teaching Emphasis:

Research:

Design, Processing, Manufacture and Characterization of Active Materials and Sensing Materials

- Organic, Biologically Inspired Nanomaterials and Devices,
- Functional Polymer Fibers and Films
- Inorganic–organic Composite Systems
- Energy Harvest and Storage System, e.g. Polymer Solar Cell and Polymer Battery Cell

Research Support (since 2000): Active Funding

- $1,540,000, Co-PI, Smart Window Technology founded by Boeing Company, 7/20/02 - 12/31/06
- $360,000, Co-PI, Development of a New Rapid Diagnosis System Based on Surface Plasma Resonance (SPR) with Digital Window for Early Detection of Cancer Symptom founded by The Biomembrane Institute (TBI), Seattle, 10/01/03 - 9/30/06
- $240,000, Co-PI, Development of Mass Production of Electrochromic Polymer-Based Smart Windows founded by Toyo Kohan Inc, Japan, 5/01/05 - 4/30/07
- $1,500,000, Co-PI, Energy Harvesting and Storage System and Their Integration to AF Aero Vehicles, AFOSR MURI#12, 2006, total grant $6,000,000, (5 years), 5/1/06 - 4/30/11
- $50,000, **PI**, Development of Smart Helmet and Goggles Windows Based on Electrochromic Polymers, Technology Gap Innovation Fund, University of Washington, 6/15/06 - 6/14/07

Service Highlights:

Session Chair
SPIE: Smart Structures and Materials, 2006
POLYCHAR-14 World Forum on Advanced Materials, 2006

Awards:

1. Postdoctoral Fellowship (world-wide), the Japan Society for the Promotion of Science (JSPS), for Foreign Researchers, 1998 — 2000
2. "Best Student Presentation" CARL KLASON PRIZE (world-wide), in the International Conference on Polymer Characterization, POLYCHAR-7, USA, 1999
3. Second-Class Prize (institute-wide), the 5th Scientific Conference of Xi'an Institute of Engineering Science and Technology, China, 1993
4. Praise Prize (nation-wide), the nation wide organization of the 3rd excellent paper prize committee of Chenweiji, China, 1993

5. Second-Class Prize (province-wide), the Annual Conference of Textile Engineering Society of Shannxi Province, China, 1993
6. Second-Class Prize (province-wide), the Annual Conference of Textile Engineering Society of Shannxi Province, China, 1991
7. Outstanding Student Fellowship, Xi'an Institute of Engineering Science and Technology, China, 1983-1986

US Patent and International Patent

1. Electrochromic Organic Polymer Synthesis and Devices Utilizing Electrochromic Organic Polymers, Inventor: **Xu, C.** and Taya, M., June 8, 2004 issued, US Patent No.6,747,780
2. Electrochromic Organic Polymer Synthesis and Devices Utilizing Electrochromic Organic Polymers, Inventor: **Xu, C.** and Taya, M., Feb. 21, 2006, issued, US Patent No.7,002,722
3. Electrochromic Organic Polymer Synthesis and Devices Utilizing Electrochromic Organic Polymers, Inventor: **Xu, C.** and Taya, M., May 2, 2006, issued, US Patent No. 7,038,828
4. Electrochromic Organic Polymer Synthesis and Devices Utilizing Electrochromic Organic Polymers, Inventor: **Xu, C.** and Taya, M., Canadian patent, application No.2454615
5. Electrochromic Organic Polymer Synthesis and Devices Utilizing Electrochromic Organic Polymers, Inventor: **Xu, C.** and Taya, M., European patent, application No.1412812
6. Electrochromic Organic Polymer Synthesis and Devices Utilizing Electrochromic Organic Polymers, Inventor: **Xu, C.** and Taya, M., Japanese patent, application No.2003-507,626
7. Electropolymerization of enhanced electrochromic polymer film, Inventor: **Xu, C.** and Taya, M., US patent, application No.4425PT, converted on August 13, 2004, 10/917,954
8. Switchable Window Based on Electrochromic Polymers, Inventor: Liu, L., **Xu, C.**, Legenski, E. S. and Taya, M., February 28, 2005 filed, PCT/US 05/06806
9. Green color related electrochromic monomers and polymers, Inventor: Liu, L., **Xu, C.** and Taya, M., August, 2005 filed. US patent 10/917.954

Selected Publications:

- Wang, J., Xu, C., Taya, M. and Kuga, Y., "Mechanical stability optimization of Flemion-based composite artificial muscles by means of proper solvent", *Journal of Materials Research,* in press
- Su, F., Suzuki, H., Xu, C., Taya, M., Handa, K. and Hakomori, S., "Development of a Surface Plasmon Resonance Biosensor for Early Detection of Cancer Symptom", *Mechanics of Materials,* in press
- Xu, C., Liu, L., Legenski, S. E., Ning, D., and Taya, M., "Switchable Window Based on Electrochromic (EC) Polymers", *Journal of Materials Research*, Vol.**19**, No.7, pp. 2072-2080
- Zhu, D., Koganemaru, A., Xu, C., Shen, Q., Li, S. and Matsuo, M., "Oxidative Stabilization of PAN/VGCF Composite", *Journal of Applied Polymer Science*, Vol. **87** (3), pp.2063-2073
- Kaburagi, M., Bin, Y., Zhu, D., Xu, C., Matsuo, M., "Small Angle X-ray Scattering From Voids within Carbon Fibers on Stabilized and Carbonized Stages", *Carbon*, Vol. **41** (5), pp.915-926
- Matsuo, M., Bin, Y., Xu, C., Ma, L., Nakaoki, T. and Suzuki, T., "Relaxation Mechanism in Several Kinds of Polyethylene Estimated by Dynamic Mechanical Measurements, Positron Annihilation, X-ray and ^{13}C Solid-State NMR", *Polymer*, **44** (15), pp.4325-4340

Appendix H. HEC Board Summary

a. Name of Unit Authorized to Offer Degrees

Department of Mechanical Engineering

b. School or College as Applicable

College of Engineering

c. Exact Titles of Degrees Offered

Bachelor of Science in Mechanical Engineering

Master of Science in Mechanical Engineering

Master of Science in Engineering (College of Engineering degree for which there is an approved Mechanical Engineering program)

Doctor of Philosophy

d. Year of Last Review

1993

e. Brief Description of the Field and Its History at the University of Washington

Mechanical engineering is a well-defined profession whose core is the application of physics, mathematics, and other fundamental sciences to the design of useful mechanical devises. This encompasses the manufacturing of virtually all mechanical hardware, ranging from microelectronics to airplanes. Design of moving equipment entails kinematics, dynamics, and control technology. This may be thought of as a **dynamics stem** of mechanical engineering. Furthermore, to assure that equipment components do not fail or deteriorate, mechanical engineering entails all the technology of calculating loadings and the response of materials during loading, as well as lubrication, wear, corrosion, *etc*. This comprises the **mechanics of materials** stem. Early in its development mechanical engineering became the profession responsible for the power that drove machinery. By extension, this responsibility expanded to the engineering aspects of thermal energy conversion, *e.g.,* thermal power plants, heat transfer, environmental thermal control, and motive power for vehicles. This is the **thermal/fluids stem**. Finally, there is recognition that rational design is the art of applying scientific principles to the solution of practical problems. Design has become a process that lies partly in the realm of creative art and partly as a codified methodology. This constitutes the **design stem**.

Mechanical engineering undergraduate education provides a foundation of disciplinary competence in each of the four stems indicated above (*i.e.,* technical fundamentals plus design competence). Many employers accept the 4-year BSME degree as a terminal, entry-level degree.

However, it is widely recognized that that many employers prefer the additional training that comes with the MSME degree. In particular, they value the additional technical coursework and the independent project experience that comes with generating a thesis. Thus, there is significant demand on the part of both students and employers for the terminal, professional MSME degree.

Our program at the University of Washington just celebrated it's centennial, although instruction in mechanical engineering goes back at least 10 years before the official establishment of the Department. The Department has offered the MSME degree since 1921, but the granting of significant numbers of graduate degrees did not begin to occur until the late 1950s, by which time the MSME program had begun to resemble its present form.

The Department's PhD program was approved by the University in 1959. It focuses on engineering science, with a wide degree of freedom for course selection available to the student and the advisory committee to meet the specific student's educational needs. At present we graduate around 10 PhDs per year, although as noted elsewhere in this self-study, we would like to increase this to around 20. Approximately half our PhDs pursue an academic career, initially via post-doc appointments or entry-level academic positions. The other half primarily enter the corporate world. An important feature of PhD employment in mechanical engineering is the robust demand for PhDs by the private sector. This is a reflection of progressively more complex technology needed to stay competitive in the present environment.

f. Documentation of Continuing Need for the Program

This issue can be addressed via a number of points that reflect the demand for the services we offer. These are detailed in other parts of the self-study.

- Demand for undergraduate seats in our program. We generally have around 250 applicants for our 100 available seats. These are filled by making around 130 offers, a 70% acceptance rate.
- The substantial success in our graduates at all degree levels in finding employment in the profession and in academia.
- The strong demand for our research services, as indicated by the more than doubling of our research expenditures provided by grants and contracts over the last 5 years.

g. Assessment Information Relating to Student Learning Outcomes and Program Effectiveness

The primary assessment work for our BSME degree falls under the methodologies employed as part of our ABET accreditation process. This process emphasizes quantitative assessment of outcomes, with these assessments being fed back into the program as part of a self-improvement cycle. The main assessment strategies include:

- *Standardized Exam:* We examine the performance of our students on the various parts of the standardized licensing exams relative to that of our peers.
- *Surveys:* We survey both our graduates and their employers regarding the suitability of their academic preparation to their professional practice.

- *Instructor Course Assessment:* We review each offering of each course on an annual basis to determine if all the required course elements were included in an effective manner.
- *Rubrics:* We assess senior design projects according to a set of criteria that reflect what we feel should come out of this capstone exercise.
- *Technical Writing Assessment:* The Department of Technical Communication provides an assessment of student writing skills via review of a blind sample of all the writing assignments collected from one or more classes.
- *Visiting Committee:* Our industrial advisory committee is used to provide review of specific aspect of our program. For example, last year the committee conducted a third party audit of our co-op students to identify whether the students found their academic preparation adequate for the work they were asked to perform.
- *Center for Instructional Development and Research:* This group provides direct assessment of learning and teaching techniques for individual classes, and is used on a voluntary basis by many instructors.

h. Degrees Awarded

	2003-2004	2004-2005	2005-2006
BSME Degrees Awarded	73	92	85
MSME and MSE Degrees Awarded	40	37	38
PhD Degrees Awarded	9	6	9

i. Plans to Improve Program Quality

The Mechanical Engineering Department maintains a strategic plan that consists of both short-term elements (tactical plans for the next year) and long-term elements (strategic plans for the next five-ten years). The strategic plan is a standing discussion item during the annual ME Retreat held in mid-September every year, and is also discussed on an as-needed basis throughout the academic year.

Tactical planning typically consists of:

- new research initiatives, such as major proposals under development involving new or existing research centers or research thrusts,
- new educational initiatives, such as new undergraduate/graduate course sequence(s) supporting specific research area(s),
- discussion of any faculty search(es) to be conducted during the upcoming academic year,
- dates of major events during the upcoming year (*e.g.,* Visiting Committee meetings, department-sponsored social events, COE Open House, *etc.*), and
- various development efforts (*e.g.,* strategic invitations of external seminar speakers, ME Leadership Seminar speakers, ME Scholarship Luncheon, *etc*.)

Longer-term strategic planning elements typically consist of:

- research topics likely to experience continued/increased funding,
- faculty/staff hiring plans, as related to research funding trends, individual faculty/staff approaching retirement age, departmental teaching needs, and
- infrastructure needs, especially as related to lab space allocation and improvements.

All ME faculty (tenured, tenure-track, and research) participate in the strategic planning process as well as selected staff persons including Departmental Administrator Sue Chen, Student Services Director Margo Segimoto, ME Lab Engineering Bill Kuykendall, Senior Computer Specialist Brendon Church, and ILF Manager Russ Noe. Major Gifts Officer Anne Fitzmaurice-Adams (a member of the Dean's Staff) also participates in ME development strategies.

Current Research Thrusts

Although the ME discipline is multidisciplinary by nature and therefore the activities of ME faculty defy easy categorization, the current research activities of the department can be roughly grouped as follows:

- Advanced Materials and Manufacturing
- Environmentally-Sensitive Energy Conversion
- Controls Engineering and Mechatronics
- Health Systems and Biotechnologies
- Engineering Design

SUPPLEMENTAL APPENDICES

Appendix 1. Writing Assessment

ME Writing Assessment Summary

Prepared by Karen Kasonic
8/2/06

As part of the college-wide writing assessment program, the following faculty evaluated a sample of ME student papers during summer of 2006.

- Karen Kasonic, faculty, Technical Communication
- Ann Mescher, ME faculty
- Brian Fabien, ME faculty
- John Kramlich, ME faculty

The assessment included a detailed rating of strength based on the Performance Outcomes for Engineering Writing at the University of Washington. For the ratings, papers were scored as Unacceptable, Weak, Low Competent, Competent, High Competent, or Strong.

Seven papers were collected. One paper was used for training purposes. The team met to discuss the assessment process; we then each evaluated the training paper. Our evaluations were discussed until we reached consensus.

Each evaluator then took home and rated a set of papers. Each paper needs an evaluation by two different people to ensure consistency. Evaluations must be within one step to be considered consistent, for example one paper could be rated high competent by one evaluator and strong by the second evaluator.

The papers are all from ME students and were all written in teams. These papers are from senior-level capstone courses and should reflect the writing ability of ME students upon graduation.

Summary of Results

Of the 6 papers, all had consistent evaluations between team members. The table below shows the distribution of the ratings. Every 2 ratings represent one paper. For example, the 6 Competent ratings could have come from the same 3 papers.

Table 1. Distribution of Ratings for ME Assessment, Summer 2006, Overall Evaluation:

Unacceptable	0
Weak	0

Low Competent	1
Competent	6
High Competent	2
Strong	3

Of the 6 papers, none were evaluated as unacceptable (to receive a not acceptable rating, the paper needed to show evidence that the student was not ready to write on the job). One evaluation rated a paper low competent, but all other evaluations were competent or above. This is a very strong indication that ME students are prepared to write in the workplace.

It is helpful to look at these evaluations next to the results for the entire College of Engineering. The last college-wide assessment was in 2001.

Table 2. Comparison of 2006 ME results with 2001 results for the College of Engineering as a whole. Percents represent the percent of the total number of evaluations (not individual papers, since each paper is evaluated by two people) for each category.

	ME 2006	CoE 2001
Unacceptable	0%	16%
Weak	0%	--
Low Competent	8%	17%
Competent	50%	45%
High Competent	17%	11%
Strong	25%	11%

This comparison is interesting because it indicates that ME students have stronger communication skills than the college as a whole. ME has more students writing below the competent level, and also a higher percentage of students writing at the strong level.

While this assessment indicates that ME students are prepared to write in the workplace, we must also consider that these were not individually-written papers. Papers written by a team are expected to be stronger, since the best communicators on the team can fix problems other students may have with their writing. It would be beneficial for ME to repeat the assessment project with a few papers from a senior course, written by individual students.

In addition to the holistic evaluation discussed above, the evaluators considered specific criteria from the Performance Outcomes for UW Engineering Writing. The areas that were rated highest by evaluators are:

- Clearly states the purpose, providing an explicit justification for the document.
- Substantiates claims and, when appropriate, addresses alternative claims.
- Exhibits a logical progression and structures the content to represent that logical progression.

These items are what we call "global" writing issues. While local issues, such as grammar and mechanics, can easily be fixed by an editor, it's the content and organization that the subject matter experts must get right. ME student's strengths in these areas are very impressive.

The areas that received the most weak and unacceptable ratings are:

- Uses proper citation form.
- Includes citations for other's ideas, including any information and non-textual material from sources outside the writer.
- Is designed to help readers navigate through content.
- Provides clear labels for tables, figures, and equations and uses sufficient space around these non-textual elements.

These writing issues fall into the ethics category and presentation category. They can be improved rather quickly by making expectations clear in the assignment description and by reminding students of resources such as the Engineering Library handouts on citations and the peer tutors at the Engineering Writing Center. ME might consider having the writing center director visit capstone courses for two short lectures on citing sources and document design.

Conclusions and Recommendations

The student papers from ME suggest that student writing is well above the college average. Because we did not evaluate the assignment description, it is difficult to determine whether or not the students were aware of the assignment expectations. We should make sure students are aware of the expectations for all ME writing assignments. The Engineering Communication Program director will work with individual faculty members to revise assignment descriptions and develop evaluation criteria for writing assignments.

The weak areas noted in the papers varied from surface-level problems to more serious issues involving ethics. Use of citations continues to be a problem for students, and we should do more both in the stand-alone classes and in departmental classes with using sources.

Perhaps most importantly, students should be made aware of the standards by which they will be judged in all areas of their writing (i.e., the Performance Outcomes for Engineering Writing should be familiar to students). These outcomes are used in the stand-alone courses and should also be a familiar evaluation tool for assessing student writing in department courses.

There are several ways that we could work to improve student writing over the next two years (before a 2008 assessment).

- Require that students take TC 231 before entering the major, as other engineering departments. The course has been expanded thanks to funding from Undergraduate Education. Every student who wants to should have no trouble registering for the course before his or her junior year.
- Require student use of the Engineering Writing Center (for specific classes or assignments).

- Offer student workshops on common areas of concern such as citing sources and organization (these workshops are offered by the EWC).
- Encourage faculty to have a writing center director visit their course.
- Encourage faculty participation in workshops offered by Karen Kasonic:
    - Writing effective assignment descriptions
    - Introducing writing assignments to students
    - How to effectively grading writing assignments
    - How to provide quality feedback on student writing
    - Working one-on-one with student writers during office hours
- Karen Kasonic can also consult with faculty on an individual basis.
- For the 2008 writing assessment, use individually-written papers from a senior level ME course.

The overall goal is to prepare students for the kind of writing they will do in their field after graduation. Over the past 5 years, ME has made writing and its importance more visible in the department. This is starting to motivate students to work harder and produce better documents. Workshops, the writing center, and effective feedback on their writing might help students to further recognize the value of good communication skills. The goal of the next assessment should be to eliminate any areas rated as "Weak" by evaluators.

Appendix 2. Notes on Advance Graduate Student Survey

The purpose of the survey was primarily to review the present climate and seek ways to improve this for the future. The methodology was a small group discussion with volunteer graduate students. The discussion was organized by two faculty members (Profs. Adee and Mescher). This was conducted in 2005, and many of the issue brought up have been or are being addressed (*these are shown in italics*).

Recruiting

The students were generally pleased with the application process. Many were drawn to the by a tie to the region, and many recognized the regional excellence of the program. Many felt the department needed to do a better job of providing information on ongoing research projects.

Retention

Some students had concerns about courses listed in the catalog that are rarely or never offered. They also wanted a firm list of expected offerings for at least two years out (*this has been generated, and is shown as Appendix 3*). This could be separated into "guaranteed" courses and courses "offered" that will proceed if there is sufficient enrollment. They also wish a centralized list of courses outside of ME.

There was some desire for more mentoring at the outset. Presently students meet with a member of the advising staff and the Graduate Program Coordinator, who suggests members of the faculty the students may wish to interview to find an advisor and a thesis project. While we expect the students to be proactive in this process, many find this intimidating. The department does devote the fall seminar series to research talks by the faculty (two a week). Some wish for a system under which current graduate students are used to mentor new ones.

One issue brought up was a desire for an improved seminar. At present the department sponsors a series of specialty seminars (Renewable Energy, Biomechanics, Controls, Smart Materials) in addition to the departmental seminar. New students want a broad seminar that addresses general research opportunities. *We continue to provide seminars in the fall in which faculty provide summaries of the ongoing research. Also, in the last year the department instituted the "Leadership Seminar Series" in which successful alumni at all degree levels are brought back to campus to talk about their careers and the role ME played in their preparation. This partly addresses the issue, as well as the wish for more information on employment and careers.*

One request was for more social interaction. This has been a perennial problem here at the UW given our nature as a commuter school. They would like more graduate student office space to provide a platform for interaction. *We have, however, instituted a series of social events throughout the year. These include an orientation lunch (with faculty and current graduate students) in the fall, a fall picnic, a departmental night at a local hockey game,, and a commencement celebration.*

Career Development

The students ask for more contact / interaction with "regional" companies. (*We have partly addressed this with the Leadership Seminar Series described above.*) The students also want more opportunities to teach: Guest lecturer, Teach a class as a TA. (*We have adopted a rule that any PhD student who wants to teach a lecture class will be afforded that opportunity.*) The students would also like more involvement with faculty in grant preparation. They expect faculty to assist in networking

Appendix 3. Course Offering Matrix

			A03	W04	Sp04	A04	W05	Sp05	A05	W06	Sp06	A06	W07	Sp07	A07	W08	Sp08
123	Graphic Des.	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
230	Dynamics	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
323	Thermo	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
331	Heat Trans	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
333	Fluids	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
341	Energy/Env	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
354	Material Lab	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
355	Mfr. Proc	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
356	Machine Des	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
373	System Dyn I	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
374	System Dyn II	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
395	Int Design	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
403	Material Removal	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
406	Corrosion/Surface	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
409	Num Control/CAD	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
415	Sustainability	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
424	Combustion	Even	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
425	HVAC	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
426	Renewable Eng	Odd	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
430	Adv. Energy	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
431	Adv. Fluids	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
432	Gas Dyn	?	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
433	Turbomach	Summers?	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
436	Friction/Wear	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
440	Advanced Materials	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
442	Renewable Energy	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
445	Intro Biomech	?	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
450	Intro Composites	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
459	Intro Fracture	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
460	Kin/Linkage	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
468	Air Pollution	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
469	Dynamics Applications	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
470	Vibrations	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
471	Automatic Control	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
473	Instrumentation	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
474	Sys Model/Simulation	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
477	Embedded Computing	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
478	Finite Element	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
480	CAD	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
481	Combustion Engines	?	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
485	Electronic Packaging	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
487	Elect Pkg Lab	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
490	Nav Arch I	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
491	Nav Arch Ii	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
492	Nav Arch III	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
495	Generic Design	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
495	SAE	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
495	Sub	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
495	Fuel Cell	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
495	Mechat Desig	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
498	Rapid Prototyping		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
498	Biothermal Systems		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
498	Introduction to CATIA		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
498	Mechat Des Prep	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
498	Acoustics		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
498	Bio Framework for Eng		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
498	Product Liability		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
498	Nano Materials		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
498	SAE Introduction	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

			A03	W04	Sp04	A04	W05	Sp05	A05	W06	Sp06	A06	W07	Sp07	A07	W08	Sp08
501	Mfr Proc.	Y	■			■			■			■			■		
502	Placticity/Metal Form	?															
504	MEMS	Y	■			■			■			■			■		
505	CIM Sys	?			■												
508	Mech. Measurement Sys.	Y			■					■						■	
510	Math Found Sys Theory	Odd	■			■			■						■		
518	Mfr Sem	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
520	Sem	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
521	Thermo	Y		■			■			■			■			■	
522	Stat Thermo	Even			■							■					
523	Energy Sem	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
524	Combustion	Odd					■						■				
525	Acoustics I	Y								■							■
526	Acoustics II	N													■		
530	Cond/Radiation	N					■							■			
531	Cond	Y	■			■			■			■			■		
532	Conv HT	Even			■					■							■
533	Fluids I	Y	■			■			■			■			■		
534	Fluids II	Odd					■						■				
535	Computer Techniques	Y			■		■			■			■				■
537	Fluid Topics	N															
538	Turb BL Theory	N															
541	Fatigue	Even								■						■	
543	Turbulence	Even		■						■						■	
544	Turb Modeling	Even															■
547	Linear Systems	Y	■			■			■			■			■		
548	Lin. Multivariable Control	Y		■			■			■			■			■	
549	Est and Syst Identification	Y			■			■			■			■			■
550	Non Lin Opt Control	Odd	■						■						■		
551	Elast I	Y		■			■			■			■			■	
552	Elast II	On Dem									■						■
553	Adhesion	Even			■						■						■
555	Thermoelasticity	N															
556	Expt Stress Anal I	Y	■			■			■			■			■		
557	Expt Stress Anal II	Even								■			■			■	
559	Fracture Mech	Y		■			■			■			■			■	
560	Advanced Fracture	Even															■
562	Electronic Composites	Odd			■			■						■			
563	Adv. Composites	Y			■			■			■			■			■
564	Math I	Y	■			■			■			■			■		
565	Math II	Y		■			■			■			■			■	
566	Random Proc	?															
572	Design: Conceptual	?															
573	Design: Probabilistic	?															
578	Opimization												■				
579	Fluid Power Sys	?															
581	Digital Control I	Y		■			■			■			■			■	
582	Digitial Control II	Even			■						■						■
583	Non-Linear Control Sys	Odd						■						■			
584	Airbreathing Engines	?															
585	Sys ID & Adaptive Crtl										■						
588	Dynamics/Vibrations	Y	■			■			■			■			■		
589	Vibrations II	Even		■						■			■			■	
590	Vibrations III	?															
591	Robotics Sem	Y	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
593	Feed Forward Control	Even			■						■						■
594	Robust Control												■				
598	Biomech Sem	Y	■			■			■			■			■		
599	Energy Conv	Y	■			■			■			■			■		
599	Product Liability														■		
599	Cell Solids								■								
599	Rapid Prototyping									■			■			■	
599	Renewable Energy									■			■			■	
599	Biothermal Systems									■				■			
599	Cont. Vib.												■				
599	Adv. Fluid Mech												■			■	
599	Comp. Methods in Biomech									■							
599	Bio Framework for Eng										■						
599	Micro/Nano Mech Mater													■			
599	Life Cycle Assessment										■			■			■
599	Mat. For Sensors/Act										■						■
599	Combustion	Even									■						■

Appendix 4. Undergraduate Advising Guide

The guide is shown as a separate attachment at the end of the document.

Appendix 5. Summary of Financial Aid Offers to New Graduate Students (Autumn 2006)

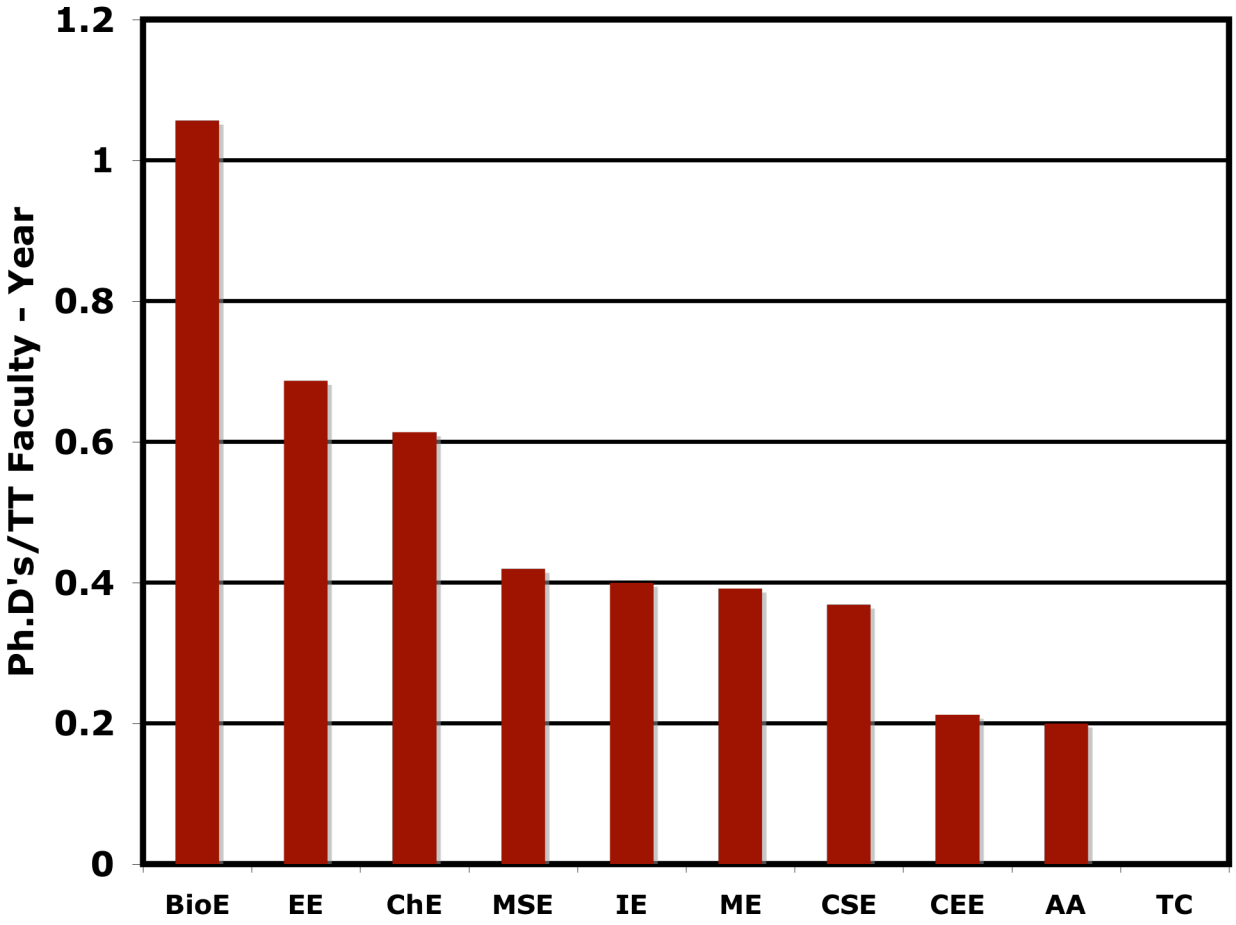
Graduate Financial Aid Commitments for AY 06/07

	TA	TSA RA	Grant RA	Fellowship
Incoming				
William C. Creamer	3Q			
David R. Dall'Osto	3Q			
Weiping Ding			4Q Gao	
Alison J. Dinsel				Boeing (9k$)
Daniel A. Flores	3Q			
Spencer J. Grange	3Q			Coen (9k$)
Skye E. Gruen	3Q			
Adi Karalic	3Q			
Erasmo Lopez				Kaiser (9k$)
Patrick M. McGah	2Q	1Q		TSA (1k$)
Shruti Pai			4Q Ledoux	
Faith E. Pardue				Cohn (9k$)
Christie D. Qualtrough	3Q			
Robert A. Taylor	3Q			
Brian D. Walsh	2Q	1Q		TSA (1k$)
Travis Walter	3Q			
Kelly H. Zuehlsdorff	2Q	1Q		TSA (1k$)

The TA appointments include a stipend of $1450/month plus a tuition waiver. The RA appointment stipend is $1600/month, and the tuition is covered by the grant paying the stipend. The fellowships do not include tuition. Many of these are given to students who have external support (*e.g.,* their employer is covering their salary while they are in school).

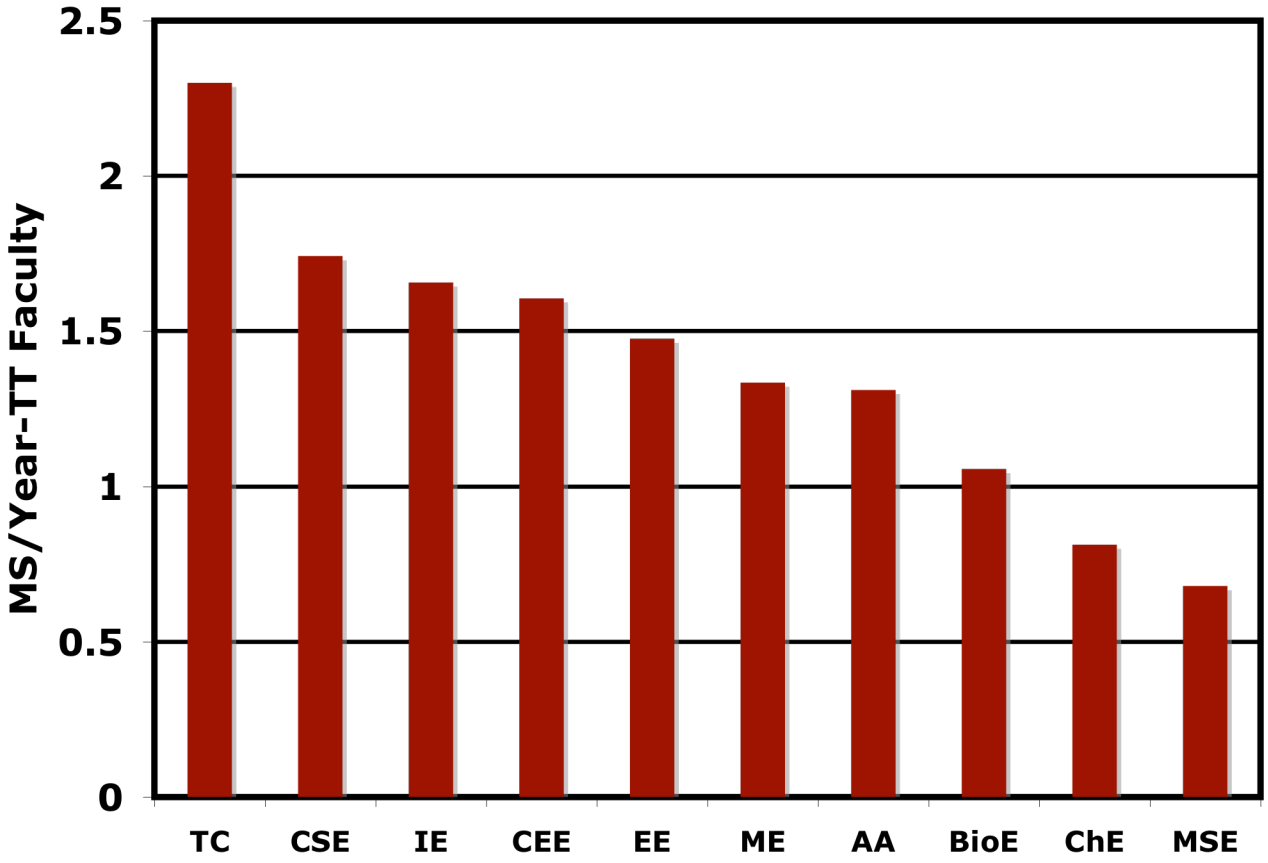
Appendix 6. Comparative Per Capita PhD and MS Production

The following figure shows per capita PhD production by the ten departments and programs in



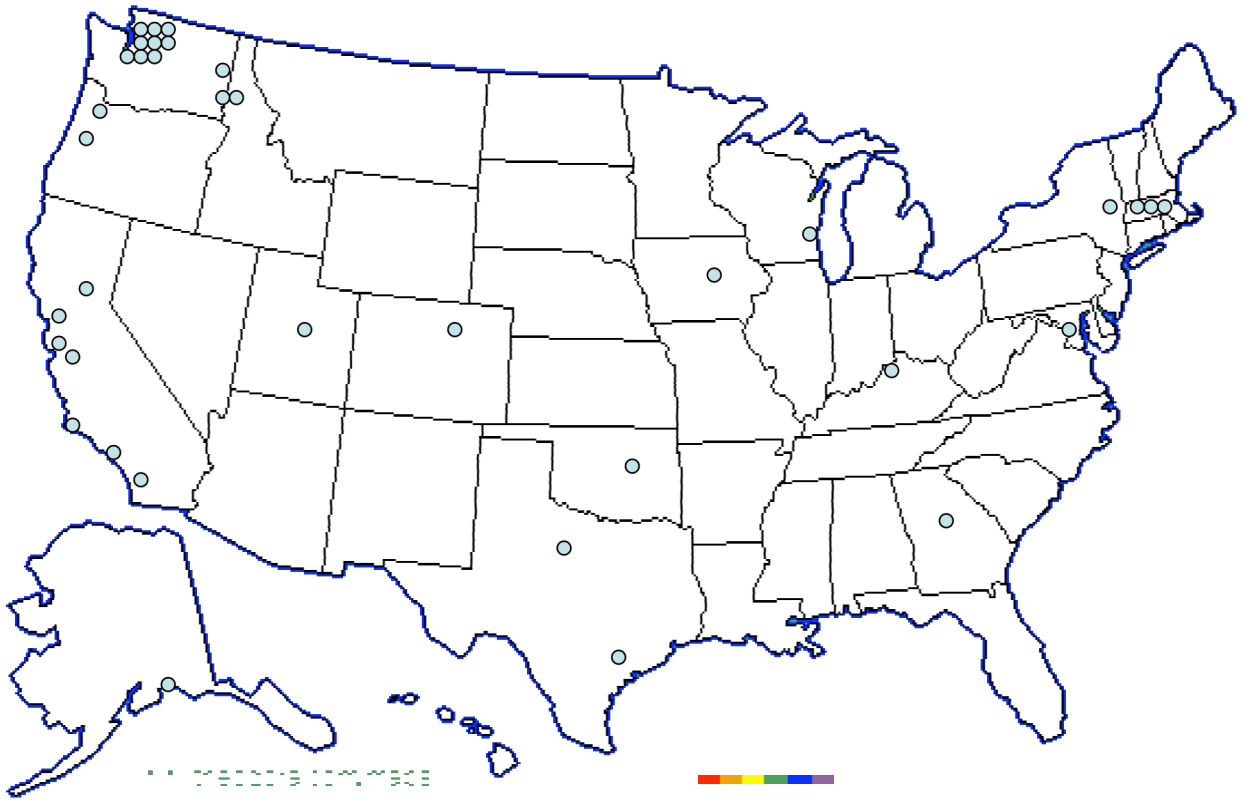
the College of Engineering averaged over 2000-2005. Bioengineering represents a special case in which the graduate program is the dominent feature, and an undergraduate program was only recently added. EE and ChE both show similar productivity, while MSE, IE, ME, and CSE all show similar per capita PhD productivity. Our near-term goal is to increase our productivity by 50%, and to double it in the long term. We believe our increasing research income will provide the resource base needed to make such goals realistic.

The next figure shows MS productivity. This figure is a little more complicated to interpret. Some programs do not emphasize the MS. Others have large enrollments due to self-sustaining, class only degrees. Some disciplines have significant employment demand for the MS, while others do not.


MS/Year-TT Faculty
2.5
2
1.5
1
0.5
0
TC
CSE
IE
CEE
EE
ME
AA
BioE
ChE
MSE

Appendix 7. Geographical Diversity of our Graduate Students

The following figure shows the locations from which each of our entering graduate students for autumn 2006 made their application. We see that while the largest number originated from Western Washington, we are represented by a broad range of diversity.



In addition, international students were represented by two from India, five from East Asia, one from Italy and one from Turkey.

Appendix 8. Faculty Recruiting Schedule from Strategic Plan

Year	Specific Research Area	Overall Depart Thrust Area	Academic rank
1	Manufacturing of Advanced Materials and Structures for Air/Ground Vehicles	Advanced Materials and Manufacturing-Engineering Design	Assistant-Associate
	Biosensors/Bioinstrumentation	Health Systems and Biotechnologies	Assistant-Associate
2	Energy Harvesting Materials and Devices, Alternate Energies, or Coal research	Environmentally Sensitive Energy Conversion-Engineering Design	Assistant-Associate
	Quantum Systems Engineering	Controls Engineering and Mechatronics-Engineering Design	Professor
3	Manufacturing of Advanced Materials Air/Ground Vehicles	Advanced Materials and Manufacturing-Engineering Design	Assistant-Associate
	Biomaterials (Inplants and Prostheses)	Health Systems and Biotechnologies-Engineering Design	Professor
4	Nanomanufacturing	Advanced Materials and Manufacturing-Engineering Design	Assistant-Associate
	Energy Storage materials and devices; Alternate Energies, or Coal/Fossil Fuel research	Environmentally Sensitive Energy Conversion-Engineering Design	Assistant-Associate
5	Nanomechanisms-nanorobotics	Controls Engineering and Mechatronics - Health Systems and Biotechnologies-Engineering Design	Assistant-Associate
	Nanomechanics	Advanced Materials and Manufacturing-Engineering Design	Associate-Professor

Each proposed hire is based on the following:

- Priority research area
- Extension of existing strength, new hire can collaborate/team with existing people
- Proposed rank based on existing strength. For example, an area presently represented by two junior faculty may be best complemented by an established leader. Hence, the proposed hire might be at the professor rank.

Appendix 9. Diversity Data on Applicants, Admission Offers, and New Students

1. HOW MANY APPLICATIONS DID YOU RECEIVE FOR AUTUMN 2006 ADMISSIONS?

MASTER'S

	Hawaiian/Pacific Is.		African-American		Asian-American		Hispanic-American		Native American		Caucasian		Foreign National		Other (ethnicity unreported		Total	
	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT
Men			1		6	1	5				64	2	31	1	14	1	121	5
Women			2		3	2	1				14		4	1			24	3
Total:	0	0	3	0	9	3	6	0	0	0	78	2	35	2	14	1	145	8

DOCTORAL

	Hawaiian/Pacific Is.		African-American		Asian-American		Hispanic-American		Native American		Caucasian		Foreign National		Other (ethnicity unreported		Total	
	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT
Men			1		1		1		1		5		22		3		34	0
Women					1						2		5				8	0
Total:	0	0	1	0	2	0	1	0	1	0	7	0	27	0	3	0	42	0

Total MS/PhD	0	0	4	0	11	3	7	0	1	0	85	2	62	2	17	1	187	8

2. HOW MANY OF THESE APPLICANTS WERE ACCEPTED FOR AUTUMN 2006 ADMISSION?

MASTER'S

	Hawaiian/Pacific Is.		African-American		Asian-American		Hispanic-American		Native American		Caucasian		Foreign National		unreported		Total	
	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT
Men					5		5				53	2	18		9	1	90	3
Women			1		3	2	1				14		2				21	2
Total:	0	0	1	0	8	2	6	0	0	0	67	2	20	0	9	1	111	5

DOCTORAL

	Hawaiian/Pacific Is.		African-American		Asian-American		Hispanic-American		Native American		Caucasian		Foreign National		unreported		Total	
	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT
Men					1		1				2		7		1		12	0
Women											2		2				4	0
Total:	0	0	0	0	1	0	1	0	0	0	4	0	9	0	1	0	16	0

Total MS/PhD	0	0	1	0	9	2	7	0	0	0	71	2	29	0	10	1	127	5

3. HOW MANY OF THOSE ACCEPTED ACTUALLY ENROLLED IN AUTUMN 2006?

MASTER'S

	Hawaiian/Pacific Is.		African-American		Asian-American		Hispanic-American		Native American		Caucasian		Foreign National		unreported		Total	
	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT
Men					2		4				12	1	6		3	1	27	2
Women			1		3	2	1				6		2				13	2
Total:	0	0	1	0	5	2	5	0	0	0	18	1	8	0	3	1	40	4

DOCTORAL

	Hawaiian/Pacific Is.		African-American		Asian-American		Hispanic-American		Native American		Caucasian		Foreign National		unreported		Total	
	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT
Men							1				2		4				7	0
Women											1		1				2	0
Total:	0	0	0	0	0	0	1	0	0	0	3	0	5	0	0	0	9	0

Total MS/PhD	0	0	1	0	5	2	6	0	0	0	21	1	13	0	3	1	49	4

Appendix 10. PhD Requirement Check List

GENERAL EXAM: should be taken within one year after passing Qualifying Exam

Date Completed		Deadline
	Select an Initial/Informal Faculty Advisor and consult regularly	1st Month in the program
	Qualifying Exam Students are required to take a Qualifying Examination given twice yearly, normally during months of November and May. (For example, if you enter Summer or Autumn quarter, you must take the exam in May; If you enter Winter or Spring quarter, you must take the exam in November.)	One calendar year after entry to PhD Program
	Proposing a Supervisory Committee After passing the Ph.D. Qualifying Examination, students need to provide the names of the committee chair, Graduate Student Representative (GSR) and at least two ME faculty to the ME-Student Services office in-person or via email: megrad@u.washington.edu to establish your PhD Supervisory Committee. Please indicate which quarter you plan to take the General Exam. GSRs are selected by the student in consultation with the committee chair and/or the Graduate Program Coordinator (GPC). All endorsed Graduate Faculty, with the exception of affiliates, are eligible to serve as GSRs. GSR assignments are unlimited with the exception that faculty are limited to no more than four concurrent appointments within a specific department.	Allow at least 4 months prior to General Exam
	Establishing a Supervisory Committee Upon approval of the Graduate Program Coordinator (GPC), the ME-Student Services Office will notify the Graduate School (GS) of the committee appointment. The GS will confirm the Supervisory committee membership via email.	
	Communicating with the GSR and Committee The student is responsible to contact the GSR after the appointment is confirmed. It is important to consult with the full committee and inform them of your progress.	On-going
	Applying for the General Examination After completing 60 credits (18 must be graded), the student will complete the "Request for General Examination to Graduate School" form. (Note: this needs to be typed and requires signatures (or email agreements) from all committee members. Reserve a Conference Room and Projector, if needed at the front desk. ***Be sure to provide a copy of your signed Request Form to the ME Student Services Office before submitting it to the GS.*** http://www.grad.washington.edu/forms/forms.htm	At least 3 weeks prior to the General Exam
	Receiving the Warrant for the General Exam ME Student Services Office receives the Warrant for General Exam and notifies the student when the it arrives to the ME Dept (typically one week prior to the Exam).	
	Preparing for the General Exam Prepare a written summary describing your dissertation topic and your plan of proposed research. Summary is to include a pertinent literature review and any preliminary results obtained. You will be examined orally on your general area of research interest, and specifically on your proposed plan of research.	Submit copies of your summary to **all** members of your Supervisory Committee recommended at least 2 weeks prior to General Exam date
	Announcing the General Exam to Faculty & Students Notify the ME Student Service Office to announce to faculty and students of your upcoming Exam. Provide the exact title of your dissertation, date, time and location of your General Exam.	At least two weeks prior to General Exam
	Submitting a copy of the warrant to ME Student Services Office & to the Graduate School Following General Exam, THE student takes the signed Warrant to the Graduate School. ***Be sure to provide a copy of your signed Warrant to the ME Student Service Office before submitting it to the Graduate School.***	No later than the last day of the quarter you wish to advance to candidacy
	You must maintain registration as a full- or part-time graduate student for the quarter in which you take the General Exam.	

PhD FINAL EXAMINATION

Date Completed		Deadline
	Establishing your Reading Committee E-mail Mee-Ling Hon or Margo Segimoto (megrad@u.washington.edu) in order to establish your Reading Committee (min 3 faculty)	Prior to scheduling the Final Exam, as soon as the dissertation draft is complete
	Appointing your Reading Committee Graduate School (GS) appoints the reading committee. You will receive an email confirmation from the GS when the committee is appointed	
	Submitting Dissertation copies to your Reading Committee Provide a dissertation copy to your Reading Committee; you must be registered for a minimum of 2 credits of ME 800 during the quarter in which your dissertation is being read. The document submitted to the Reading committee should be complete but not necessarily in finished format	Recommended: Allow **30 days** for the dissertation to be read by your Reading Committee; Suggested Recommendation: Provide copies to Reading Committee a suggested 7 weeks prior to Final Exam
	Applying for the Final Examination Submit typed and signed "Request for Final Examination" to the Graduate School. http://www.grad.washington.edu/forms/forms.htm (Note: Dissertation must have been read by Reading Committee before this Request Form can be sent to the GS.) ***Be sure to provide a copy of your signed Request Form to the ME Student Service Office.***	At least 3 weeks prior to Final Exam
	Receiving the warrant for the Final Exam Department receives the warrant approximately one week prior to the Exam	One week prior to Final Exam
	Announcing the Final Exam to students and faculty Student notifies the ME Student Service Office with the exact title of dissertation, date, time and location of the upcoming Final Exam.	
	Formatting your dissertation Your dissertation must be properly formatted according to UW guidelines. A manual for dissertation preparation may be found at: http://www.grad.washington.edu/stsv/stylman/00stylman.htm	
	Submitting a copy of the warrant to ME Student Services Office & GS Following Final Exam, the student takes the original signed Warrant to GS. ***Be sure to provide a copy of your signed Warrant for your student file.***	Last day of the quarter of your final exam.
	Submitting the thesis to the Graduate School You must maintain registration as a full- or part-time graduate student for the quarter in which the PhD degree is conferred. A maximum of 60 days (from the date of your final exam) to submit the dissertation to the GS. If this time expires, another Final Examination may be required. **Note:** If the student does not submit the dissertation by the last day of the quarter, registration (or late fee) will be required for the following quarter even if the 60 day time period has not yet expired.	60 days from the date of your final examination. *(See UW Graduate School website)*
	Binding fees are to be paid at the Cashier's Office, 129 Schmitz. The green receipt must be presented to the GS at the time the dissertation is submitted. The mandatory dissertation fees: $25 covers binding costs for two copies required by the UW **and** $60 for microfilming the abstract or entire dissertation. Optional $45 copyright processing fee available only when an entire dissertation is microfilmed. For complete details refer to: http://www.grad.washington.edu/stsv/doctoralinfo.htm#Dissertation (note: All fees are subject to change)	*(See UW Graduate School website)*

Plan of Study for Master's Degree: Thesis Option

Student Name (print or type)_____ Advisor's Name (print or type)_____

Entry Qtr/Yr_____ Expected Graduation Qtr/Yr_____ TIE (check if in the TIE program): (

COURSE NUMBER & TITLE		NUMBER OF CREDITS IN EACH CATEGORY:				Qtr/Yr	Grade
List only numerically-graded coursework (min 30 credits) and thesis research (min. 12 credits)		500 – level ME (min 12 credits)*	500 – level non-ME*	400 – level (max 9 credits)	Thesis research (min 12 credits)		
TOTALS FOR EACH CATEGORY:						Grand Total (min 42 credits) :	

*Requirements:

Course grades must be 2.7 or above to count toward 30-credit total.

500-level ME category must include engineering analysis courses: ME 564 and ME 565

One computational or numerical analysis course must be selected from ME 535, ME 599C, AA 509, AA 540, CESM 504, EE 517, or AMATH 584.

Optional non-ME courses should be from related departments: engineering, mathematics, physical sciences or approved biological sciences.

A satisfactory *CR* grade must be earned in departmental seminars every quarter. *Seminars do not count toward 42-credit total.*

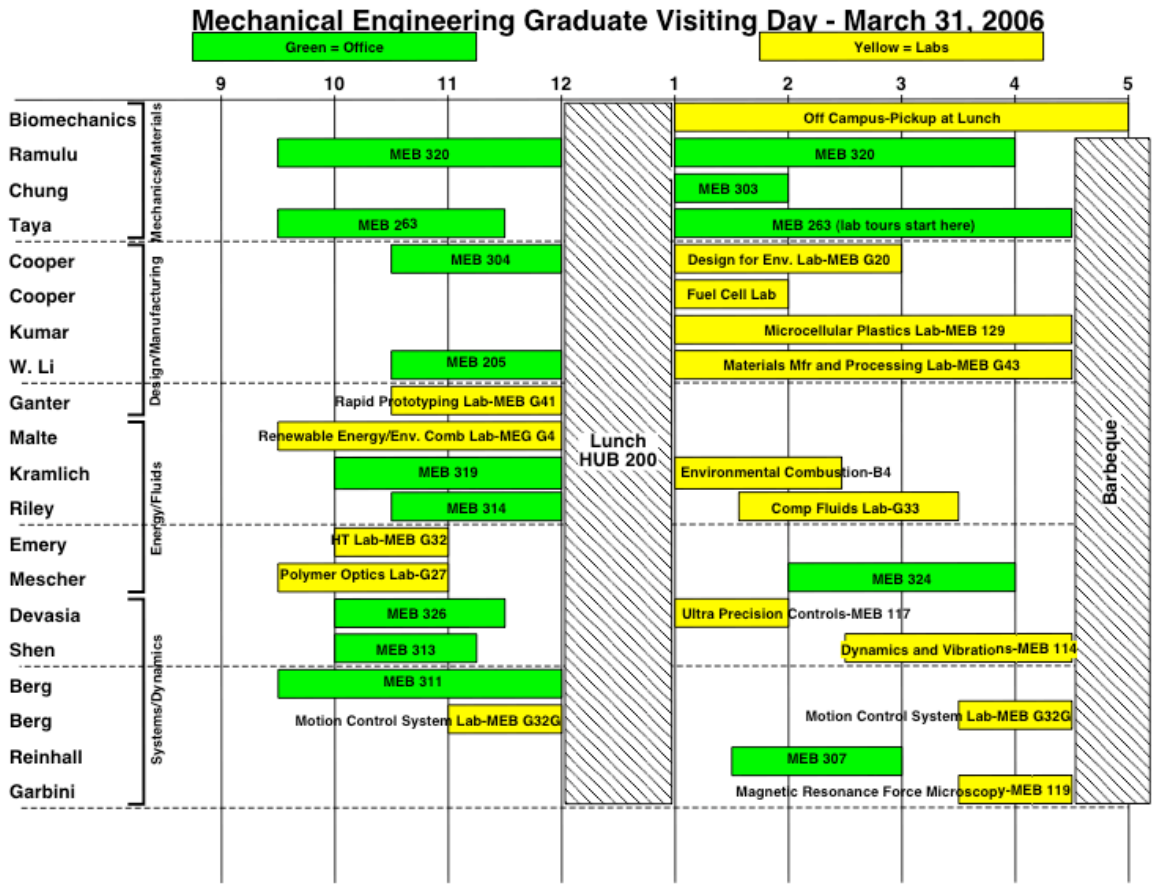
(There is no seminar requirement for TIE students).

Advisor's Signature_____ Date_____

(adv:12/97)

Appendix 12. Schedule for Prospective Graduate Student Visitation Day

The visit starts with a continental breakfast with graduate students and an introduction by the GPC. The morning and afternoon consist of visits to labs and faculty offices according to the schedule shown below. The "open house" format allows the students to design their own schedule, which appeared to work very well. Lunch is held at a reserved room in the Student Union. The seating is by technical area (e.g., all the energy and fluids people sit together). Again, the prospective students sit with faculty and current graduate students. Finally, the department does a barbeque at the end of the day. The visiting day is scheduled to avoid those of other large west coast schools (*e.g.,* Berkeley and Stanford coordinate their days, and we clearly want to avoid conflicting with either of these). The day is usually schedule for a weekend to allow the visitors to see Seattle.



Appendix 13. MSME Admission Requirements

Master of Science in Engineering (MSE)

Graduation Requirements

The graduation requirements for the MSE are the same as those of the MSME. Please see the listing under the MSME for these requirements.

Admission Requirements

The following list the minimum requirements, along with the UW courses that satisfy these requirements.

Mathematics

One year of college calculus (Math 124. 125, 126)
One quarter of differential equations (Math 307)
One quarter of linear algebra (Math 308)

Natural Science

Two quarters of college chemistry (Chem 142, 143)
Three quarters of college physics (Phys 121, 122, 123)

Engineering Fundamental Courses

One quarter of introductory computer graphics (ME 123)
One quarter of introductory programming (CSE 142)
One quarter of fundamental material science (MSE 170)
One quarter of statics (AA 210)
One quarter of introductory mechanics of materials (CEE 220)
One quarter of dynamics (ME 230)
One quarter of circuit theory (EE 215)

Appendix 14. Teaching Assignment Information

Teaching Loads for 06/07					
				Other(seminars, capstone,	
	Autumn	Winter	Spring	administration)	
Adee	490	491+498(CATIA)	492+498(CATIA)	123/sub: AWSp	
Berg	473 (w. Garbini)	477(w. Devasia)	583	591: A	
Chung	498 (Nano Matr)	356	356		
Cooper	395	415	Fulbright Fellowsh	fuel cell: AW	
Devasia	230			591: A, mech des: WSp	
Emery	522		331	sae/senate: AWSp	
Fabien	469		230+535	ass chr	
Ganter	480	498(rapid proto)	355		
Gao	331	323	599 (Bio Ht/Mass)		
Garbini	471 (w. Berg)	373	374		
Kramlich	430	521	524	520: AWSp, ass chr/GPC	
Kumar	Sabatical	Sabatical	Sabatical		
Labossiere	478+556	355+450	440+478		
Li,,J	354	354	599 (Micro/Nano)		
Li,W	409	508	355		
Malte	341	442	426	523: AWSp	
Mescher	531	431	530		
Ramulu	501	459(w. 559)		518: AWSp	
Reinhall	498*	230	525 (w. Dahl)	fuel cell: AW	
Riley	533	534	333		
Shen	588	599 (Cont Vib)	230 (w. Fabien)		
Storti	564	470+565			
Taya	485+487	551	562		
Tuttle				chair	
Notes:	Tenure track only				
	Co-Listed courses only shown once				
*498/599: Product Liability w. Scheibe					

AY 2006/2007 Course Coverage

		Autumn	Winter	Spring
123	Visual/CAD	Jones/Adee	Jones/Adee	Jones/Adee
124	CAD Lab	Jones/Adee	Jones/Adee	Jones/Adee
230	Dynamics	Devasia	Reinhall	Shen/Fabien
323	Thermo	Kosaly	Gao	
331	Heat Trans	Gao		Emery
333	Fluids		Aliseda	Riley
341	Energy/Enviorn	Malte		
354	Mech Material Lab	Li,J	Li,J	
355	Mfr Proc		Labossiere	Ganter
356	Machine Des		Chung	Chung
373	Intro Sys Dyn		Garbini	
374	Sys Dyn Anal/Des			Garbini
395	Intro Des	Cooper		TBA
406	Corrosion			Sandwith
409	Num Control/CAM	Li,W		
415	Des for Environ		Cooper	
425	HVAC			Elder
426	Sustain Energy			Malte
430	Adv. Energy Conv	Kramlich		
431	Adv. Fluids		Mescher	
440	Adv Mech Matr			Labossiere
442	Ren Energy		Malte	
445	Sci in Biomech	Sanders		
450	Compos Mat Des		Labossiere	
459	Fracture Mech I		Ramulu	
468	Air Poll Cont Des		Pilat	
469	Appl Sys Dyn	Fabien		
470	Mech Vib.		Storti	
471	Auto Control	Garbini/Berg		
473	Instrument	Berg/Garbini		
477	Embedded Comput		Berg/Devasia	
478	Finite Element	Labosseire		Labossiere
480	Intro CAD	Ganter		
485	Elect Package	Taya		
487	Elect Pkg Lab	Taya		
490	Nav Arch I	Adee		
491	Nav Arch II		Adee	
492	Nav Arch III			Adee
495	SAE	Emery	Emery	Emery
495	SUB	Adee	Adee	Adee
495	Fuel Cell	Rein/Coop	Rein/Coop	
495	Industrial			TBA
495	Mechatron			Devasia
498	SAE	Emery	Emery	
498	Product Liability	Scheibe/Reinhall		
498	Nanomaterials	Chung		
498	Intro to CATIA		Adee	Adee
498	Mechatron		Devasia	
498	Rapid Proto		Ganter	
498	SAE Intro			Emery
498	Acoustics(525)			Dahl/Reinhall
499	SAE	Emery	Emery	Emery
499	SUB	Adee	Adee	Adee
499	Fuel Cell	Rein/Coop	Rein/Coop	

		Autumn	Winter	Spring
501	Mfr Proc	Ramulu		
504	Intro MEMS	Parviz		
510	Math Found Sys.	Damborg		
518	Mfr Sem	Ramulu	Ramulu	Ramulu
520	Dept Sem	Kramlich	Kramlich	Kramlich
521	Thermo		Kramlich	
522	Statistical Thermo	Emery		
523	Eng/Environ Sem	Malte	Malte	Malte
524	Combustion			Kramlich
525	Acoustics			Dahl/Reinhall
530	Heat Cond/Rad			Mescher
531	Conduct HT	Mescher		
533	Fluids I	Riley		
534	Fluids II		Riley	
535	Comp Techniques			Fabien
547	Linear Sys	Ly		
548	Lin Mult Var Crtl		Rysdyk	
549	Estim & Sys Indent			Chizeck/Morg
551	Elasticity I		Taya	
556	Expt Stress I	Labossiere		
559	Intro Fracture(459)		Ramulu	
562	Intro Elect Comp			Taya
563	Adv. Composit			Das
564	Mech Eng Analys I	Storti		
565	Mech Eng Analys II		Storti	
578	Optimization		AA Dept	
581	Digital Crtl I		Chizeck	
583	Non-Linear Control			Berg
588	Dyn/Vib	Shen		
591	Rob/Control Coll	Dev/Berg	AA Dept	EE Dept
594	Robust Control		AA Dept	
598	Biomech Sem	Ching		
599	Adv Eng (430)	Kramlich		
599	Prod Liab (498)	Scheibe/Reinhall		
599	Rapid Proto (498)		Ganter	
599	Ren Eng (442)		Malte	
599	Adv. Fluids (431)		Mescher	
599	Continuous Vib		Shen	
599	Bio Ht/Mass Trans			Gao
599	Micro/Nano Mechan			Li,J

Appendix 15. One Year Alumni Survey

Survey appears on the following four pages.

University of Washington
Department of Mechanical Engineering

Bachelor's Degree Survey

1. We are interested in what you have been doing since you received your Bachelor's degree

If you are currently working, have you attended graduate or professional school?
O Yes
O No
If yes, please provide:
Institution

Field of Study

If you are currently a student, have you worked full time since finishing your Bachelor's degree?
O Yes O No
If yes, please provide:
Job title (last job)

Employer

City, State

Please fill out one of the three sections below, according to you current primary activity

2. If you are primarily employed, please answer the following questions:

Describe your present job
O Part time
O Full time temporary
O Full time, not in ME
O Full time, ME

Do you plan to return to school?
O Yes, post graduate in ME
O Yes, post graduate in other engineering
O Yes, not in engineering
O No

Please provide:
Job title

Employer

City, State

3. If you are a student, please answer the following questions

Degree sought and major area

Educational Institution

4. If you are neither working nor a student, please answer the following

Why are you not currently working?
O I am volunteering
O I am raising a family
O Caring for an ill relative
O Other
O Looking for work
O Have been unable to find an appropriate job
O Traveling/reflecting

Tee Shirt Size (Circle One)	XXL	XL	L	M	S
Address for Tee Shirt:					

We are very interested in whether

1. The present curriculum provides skills that you need on the job or in graduate school.
2. The ME department has provided a satisfactory contribution to your development in each area.

The questions below provide you with an opportunity for general feedback. The last page provides you with space for more specific input.

Value of the Subject Area to Your Career						Satisfaction with ME Department Impact					
					Required Courses, Please Complete All						
5	4	3	2	1	Required Energy and Fluids: 320/323/333/331	5	4	3	2	1	
5	4	3	2	1	Required Systems, Dynamics and Design: 373/374	5	4	3	2	1	
5	4	3	2	1	Required Mechanics/Materials/Mfr.: 354/355/356	5	4	3	2	1	
5	4	3	2	1	Required Design: 395	5	4	3	2	1	
					Elective Threads, Complete as appropriate*						
5	4	3	2	1	Energy Thread: 424/425/426/430/481	5	4	3	2	1	
5	4	3	2	1	Fluids Thread: 431/433	5	4	3	2	1	
5	4	3	2	1	Mechanics of Materials Thread: 440/450/459	5	4	3	2	1	
5	4	3	2	1	Manufacturing Thread: 403/409	5	4	3	2	1	
5	4	3	2	1	Mechatronics Thread: 473/477	5	4	3	2	1	
5	4	3	2	1	Electronic Packaging Thread: 485/487	5	4	3	2	1	
5	4	3	2	1	Dynamics and Control Thread: 469/470/471/474	5	4	3	2	1	
5	4	3	2	1	Numerics and CAD Thread: 478/480	5	4	3	2	1	
5	4	3	2	1	Naval Architecture Thread 490/491/492	5	4	3	2	1	
					Capstone Design: Complete One						
5	4	3	2	1	Generic	5	4	3	2	1	
5	4	3	2	1	Formula SAE Car	5	4	3	2	1	
5	4	3	2	1	Fuel Cell Technology	5	4	3	2	1	
5	4	3	2	1	Human-Powered Submarine	5	4	3	2	1	
5	4	3	2	1	Mechatronics	5	4	3	2	1	

Essential | Very Important | Important | Somewhat Important | Not Important

Very | Mostly | Somewhat | Little | Not at All

Course List

320-Thermo 1	433-Turbomachinery
323-Thermo 2	440-Advanced Mech. Mat.
331-Heat Transfer	450-Composite Materials
333-Fluids	459-Fracture Mechanics
354-Materials Lab	460-Kinematics/Linkage
355-Manufact. Proc.	469-Advanced Dynamics
356-Machine Design	470-Vibrations
373-Sys. Dynamics 1	471-Automatic Control
374-Sys. Dynamics 2	473-Instrumentation
395-Intro. to Design	474-Sys. Model/Simul.
403-Material Removal	477-Embedded Computing
406-Corrosion	478-Finite Elements
409-CAD Manufacturing	480-Computers in Design
424-Combustion	481-Combustion Engines
425-HVAC	486-Electronic Packaging
426-Sustainable Energy	487-Elect. Package. Lab
430-Energy Conversion	490/491/492-Naval Arch.
431-Advanced Fluids	

*Complete only for those threads where you have had some or all of the courses

We are also interested in

1. How you rate your engineering skill levels
2. How you rate your satisfaction with the ME department's contribution in your development in each of these areas

The questions below provide you with an opportunity for general feedback.

How you rate Your Skills						**Satisfaction with ME Department Impact**				
5	4	3	2	1	Ability to write effectively	5	4	3	2	1
5	4	3	2	1	Skills in oral communication	5	4	3	2	1
5	4	3	2	1	Skills in defining and solving problems	5	4	3	2	1
5	4	3	2	1	Ability to work independently	5	4	3	2	1
5	4	3	2	1	Ability to work in teams	5	4	3	2	1
5	4	3	2	1	Skills in creating original engineering designs	5	4	3	2	1
5	4	3	2	1	Computer skills	5	4	3	2	1
5	4	3	2	1	Numerical analysis skills	5	4	3	2	1
5	4	3	2	1	Entrepreneurial skills	5	4	3	2	1
5	4	3	2	1	Management/leadership skills	5	4	3	2	1
5	4	3	2	1	Ability to locate information for solving problems	5	4	3	2	1
Excellent	Very Good	Good	Fair	Poor		Very	Mostly	Somewhat	Little	Not at All

Please list up to three courses that have been especially valuable to your career, and let us know why you chose them

Please list any courses for which you see marginal or low utility to your career or your general education, and say why.

Indicate any subject matter that is not covered in the present curriculum that you feel would have helped you

Extra-Curricular Activities

We are interested in your thoughts about **ongoing** activities outside of classes
For the following, please address (1) the importance of the area to you,
(2) how well we are doing this activity now, (3) your thoughts on how
the activity could be improved.

Academic Counseling

Social Interactions: Barbecues, picnics, etc..

We are also considering your thoughts on new initiatives. For the following
please address its importance, and any ways the activity could be made more
meaningful

Career Counseling Meeting with faculty on career plans. Possibly assigning each
student a faculty advisor with periodic meetings (e.g., once a quarter).

Networking with Industry: Industrial seminars or career paths, resumes,
interview techniques. Visits to local industries.

Individual research projects: More opportunities for ME 499 work.

Would you like to be involved in student mentoring? For example, giving a
seminar on your industry, career paths, interview stratagies, etc.

APPENDIX 16. Summary of Research Thrusts and Collaborations of ME Faculty

● ADVANCED MATERIALS AND MANUFACTURING

ME Faculty
Jae Chung, Mark Ganter, Vipin Kumar, Jiangyu Li, Wei Li, Ann Mescher, Mamidala Ramulu, Colin Sandwith, Duane Storti, Minoru Taya, Mark Tuttle, Chunye Xu

Collaborators within UW
Kuen Lin, Eli Livne, Paolo Feraboli (AA)
Brian Flinn, Raj Bordia, Fumio Ohuchi (MSE)
Yasuo Kuga (EE)

● ENVIRONMENTALLY-SENSITIVE ENERGY CONVERSION

ME Faculty
Joyce Cooper, Ashley Emery, John Kramlich, Phil Malte, Per Reinhall, Jim Riley

Collaborators within UW
Eric Stuve, Dan Schwartz, Bruce Finlayson (ChE)
Bob Breidenthal, Jim Hermanson, Dana Dabiri (AA)
Tim Larson (CEE)
Dean Heerwagen and Joel Loveland (Architecture)
Jane Koenig (Public Health)
Dan Grunbaum (Oceanography)

● CONTROLS ENGINEERING AND MECHATRONICS

ME Faculty
Marty Berg, Peter Dahl, Santosh Devasia, Brian Fabien, Joe Garbini, Steve Shen

Collaborators within UW
Eli Livne, Uy-Loi Ly, Mehran Mesbahi, Kristi Morgansen, Rolf Rysdyk (AA)
Robert O'Malley, R. T. Rockafellar (AMath)
Dieter Fox (CSE)
Bradley Holt, Larry Ricker (ChE)
Howard Chizek, Dan Dailey, Mark Damborg, Mohamed El-Sharkawi, Blake Hannaford, Eric Klavins, Alex Mamishev (EE)

- HEALTH SYSTEMS AND BIOTECHNOLOGIES

ME Faculty
Ping Ao, Martin Berg, Randy Ching, Jae Chung, Santosh Devasia, Dayong Gao, Joseph Garbini, Hunter Hoffman, Glen Klute, Vipin Kumar, William Ledoux, Wei Li, David Nuckley, Per Reinhall, Jim Riley, Eric Seibel, Steve Shen, Wei-Chih Wang

Collaborators within UW
Kirk Beach, Barbrina Dunmire (BioE)
Linda Shapiro and Steve Seitz (CSE)
Brian Otis (EE)
Guozhong Cao (MSE)
Ethan Merritt (Biochemistry)
Robb Glenny (Pulmonary and Critical Care Medicine, UWMC)
David Haynor (Radiology, UWMC)
C. Diana Jorden and Melissa Upton (Pathology, UWMC)
Lilian Price (Comparative Medicine, UWMC)
Jason Dominitz (VA Hospital & UWMC)
Tom Reh (Biological Structure, SOM)
Daniel Chiu (Chemistry)
Antao Chen (APL)
John Kelly (Ophthalmology, UWMC and Childrens)
Clifford Hume (Otolaryngology)
John Sidles (Orthopaedics and Sports Medicine)

Appendix 17. Total Direct Expenditures from External Support by Source of Support and by College and Department

Fiscal Year Ending June 30, 2005

(does not include fellowships and gifts)

College and Department	*Dept. of Health & Human Svcs.*	*Dept. of Defense*	*Dept. of Energy*	*Dept. of Education*	*Natl. Sci. Foundation*	*Other Federal (A)*	*Non-Federal (B)*	*Total*
Engineering								
Aeronautics and Astronautics	-	599,388	3,478,211	-	176,516	617,934	502,469	5,374,518
Bioengineering (D)	6,469,437	84,206	41,758	-	831,618	53,073	1,068,184	8,548,276
Chemical Engineering	1,043,845	727,344	382,169	1,828	842,645	-	1,305,618	4,303,449
Civil Engineering	1,109,878	457,361	560,405	-	1,066,622	1,259,987	2,681,460	7,135,713
Computer Science and Engineering	271,712	1,744,766	-	117,334	4,099,413	254,127	1,880,524	8,367,876
Electrical Engineering	3,613,857	2,602,019	86,248	21,693	3,253,348	233,765	2,996,830	12,807,760
Industrial Engineering	154,695	22,105	-	26,249	53,398	5,656	336,442	598,545
Materials Science and Engineering	151,759	794,503	69,656	-	999,709	48,153	1,532,917	3,596,697
Mechanical Engineering	981,353	922,340	133,312	-	505,417	442,074	1,892,894	4,877,390
Technical Communication	-	-	-	-	282,323	70,922	192,153	545,398
Total Engineering Departments*	**$ 13,796,536**	**7,954,032**	**4,751,759**	**167,104**	**12,111,009**	**2,985,691**	**14,389,491**	**56,155,622**

Year	*2001*	*2002*	*2003*	*2004*	*2005*	*Percent increase, 2004 over 2001*
Mechanical Engineering	2,255,954	2,628,422	3,026,762	4,120,132	4,877,390	116
College of Engineering**	$ 42,560,587	49,798,075	53,132,951	58,102,506	62,948,748	48

*Excludes Dean's Office ($5,583,471) and the Engineered Biomaterials Engineering Research Center ($1,209,655, not associated with a department).

**These are included in the yearly COE expenses.

Appendix 18. Speakers for the Winter 2007 Leadership Seminar Series

Lecture Date	Name	Graduation Year	Title, Company/ Organization	Industry Affiliation
1/9/07	Mark Tuttle John Kramlich Brian Fabien	Non-Alumns	Professors, Dept Mechanical Engineering, UW	Academia
1/16/07	Teodora Schuman	MSME 1994, PhD, 2000	Assistant Professor, College of Science & Engineering, Seattle University	Academia
1/23/07	Doug Graesser	BSME 1986, MSME 1988, PhD 1993	Co-Owner, NSE Composites	Consulting/Advanced Composite Structures
1/30/07	Michael Redenbaugh	BSME 1971	CEO, Bell Helicopter Textron	Aerospace
2/6/07	Alex Kunzler	Non-Alum	Founder, Spinal Dynamics Corp. (Retired)	Biomechanical Devices
2/13/07	Steve Pratt	BSME 1970	Chairman, President and CEO, ESCO Corp.	Manufacturing
2/20/07	Kelly McGee	BSME 1968	Director, Test Engineering, Lockheed Martin	Aerospace
2/27/07	Larry Anderson	MSME 1961, PhD 1966	Group Vice President, Exponent, Inc.	Forensic Engineering - Consulting
3/6/07	Peter Marguglio	BSME 1968	President, Eatec Corporation	Software

MECHANICAL ENGINEERING UNDERGRADUATE ADVISING GUIDE

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Revised July 2006

Bachelor of Science in Mechanical Engineering (BSME)

Mission

Our mission in undergraduate education is to provide the resources and educational opportunities that prepare men and women for careers in Mechanical Engineering and related fields, and to foster the development of the leadership skills that are the basis of effective contributors to society.

Goals/Program Educational Objectives

1. *Preparation for the profession*. At the end of their education, students should possess a tool chest of skills and knowledge that positions them for success as (1) entry-level engineers in existing firms, or (2) graduate students in any program in the country. This does not preclude other activities, such as volunteerism, self-employment, or academic study in another discipline. Students succeed in this goal by being able to: Use fundamental science and engineering analysis to solve engineering problems; Successfully execute engineering designs, including effective use of project management tools; Perform effectively in teams through oral, written and graphical communication.

2. *Contribution to society*. Students succeed in this goal by being able to: Think critically, in the sense of broadly educated individuals; Perform independent, informed analysis on issues inside and outside of technology; Continue lifelong learning.

Outcomes

Each Student in the receiving of a BSME degree from the program will demonstrate:

1a. Background in mathematics, science and engineering principles.

1b. Ability to apply this knowledge to the formulation and solution of Mechanical Engineering problems.

2a. Ability to design thermal and mechanical components to achieve a desired goal.

2b. Ability to develop, conduct, and analyze experiments or tests that may aid in this design process.

3. Understanding of the necessary professional abilities of a practicing engineer including ethical conduct, teamwork in the pursuit of a goal and effective communication.

4. Ability to conduct a computer based design and analysis in engineering applications.

5. Exposure to a general education program that aids in the understanding of and increase the appreciation of the “non-technical” world.

6. Realization of the business environment in which engineering is practiced.

7. Awareness and necessity of continuing education, graduate study and other life long learning experiences.

Code of Ethics of Engineers

The Fundamental Principles

Engineers uphold and advance the integrity, honor and dignity of the engineering profession by:

I. using their knowledge and skill for the advancement of human welfare;

II. being honest and impartial, and serving with fidelity the public, their employers and clients;

III. striving to increase the competence and prestige of the engineering profession; and

IV. supporting the professional and technical societies of their disciplines.

The Fundamental Canons

1. Engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.
2. Engineers shall perform services only in the areas of their competence.
3. Engineers shall issue public statements only in an objective and truthful manner.
4. Engineers shall act in professional matters for each employer or client as faithful agents or trustees, and shall avoid conflicts of interest.
5. Engineers shall build their professional reputation on the merit of their services and shall not compete unfairly with others.
6. Engineers shall act in such a manner as to uphold and enhance the honor, integrity and dignity of the profession.
7. Engineers shall continue their professional development throughout their careers and shall provide opportunities for the professional development of those engineers under their supervision.

DEGREE REQUIREMENTS FOR BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

This guide supplements the University of Washington (UW) General Catalog, Time Schedules, and other announcements about registration.

The Bachelor of Science in Mechanical Engineering (BSME) requirements set forth in this guide apply to students entering the BSME Program Autumn Quarter 2006 and thereafter until superseded by a future revision.

Students are responsible for planning their program of studies and for remaining informed of dates, deadlines, rules, and regulations. Students must maintain a University of Washington e-mail account in order to receive communications from professors and the Department of Mechanical Engineering.

A minimum **2.0** cumulative grade point average is required to graduate from the Department of Mechanical Engineering with a BSME degree. In addition, Students must achieve a minimum average **2.0** grade in each engineering fundamental and Mechanical Engineering course.

Mechanical Engineering Academics

General Degree Requirements
The BSME degree program is accredited by the Accreditation Board for Engineering and Technology (ABET) and as such, all graduates must meet certain specified requirements. A total of **180**-quarter credits are required for the BSME degree at the UW. Regardless of the number of Mechanical Engineering (ME) courses taken at another institution, a minimum of **45** credits in ME courses must be taken in residence at the University of Washington.

VLPA/I&S
The College of Engineering (COE) requires that all degree programs include a minimum of **24** credits of Visual, Literary, and Performing Arts (VLPA) and Individuals and Societies (I&S) (formerly known as Humanities and Social Sciences). Course selection to fulfill the VLPA/I&S requirements must meet the following selection criteria:

- A minimum of **10** credits of VLPA and **10** credits of I&S.
- A total of **24** credits of VLPA/I&S credits.

Foreign language courses at the third quarter level or above (e.g., GERMAN 103) may be applied towards VLPA credits.

Academic Minors
Students interested in receiving an academic minor must submit a change of major form declaring a minor prior to graduation. Information about minors is available in the ME Student Services office. For more information see the UW website at: http://www.washington.edu/students/ugrad/advising/minorlst.html

Transfer Credit
A maximum of **90** credits may be transferred from a two-year college and a maximum of **145** credits obtained from a four-year ABET-accredited college may be transferred. However, of the courses needed to satisfy departmental requirements for a BSME, some have direct transfer, and others may only be used if approved by the Director of Student Services and Faculty Undergraduate Program Coordinator. For more information see the UW website at:
http://www.washington.edu/students/uga/transfer/trcrweb.html

Advising
The ME Student Services office is located in Mechanical Engineering building (MEB) room 143. The Academic Counselors, (206) 543-5090 or *meadvise@u.washington.edu*, should be consulted for information on course scheduling, general advising on administrative procedures, rules, and regulations. Students are encouraged to utilize the ME Student Services Office for questions regarding other university resources. Additional information may be found on the ME home page at: http://www.me.washington.edu

Scholarships
The College of Engineering and the Department of Mechanical Engineering offer a limited number of academic and need based scholarships. Scholarship application forms are available in January and can be obtained in MEB 143 or from the College of Engineering website at: http://www.engr.washington.edu/score/scholarship.html

The Undergraduate Scholarship Office (USO) provides UW students with information about merit-based awards and offers workshops on how to search and apply for scholarships. For more information visit the USO office located in Mary Gates Hall (MGH) room 171 or look on their website at: http://www.washington.edu/students/ugrad/scholar/uso

Graduation
Students should apply for graduation **two** quarters before they wish to graduate. To apply for graduation, students should schedule an advising appointment with an Academic Counselor at (206) 543-5090 or merecept@u.washington.edu. Graduating seniors need to file a degree application with ME Student Services two quarters prior to their expected graduation date to qualify for Graduating Senior Priority (GSP) registration. GSP registration allows students to register on the first day of registration Period I.

Computer Facilities
The Department of Mechanical Engineering has three computer laboratories equipped with personal computers for ME students to use. There are 24 computers located in MEB 232, 19 computers located in MEB 233, and 14 computers located in the Integrated Learning Factory (ILF) design laboratory. The computer support staff is located in MEB 264 during posted office hours to assist with any computer questions or problems. They can be reached at *mehelp@u.washington.edu.*

Leave
Students should schedule an advising appointment with an Academic Counselor to discuss part-time attendance or the departmental leave policy. Students who withdraw from the University without prior written approval of the department, or are dropped for non-payment of fees, will forfeit their place in the program. Students must reapply for admission and, if re-admitted, must fulfill the requirements in effect at the time of re-admission.

Lockers
Student lockers are located on the second floor of the MEB. To register for a locker, go to the ME Fiscal Office (MEB 143A) to complete the locker registration form. The cost is $5.00 per quarter. Note: if lockers are not renewed for an additional quarter the contents will be removed the week after finals week. A hold on your transcript may be placed if the locker fees are not paid.

BSMENEWS
BSMENEWS is an email distribution list for all undergraduate Mechanical Engineering students. It is a news list to keep students informed of current events in the Department such as student society meetings, seminars, ME intramural sports, class registration, and program changes.

Mechanical Engineering Special Interest

Engineering Co-op
The Engineering Cooperative Education Program enables students to apply academic theory in a working environment. The program allows students work full time paid employment while earning academic credit. Students may apply up to 4 credits of Co-op (ENGR 321) towards their degree as ME Option credits.

How to earn Co-op credits (ENGR 321) in Mechanical Engineering

- Read the guidelines provided by the Engineering Co-Op office for report prior to starting your Engineering Co-op Internship.
- Discuss questions with the Student Services office or Engineering Co-Op office prior to leaving for the internship.
- Submit one copy of your Engineering Co-op report to Professor Vipin Kumar upon return from your Co-op Internship and also submit a copy to the Engineering Co-op Office. If you complete the report with a grade of **2.0** or better you will receive credit. The Department of Mechanical Engineering will allow a maximum of **4** credits of ENGR 321 to count towards your ME Option credits.

For information, contact the Engineering Cooperative Education Program, located in 301 Loew Hall, Box 352180, University of Washington, Seattle, WA 98195. Telephone (206) 543-8711 or see the Engineering Co-op website at:
http://www.engr.washington.edu/coop/

Global Engineering Education Exchange (Global E^3)
The Global Engineering Education Exchange program allows students to study abroad and receive academic credit for courses taken overseas. Students pay regular tuition and maintain enrollment status at the University of Washington while receiving practical training in a foreign setting for a summer, quarter, or academic year. For more information about the program visit the Global E^3 website at:
www.iie.org/pgms/global-e3

Engineer-in-Training (EIT) Exam (a.k.a. Fundamentals in Engineering (FE) Exam)
The State of Washington Board of Registration offers the Engineering in Training (EIT) Exam twice a year (October and April). The deadline for the application is **four** months prior to the exam date. For more information on the EIT see the National Society of Professional Engineers website at:
http://www.wa.gov/dol/bpd/engfront.htm

ESL Policy

Students who have not completed their English as a Second Language (ESL) requirements must enroll in and satisfactorily complete, with a grade of 3.0 or higher, at least one ESL class each quarter starting with their first quarter in the BSME program, and continue to take an ESL course each quarter until all ESL requirements are completed. Such students are required to also complete a minimum of 10 credits each quarter in non-ESL courses that satisfy the requirements for the BSME degree.

Student Societies
The Department of Mechanical Engineering has several active student chapters that work closely with the Professional Chapters of the organizations listed below. The student chapters offer the opportunity to develop and enhance teamwork, leadership, and organizational skill.

ASHRAE American Society of Heating, Refrigerating, and Air Conditioning Engineers
National: http://www.ashrae.org/ UW Chapter: http://www.pugetsoundashrae.org/uw/

ASME American Society of Mechanical Engineers
http://www.students.washington.edu/asmeuw/
Faculty Advisor, Professor I.Y. (Steve) Shen

Pi Tau Sigma Mechanical Engineering Honorary
http://students.washington.edu/ptsigma/
Faculty Advisor, Professor Bruce Adee

SAE Society of Automotive Engineers
http://students.washington.edu/~auto/
Faculty Advisor, Professor Ashley Emery

SME Society of Manufacturing Engineers
http://chapters.sme.org/s175/
Faculty Advisor, Professor Wayne Li

SNAME Society of Naval Architects and Marine Engineers
http://www.me.washington.edu/societies/sname/
Faculty Advisor, Professor Bruce Adee

SWE Society of Women Engineers – College of Engineering organization
http://students.washington.edu/swe/
Faculty Advisor, Professor Deirdre Meldrum

Tau Beta Pi Engineering Honor Society – College of Engineering organization
http://www.tbp.org/pages/main.cfm
Faculty Advisor, Professor Mamidala Ramulu

Applications can be obtained in the Student Lounge, MEB 253, or from the current student officers. For more information see the ME website at:
http://www.me.washington.edu/societies/

General Graduation Requirements for Mechanical Engineering

The Department of Mechanical Engineering requires a minimum of 180 credits for graduation.

Mathematics	**(24 cr.)**	
MATH 124, 125, 126	(15 cr.)	Calculus with Analytic Geometry
MATH 307 OR AMATH 351	(3 cr.)	Introduction to Differential Equations
MATH 308 OR AMATH 352	(3 cr.)	Linear Algebra with Applications
MATH 309 or MATH 324 or AMATH 353	(3 cr.)	Linear Algebra or Advanced Calculus
Physics and Chemistry	**(25 cr.)**	
PHYS 121, 122, 123	(15 cr.)	Mechanics, Electromagnetism and Oscillatory Motion, & Waves
CHEM 142, 152	(10 cr.)	General Chemistry with laboratory
Written and Oral Communication	**(12 cr.)**	
English Composition	(5 cr.)	Any course selected from the UW English Composition List
TC 231	(3 cr.)	Introduction to Technical Writing
TC 333 or ENGL 182 or ENGL 281 or ENGL 381	(4 cr.)	Advanced Technical Writing and Oral Presentations
Engineering Fundamentals	**(31 cr.)**	
CSE 142	(4 cr.)	Computer Programming for Engineers
AA 210	(4 cr.)	Engineering Statics
EE 215	(4 cr.)	Fundamentals of Electrical Engineering
IND E 315 or MATH 390	(3 cr.)	Probability and Statistics for Engineers
ME 123	(4 cr.)	Introduction to Visualization and Computer-Aided Design
MSE 170	(4 cr.)	Fundamentals of Material Science
CEE 220	(4 cr.)	Introduction to Mechanics of Materials
ME 230	(4 cr.)	Kinematics and Dynamics
Visual, Literary and Performing Arts (VLPA)/ Individuals & Societies (I&S) (formerly Humanities and Social Sciences)	**(24 cr.)**	A minimum of 10 credits of Visual, Literary and Performing Arts and 10 credits of Individual and Societies
ME Core Courses	**(45 cr.)**	
ME 323	(5 cr.)	Thermodynamics
ME 331	(4 cr.)	Introduction to Heat Transfer
ME 333	(5 cr.)	Introduction to Fluid Mechanics
ME 354	(5 cr.)	Behavior of Engr Material Lab
ME 355	(4 cr.)	Manufacturing Process
ME 356	(4 cr.)	Machine Design Analysis
ME 373	(5 cr.)	Introduction to System Dynamics
ME 374	(5 cr.)	System Dynamic Analysis/Design
ME 395	(4 cr.)	Introduction to Mechanical Design
ME 495	(4 cr.)	Mechanical Engineering Design
ME Option Courses	**(19 cr.)**	
Total Credits Required for Graduation	**(180 cr.)**	

Mechanical Engineering Sample Schedule I

First Year - Pre Engineering

MATH 124	(5)	MATH 125	(5)	MATH 126	(5)
CHEM 142	(5)	CHEM 152	(5)	PHYS 121	(5)
ENGL. COMPOSITION	(5)	VLPA / I&S	(5)	VLPA / I&S or CSE 142 or ME 123	(5)
Quarter Total	**(15)**	**Quarter Total**	**(15)**	**Quarter Total**	**(15)**

Year Total (45)

Second Year - Pre Engineering

MATH 307 or AMATH 351	(3)	PHYS 123	(5)	CEE 220	(4)
PHYS 122	(5)	CSE 142	(4)	ME 230	(4)
TC 231	(3)	VLPA / I&S or ME 123 or MATH 308 or AMATH 352	(3)	MATH 308 or AMATH 352	(3)
ME 123	(4)	AA 210	(4)	VLPA / I&S	(4)
Quarter Total	**(15)**	**Quarter Total**	**(16)**	**Quarter Total**	**(15)**

Year Total (46)

Third Year - Mechanical Engineering

MSE 170	(4)	ME 333	(5)	ME Option	(4)
EE 215	(4)	ME 354	(5)	ME 355 or ME 356	(4)
ME 323	(5)	ME 373	(5)	ME 374	(5)
MATH 309 or 324 or AMATH 353	(3)			IND E 315/Math 390	(3)
Quarter Total	**(16)**	**Quarter Total**	**(15)**	**Quarter Total**	**(16)**

Year Total (47)

Fourth Year - Mechanical Engineering

ME Option	(4)	ME Option	(3)	ME Option	(4)
ME 331	(4)	ME 355 or ME 356	(4)	ME 495	(4)
ME 395	(4)	TC 333 or English 182, 281, 381	(4)	VLPA / I&S	(4)
VLPA/ I&S	(3)	ME Option	(4)		
Quarter Total	**(15)**	**Quarter Total**	**(15)**	**Quarter Total**	**(12)**

Year Total (42)

NOTE: Courses are subject to change. It is the responsibility of the student to check with an ME academic counselor for up-to-date course offering information.

Mechanical Engineering Sample Schedule II

First Year - Pre Engineering

MATH 124	(5)	MATH 125	(5)	MATH 126	(5)
CHEM 142	(5)	CHEM 152	(5)	PHYS 121	(5)
ENGL. COMPOSITION	(5)	VLPA / I&S	(5)	ME 123	(4)
Quarter Total	**(15)**	**Quarter Total**	**(15)**	**Quarter Total**	**(14)**

Year Total (44)

Second Year - Pre Engineering

MATH 307 or AMATH 351	(3)	PHYS 123	(5)	MSE 170	(4)
PHYS 122	(5)	CSE 142	(4)	ME 230	(4)
TC 231	(3)	VLPA / I&S	(2)	EE 215	(4)
AA 210	(4)	CEE 220	(4)	VLPA / I&S	(3)
Quarter Total	**(15)**	**Quarter Total**	**(15)**	**Quarter Total**	**(15)**

Year Total (45)

Third Year - Mechanical Engineering

ME 354	(5)	ME 323	(5)	ME 333	(5)
TC 333 or English 182, 281, 381	(4)	ME 355 or ME 356	(4)	ME 355 or ME 356	(4)
MATH 308 or AMATH 352	(3)	ME 373	(5)	ME 374	(5)
VLPA / I&S	(2)			IND E 315/Math 390	(3)
Quarter Total	**(14)**	**Quarter Total**	**(14)**	**Quarter Total**	**(17)**

Year Total (45)

Fourth Year - Mechanical Engineering

ME Option	(4)	ME Option	(4)	ME Option	(3)
ME 331	(4)	MATH 309, 324, or AMATH 353	(3)	ME Option	(4)
ME 395	(4)	VLPA / I&S	(4)	ME 495	(4)
VLPA / I&S	(4)	ME Option	(4)	VLPA / I&S	(4)
Quarter Total	**(16)**	**Quarter Total**	**(15)**	**Quarter Total**	**(15)**

Year Total (46)

NOTE: Courses are subject to change. It is the responsibility of the student to check with an ME academic counselor for up-to-date course offering information.

Engineering Fundamentals and ME Professional Program Courses
Autumn 2006-Spring 2007

(all courses are required)

Mechanical Engineering Course Syllabi Information is available on the ME website at:
http://www.me.washington.edu/courses/abet/

A A 210 Engineering Statics (4)
Vector analysis applied to equilibrium of rigid body systems and subsystems. Force and moment resultants, free body diagrams, internal forces, and friction. Analysis of basic structural and machine systems and components. Prerequisite: either MATH 126, MATH 129, or MATH 136; PHYS 121; recommended: graphics background. Offered: AWSpS.

CEE 220 Introduction to Mechanics of Materials (4) Introduction to the concepts of stress, deformation, and strain in solid materials. Development of basic relationships between loads on structural and machine elements such as rods, shafts, and beams, and the stresses, deflections, and load-carrying capacity of these elements under tension, compression, torsion, bending and shear forces, or combinations thereof. Prerequisite: AA 210. Offered: AWSp.

CSE 142 Computer Programming I (4)
Basic programming-in-the-small abilities and concepts. Highlights include procedural and functional abstraction with simple built-in data type manipulation. Basic abilities of writing, executing, and debugging programs. Offered: AWSpS.

E E 215 Fundamentals of Electrical Engineering (4) NW
Introduction to electrical engineering. Basic circuit and systems concepts. Mathematical models of components. Kirchoff's laws. Resistors, sources, capacitors, inductors, and operational amplifiers. Solution of first and second order linear differential equations associated with basic circuit forms. Prerequisite: either MATH 126, MATH 129, or MATH 136; PHYS 122. Offered: AWSpS

IND E 315 Probability and Statistics for Engineers (3)
Application of probability theory and statistics to engineering problems, distribution theory and discussion of particular distributions of interest in engineering, statistical estimation and data analysis. Illustrative statistical applications may include quality control, linear regression, and analysis of engineering data sets. Prerequisite: either MATH 136 or MATH 307. Offered: AWSpS.

MSE 170 Fundamentals of Material Science (4) Fundamental principles of structure and properties of materials utilized in practice of engineering. Properties of materials are related to atomic, molecular, crystalline structure. Metals, ceramics, multiphase systems, and polymeric materials. Relationships between structure and electrical, mechanical, thermal, chemical properties. For advanced freshmen and sophomores. Prerequisite: either CHEM 150, CHEM 152, or CHEM 155. Offered: AWSp

ME 123 Introduction to Visualization and Computer-Aided Design (4)
Methods of depicting three-dimensional objects and communicating design information. Development of three-dimensional visualization skills through freehand sketching and computer-aided design using parametric solid modeling. Offered: AWSp.

ME 230 Engineering Kinematics and Dynamics (4)
Kinematics of particles, systems of particles, and rigid bodies; moving reference frames; kinetics of particles, systems of particles, and rigid bodies; equilibrium, energy, linear momentum, angular momentum, Euler equations, and special problems (e.g., central force motion, vibration). Prerequisite: AA 210. Offered: AWSp.

ME 323 Thermodynamics (5) Applications of thermodynamic principles: properties of pure substances from an advanced point of view, nonreactive gas mixtures, energy analysis of reactive mixtures, chemical equilibria, combustion, power, refrigeration cycle analysis. Prerequisites: Chem 142, Math 126, Physics 121. Offered: AW

ME 331 Introduction to Heat Transfer (4) Study of heat transfer by conduction, radiation, and convection; elementary heat-exchanger design. Prerequisites: ME 333 or CEE 342. Offered: ASp.

ME 333 Introduction to Fluid Mechanics (5) Introduction to the basic fluid laws and their application. Conservation equations, dynamic similarity, potential flow, boundary layer concepts, effects of friction, compressible flow, fluid machinery, measurement techniques. Prerequisites: ME 323 and MATH 307 or AMATH 351. Offered: WSp

Note: Course offerings are subject to change. It is the responsibility of the student to check with the ME Student Services office for up-to-date course offering information.

ME 354 Behavior of Engineering Materials (5) Study of the properties and behavior of engineering materials including stress-strain relations, strength, deformation mechanisms, fracture, creep, and cyclic fatigue. Introduction to experimental techniques common to structural engineering, interpretation of experimental data, comparison of measurements to numerical/analytical predictions, and formal, engineering report writing. Lecture and laboratory. Prerequisite: MSE 170 and CEE 220. Offered: AW.

M E 355 Introduction to Manufacturing Processes (4) Study of manufacturing processes, including interrelationships between the properties of the material, the manufacturing process and the design of components. Interpretation of experimental data, comparison of measurements to numerical/analytical predictions, and formal, engineering report writing. Prerequisite: ME 354. Offered WSp.

ME 356 Machine Design Analysis (4) Analysis, design, and selection of mechanical and electromechanical subsystems and elements such as gears, linkages, cams, and bearings. Lecture and laboratory. Prerequisites: ME 354. Offered: WSp.

ME 373 Introduction to System Dynamics (5)
Mathematical modeling, analysis, and design of physical dynamic systems involving energy storage and transfer by lumped-parameter linear elements. Time-domain response by analytical methods and numeric simulation. Laboratory experiments. Prerequisite: either AMATH 351 or MATH 307; either AMATH 352 or MATH 308; E E 215; M E 230. Offered: W.

ME 374 Systems Dynamic Analysis and Design (5)
Extension of M E 373. Frequency response analysis, generalized impedance concepts and applications, Fourier series analysis and Laplace transform techniques. Modeling and analysis of electromechanical actuators and rotating machinery. Laboratory experiments and design projects. Prerequisite: M E 373. Offered: Sp.

ME 395 Introduction to Mechanical Design (4) Design process and methodology; decision making; optimization techniques; project planning; engineering economics; probabilistic and statistical aspects of mechanical design; ethical and legal issues. Lecture and laboratory. Prerequisites: ME 373, ME 123, ME 323, and IND E 315/Math 390. Offered: ASp.

ME 495 Mechanical Engineering Design (4) Design laboratory involving the identification and synthesis of engineering factors to plan and achieve specific project goals. Current literature and prerequisite texts are used as reference sources. Lecture and laboratory Prerequisite: M E 395. Offered: A,W,Sp.

Note: Course offerings are subject to change. It is the responsibility of the student to check with the ME Student Services office for up-to-date course offering information.

ME Option Courses

Autumn 2006-Spring 2007

(19 credits are required)

Mechanical Engineering Course Syllabi Information is available on the ME website at: http://www.me.washington.edu/courses/abet/

The BSME requirements include a minimum of 19 credits of ME Option courses. These courses are designed for seniors, and most require many of the 300-level courses as prerequisites. Maximum of 6 credits of ME 499; Up to 3 credits of any 300 or 400 level College of Engineering (COE) technical course and up to 4 credits of ENGR Co-op credits may be applied to satisfy the 19 credits of ME Option required. ME required classes will not count for ME Option credit, nor will an equivalent to a ME required class in another COE Department (e.g., CHEM E 340 will not count for ME 331 nor will CIV E 342 count for ME 333).

Non-ME Courses as ME Option
Occasionally students wish to substitute a 300 or 400 – level course offered by another College of Engineering department for ME Option course credits. Up to 3 credits of a 300 or 400 –level class offered by another engineering department and up to 4 credits of ENGR 321 (Engineering Co-op Credit), may be applied to satisfy the 19 credits required of ME Option. If you are interested in taking more credits from other engineering departments, you should complete a Graduation Petition Form obtained from the Student Services Office.

M E 341 Energy and Environment (3) *Malte* Energy consumption, US and world. Fossil energy: energy conversion systems; oil, gas and coal resources; air pollution and environmental impacts. Nuclear energy use, principles, fission reactors, fuel cycle. Offered: jointly with ENVIR 341/CHEM E 341. Prerequisites: Math 112 or Math 124 or QSci 291; Chem 120 or Chem 142 or Phys 114 or Phys 121 Offered: A.

ME 403 Material-Removal Processes (3) *Ramulu* Cutting and noncutting processes for material removal in the shaping of manufactured products. Study of forces and of power consumption and relative costs in the various processes. Prerequisites: ME 355, which may be taken concurrently. Offered: N/A.

ME 406 Corrosion and Surface Treatment of Materials (3) *Sandwith* Corrosion fundamentals and forms (galvanic, crevice, pitting, stress corrosion, erosion, hydrogen and leaching). Principles of design, materials selection, cathodic protection and surface treatments (coatings, carburizing, nitriding and plating) applied to reduce corrosion. Failure analysis applied to case studies. Offered Sp.

ME 409 Introduction to Numerical Control and Computer-Aided Manufacturing (3) *Ramulu* Control system fundamentals, numerical control (NC) machine control systems, and the design aspect of NC machine tools, programming methods of NC machines, computer-aided-manufacturing, CNC, DNC, and process optimization. Prerequisites: ME 355, which may be taken concurrently. Offered A.

ME 415 Sustainability and Design for Environment: Products for a clean future (3) *Cooper* Analysis and design of technology systems within the context of the environment, economy, and society. Applies concepts of resourses conservation, pollution prevention, life cycle assessment, and extended product responsibility. Examines the practice, opportunities, and role of engineering, management, and public policy. Offered: jointly with ENVIR 415/CEE 495. Offered W.

ME 424 Combustion Systems (4) *Malte* Combustion theory, including chemical thermodynamics, chemical kinetics, mixing and diffusion, and flame structure. Combustion chamber design concepts and performance. Pollutant formation and combustion methods for minimizing pollutant formation. Weekly laboratory. Prerequisites: ME 323, recommend ME 331 and ME 333. Offered: Even years

ME 425 HVAC Engineering (4) *Emery* Heating, ventilating and air conditioning of the built environment. Human comfort, psychometric processes, load computations, fluid distribution, and controls. Design analysis of HVAC systems is taught in the lecures and applied in the class project. Prerequisites: ME 323, ME 331.
Offered: Sp.

ME 426 Sustainable Energy Design (4) *Malte* Renewable energy systems design: solar, winged, hydro; also bio-fueled energy conversion systems of high efficiency and low emissions. Project-based learning: analysis, systems engineering, design, component characteristics, and environmental considerations. Prerequisite: ME 442 or ME 430; recommended: ME 331. Offered: Sp.

Note: Courses offerings are subject to change. It is the responsibility of the student to check with the ME Student Services office for up-to-date course offering information.

ME 430 Advanced Energy Conversion Systems (4) *Kramlich* Advanced and renewable energy conversion systems and technologies are treated. Included are high efficiency combined cycles; renewable energy conversion involving solar, wind, and biomass; direct energy conversion and fuel cells; and nuclear energy. Environmental consequences of energy conversion and environmental control are discussed. Prerequisite: M E 323. Offered: A.

ME 431 Advanced Fluid Mechanics (4) *Riley* Advanced topics in fluid mechanics, including kinematics, potential theory and vortex dynamics, viscous flow, turbulence, experimental and numerical methods and design. Prerequisite: ME 333. Offered: W.

ME 432 Gas Dynamics (3) Dynamic and thermodynamic relationships for the flow of a gas. Application of thermodynamic processes involving nozzles, diffusers, compressors, and turbines. Prerequisites: either ME 333 or CEE 342. Offered: N/A

ME 433 Turbomachinery (4) Thermodynamics, gas dynamics, and fluid mechanics of axial and centrifugal compressors, pumps, and turbines. Selection of components for engineering applications. Design problems and/or laboratory experiments to illustrate operating characteristics of turbomachines. Offered: N/A

ME 436 Lubrication, Friction, and Wear of Materials (3) *Wilson* Study of principles of friction and wear behavior of materials and of material properties that affect such behavior principles of lubrication. Applications to design of surfaces for wear resistance. Prerequisites: ME 333, ME 356. Offered N/A.

ME 440 Advanced Mechanics of Materials and Solids (3) *Labossiere* Study of mechanics of deformable bodies, including three-dimensional stress and strain tensors and their transformations. Equations of compatibility, continuity and equilibrium. Elastic constants. Failure criteria including fracture, yield and instability. Deflection relations for complex loading and shapes. Indeterminate problems. Design applications and numerical methods. Prerequisites: ME 354. Offered Sp.

M E 442 Renewable Energy (4) *Malte* Introduction to renewable energy. Principles, practices, and trends of solar, wind, hydro, and biomass (including fuel cell) energy conversion. Reductions in the environmental impact of energy conversion. Prerequisites: Either Math 112, Math 124 or QSci 291; Either Chem 120, Chem 142, Phys 114, Phys 122 Offered: jointly with CHEM E 442/ENVIR 442. Offered: W.

M E 445 Science in Biomechanics (3) *Sanders* Presents the mechanical behavior of tissues in the body and the application to design of prostheses. Tissues studies include bone, skin, fascia, ligaments, tendons, heart valves, and blood vessels. Discussion of the structure of these tissues and their mechanical response to different loading configurations. An important part of the class is a final project. Offered: jointly with BIOEN 440. Offered: N/A.

ME 450 Introduction to Composite Materials and Design (3) *Tuttle* Stress and strain analysis of continuous fiber composite materials. Orthotropic elasticity, lamination theory, failure criteria, design philosophies, as applied to structural polymeric composites. Recommended: MSE 475. Offered: W

ME 459 Introduction to Fracture Mechanics (3) *Ramulu* Deformation processes leading to fracture, and the linear elastic fracture mechanics. Fatigue crack propagation. Fracture control and failure analysis. Prerequisite: ME 354 and ME 356. Offered W

ME 460 Kinematics and Linkage Design (3) *Ganter* Synthesis of linkage-type mechanisms using graphical and computer methods. Offered: N/A

ME 468 Air-Pollution Control Equipment Design (3) *Pilat* Designs to control air pollutants from stationary sources. Procedures for calculation design and operating parameters. Fundamental mechanisms and processes of gaseous and particulate control equipment for absorption and adsorption of gaseous pollutants; electrostatic precipitation and filtration of particular pollutants. Actual case studies. Offered jointly with ChE 468 and CEE 494. Offered: W.

ME 469 Applications of Dynamics in Engineering (4) *Storti* Application of the principles of dynamics to selected engineering problems, such as suspension systems, gyroscopes, electromechanical devices. Includes introduction to energy methods, Hamilton's principle and Lagrange's equation, and the design of dynamic systems. Prerequisites: ME 374. Offered: A.

ME 470 Mechanical Vibrations (3) *Reinhall* Single-degree-of-freedom linear systems techniques. Matrix techniques for multi-degree-of-freedom linear systems techniques. Applications in vibration isolation, transmission, and absorption problems and instrumentation. Prerequisite: ME 373. Offered: W.

ME 471 Automatic Control (4) *Berg* Dynamic system modeling; control system stability and performance analysis: compensator design by Bode and root-locus methods. Prerequisite: ME 374. Offered: A.

Note: Courses offerings are subject to change. It is the responsibility of the student to check with the ME Student Services office for up-to-date course offering information.

ME 473 Instrumentation (4) *Garbini* Principles and practice of industrial measurement. Dynamics of instrument response; generalized performance analysis of sensor systems; theory of transducers for motion, force, pressure, flow, and other measurements. Lecture and laboratory. Prerequisite: ME 374. Offered A.

ME 474 Systems Modeling and Simulation (3) *Fabien* Unified approach to modeling of systems, and computer simulation of systems behavior. Selecting system variables; writing state, loop, and node equations; modal response and state transition response; system functions and convolution; analogs. Applications to control, vibrations, and other problems. Prerequisite: ME 374. Offered: N/A

ME 477 Microcomputers in Mechanical Systems (4) *Garbini* Analysis of electromechanical systems employing microcomputers for control or data acquisition. Microcomputer architecture, memory organization, assembly language programming, interfaces, and communications. Particular emphasis on design of hardware and software interfaces for real-time interaction with mechanical systems. Weekly laboratory. Prerequisites: ME 374.
Offered: W.

ME 478 Finite Element Analysis (4) *Labossiere, Reinhall* Development of theory and concepts of finite element analysis. Applications in all areas of mechanical engineering, including mechanics of solids, heat transfer, and design of dynamical systems. Weekly computer exercises. Prerequisites: ME 123, ME 374, and MATH 308 or AMATH 352. Offered: ASp.

ME 480 Introduction to Computer-Aided Technology (4) *Ganter* Principles of computer-aided technology. Computer-aided design, engineering, drafting, and manufacturing; computer-aided design systems, geometry, computer graphics, hardware, computer-aided vehicle/system design synthesis. System demonstrations, laboratories, and site visits. Prerequisites: ME 123 and CSE 142. Offered: A.

ME 481 Internal Combustion Engines (4) *Malte* Thermodynamics, fuels, performance, combustion, and exhaust emissions control for spark ignition and compression ignition piston engines. New technologies, including hybrid combustion-electric fuel cell engines. Principles and practice. Prerequisite: M E 323. Recommended: M E 333. Offered: N/A

ME 485 Introduction to Electronic Packaging and Materials (3) *Taya* The governing equations of transport phenomena: mechanical, thermal and electromagnetic behavior, thermomechanical and electromagnetic properties of packaging materials, electromagnetic characteristics of circuit and transmission lines, thermal management and reliability analysis of packaging, interconnect and material processing technology. Prerequisites: MSE 170, offered jointly with MSE 485. Offered: A.

ME 487 Laboratory in Electronic Packaging and Materials (1) *Taya, Stoebe* Laboratory course to accompany ME 485 Experiments related to design, processing and reliability of electronic packaging used in consumer electronics.
Co requisite: M E 485. Offered: jointly with MSE 487. Offered: A.

ME 490 Naval Architecture (3) *Adee* Theory of naval architecture; ship's lines, hydrostatic curves, intact and damaged stability, launching.
Offered: A

ME 491 Naval Architecture (3) *Adee* Theory of naval architecture; strength, ABS rules, water waves, ship and platform motions. Offered: W

ME 492 Naval Architecture (3) *Adee* Theory of naval architecture; dimensional analysis, resistance, model testing, propellers, steering. Offered: Sp

ME 496 Technology Based Entrepreneurship (3) Concentrates on hands on aspects of innovation and entrepreneurial enterprise development. Examines relationships between innovation, iterative prototyping, and marketing testing. Students identify market opportunities, create new technology-based products and services to satisfy customer needs, and constructs and test prototypes. Prerequisites: INDE 250. Offered jointly with INDE 496. N/A.

ME 498 Special Topics in Mechanical Engineering (1-5, variable credit) Lecture and/or laboratory. This special topics course may be counted as an ME option class. Prerequisite: Permission of instructor. Offered: AWSp.

ME 498F FSAE Special Topics (1 credit) Prerequisite: Junior Standing Offered: AWSp.

ME 499 Special Projects (2-5, variable credit, ME option max 6) Written report required. (Only graded courses may be used to fulfill ME Option credits. **Maximum** of 6 credits count for ME option) Offered: AWSp.

Note: Courses offerings are subject to change. It is the responsibility of the student to check with ME Student Services office for up-to-date course offering information.

Appendix I

Continuation Policy

While the University has general regulations governing scholastic eligibility for continuation, departments and programs in the College of Engineering have adopted additional requirements in order to make the best use of limited facilities and resources available, and to provide reasonable assurance of academic success. The following criteria and procedures will be applied to all undergraduate students.

I) Basic Criteria

A nominal average of 16 hours/quarter is required to complete graduation requirements in the conventional 12 quarters.

1. Full-time students are expected to complete 12 or more credit hours per academic quarter applicable toward the degree requirements to be considered as a full-time student. This rule is interpreted by the Mechanical Engineering Department to mean that failure to meet the 12-credit requirement for two consecutive quarters will result in automatic transfer out of the Department and the College of Engineering. The requirement of 12 credits per quarter is met when the student completes 24 applicable credits in any two consecutive quarters. Summer Quarter is not counted.

2. Part-time attendance is possible subject to departmental criteria. Written permission must be obtained from the Departmental Undergraduate Advisor. An application for part-time status must be made prior to the first day of each quarter. Students who have received permission to attend part-time must complete a minimum of six credits each quarter applicable towards their degree.

3. A student who withdraws from the University without prior written approval or is dropped for non-payment of fees must obtain approval of the departmental Undergraduate Advisor before registering or maintaining pre-registration for the following academic quarter. In such cases the department registration may be disallowed or canceled if the student's academic record is inferior to the level of admission prevailing at the time.

4. All undergraduate students who have exceeded by more that 10 credits the requirements of the BSME degree program will be transferred to the College of Arts and Sciences.

5. The grade-point average in all departmental and professional program courses must not fall below 2.00. The grade point average is computed by considering all professional program courses, including repeated courses. If the grade point average in these courses falls below 2.00, a student will be placed on departmental probation and must achieve a quarterly grade point average above 2.00 the following quarter or be transferred out of the Department and the College of Engineering.

II) Review and Notification Procedure

The progress of each student will be reviewed on a regular basis. If a student fails to meet the standards outlined above, that student will be placed on probation the following quarter, and the student will be notified in writing of the reason for probation. If the student does not show satisfactory progress in the following quarter, the student will be notified in writing, dropped from the Department of Mechanical Engineering and will be transferred to the College of Arts and Sciences. Failure to notify the student does not nullify the termination.

III) Appeals Procedure

The departments of the College recognize that inequities can result from any continuation policy. Therefore, a student who has been placed on probation or has been dismissed and believes that some facts in the record have been overlooked or misinterpreted, may request reconsideration of the probation dismissal by writing a letter to the Department Chairperson. Included in the letter should be any additional information in support of the student or any other information that the student believes is relevant. The appeal must be made within 30 days of the notification of placement on probation or dismissal. A response to the appeal will be made within 30 days.

IV) Academic Misconduct

Academic misconduct encompasses plagiarism, cheating on examinations or on individual project assignments, and theft or alteration of other people's work on academic materials for the purpose of improving one's own grades or acquiring academic credit. Students accused of academic misconduct will be referred for disciplinary action pursuant to the Student Conduct Code of the Washington Administrative Code 478-120, and if found guilty are subject to sanctions. As a function of the seriousness of such misconduct, sanctions range from a disciplinary warning to immediate dismissal from the College of Engineering and the University of Washington. The latter can and has been applied even for first offense.

Appendix II

College of Engineering Policy on Academic Misconduct

Academic misconduct or violation of Engineering Ethics is unacceptable in the practice of engineering. When you graduate and practice as an engineer, you will be subject Code of Ethics of Engineers. While preparing to be an engineer, you are subject to specific rules regarding Academic Misconduct.

Academic misconduct encompasses plagiarism, cheating on examinations or on individual project assignments, fraud, and theft or alteration of other people's work on academic materials for the purpose of improving one's own grades or acquiring academic credit. Students accused of academic misconduct will be referred for disciplinary action pursuant to the University of Washington Student Conduct Code, and if found guilty are subject to sanctions. These sanctions range from disciplinary warning (which encompasses a grade of zero on the assignment/exam in question) to recommending dismissal from the College of Engineering and from the University of Washington.

The College expects all students to behave in a mature manner and to be responsible for their own actions. The College does not accept excuses for misconduct and will prosecute all allegations of misconduct according to the procedures outlined in the College of Engineering Academic Misconduct Process.

What is Cheating?

Most academic misconduct falls under the definition of plagiarism (see below), but sometimes we refer to misconduct as cheating. The following is a list of several examples of cheating:

Examples of Cheating:

- Allowing another to prepare an assignment for you or preparing an assignment for another.
- Having another take an examination for you or taking an examination for another.
- Obtaining information about an examination or assignment that is not authorized by the instructor.
- Altering an answer to an examination after it has been turned in, whether it has been graded or not.
- Looking at another's paper during an examination or allowing another to look at your paper.
- Collaborating with another during examination or on an assignment where the work is to be done independently.
- Bringing materials or information to an examination that are not permitted by the instructor.

What is Plagiarism?

Plagiarism is taking someone else's work from any source, i.e., someone's ideas, writings, or inventions, and using it WITHOUT ACKNOWLEDGMENT. As long as you give credit to the originator of the material, you are not guilty of plagiarism. Merely enclosing statements or sentences in quotation marks is not sufficient; you must cite the source.

Examples of Plagiarism:

- Copying phrases, sentences, sections, paragraphs, or graphics from a source and not giving credit by citing the source.

- Turning in a paper from a previous class.
- Having another person write an assignment (for pay or for free) and putting your name on it.
- Modifying or paraphrasing another's ideas or writings and submitting them as your own.
- Having someone make substantial editorial changes to your paper and submitting the final version as your own.
- Turning in someone else's solution to an exam or a question on an exam as your own.
- Sharing computer code in assignments for individual students; use of someone else's computer code without acknowledgement; use of some one else's computer code when it is prohibited by the instructor.

Examples that are not Plagiarism:

- Asking someone to read your assignment and suggest possible improvements, unless specifically forbidden by the instructor.
- Getting together with other students to discuss an assignment, unless specifically forbidden by the instructor.
- Asking your instructor for help with an assignment.
- Quoting extensively from another's work but giving credit.
- Not citing sources for information that are in dictionaries or your course textbook.

Why is it so important?

Copying (or plagiarizing) someone's work, without giving due recognition, is regarded as the equivalent of STEALING AND FRAUD, especially in the Western world (USA, Canada, and Europe). It is highly probable that it will be detected, so do not do it under any circumstances. It could ruin your career.

How can I avoid Plagiarism?

ALWAYS make very clear reference to the source of the material you use and put the material taken in "quotation marks," no matter where you find it. This is perfectly acceptable and legitimate. DO NOT try to rewrite or change another person's work and pass it off as your own - this is very difficult to do and is easily detected.

When can I use other people's work?

You can always use published writings as long as you give a formal reference and acknowledgment of the source. If the information comes from a conversation with a professor or another student, give their name and recognition that it is their thought.

Again, NEVER take another person's writing or speech or message or Internet data and put it in your work without acknowledgment. It is important to always make sure in your career that everyone who makes a contribution gets credit, no matter how small their part has been!

If you have questions, please check with your instructor or TA.

What can happen if I commit Plagiarism?

At a MINIMUM the Professor will give you a very poor grade and may report the incident to the Associate Dean in the College of Engineering. You will then certainly receive a formal reprimand from the Dean, at a MINIMUM. Please refer to the Student Conduct Code of the Washington Administrative Code for a list of the possible sanctions that may be imposed.

It is foolish and completely unnecessary to plagiarize - DO NOT DO IT!

Questions about Cheating/Plagiarism

If you have any questions about the above process, please check with your instructor, TA, or departmental advising center.

Appendix III

QUARTERLY SCHEDULE WORKSHEET

AUTUMN		WINTER		SPRING		SUMMER	
Course	Cr	Course	Cr	Course	Cr	Course	Cr
Quarter Total		Quarter Total		Quarter Total		Quarter Total	

AUTUMN		WINTER		SPRING		SUMMER	
Course	Cr	Course	Cr	Course	Cr	Course	Cr
Quarter Total		Quarter Total		Quarter Total		Quarter Total	

AUTUMN		WINTER		SPRING		SUMMER	
Course	Cr	Course	Cr	Course	Cr	Course	Cr
Quarter Total		Quarter Total		Quarter Total		Quarter Total	

AUTUMN		WINTER		SPRING		SUMMER	
Course	Cr	Course	Cr	Course	Cr	Course	Cr
Quarter Total		Quarter Total		Quarter Total		Quarter Total	

CURRICULUM COMPLETION SUMMARY

A total of 180 credits are required for completion of the BSME degree.

MATHEMATICS:
Required (24 cr. min.)

*MATH 124	(5)	_____
*MATH 125	(5)	_____
*MATH 126	(5)	_____
♦MATH 307 or AMATH 351	(3)	_____
MATH 308 or AMATH 352	(3)	_____

Students may select one of the following Recommended classes to complete the Remaining 3 MATH credits:

MATH 309	(3)	_____
MATH 324	(3)	_____
AMATH 353	(3)	_____
_____	( )	_____
_____	( )	_____

MECHANICAL ENGR:
Required (45 cr.)

ME 323	(5)	_____
ME 333	(5)	_____
ME 331	(4)	_____
ME 354	(5)	_____
ME 355	(4)	_____
ME 356	(4)	_____
ME 373	(5)	_____
ME 374	(5)	_____
ME 395	(4)	_____
ME 495	(4)	_____

NATURAL SCIENCES:
Required (25 cr.)

*CHEM 142	(5)	_____
*CHEM 152	(5)	_____
*PHYS 121	(5)	_____
*PHYS 122	(5)	_____
PHYS 123	(5)	_____

WRITTEN COMMUNICATIONS:
Required (12 cr.)

*Engl Comp	(5)	_____
*TC 231	(3)	_____
TC 333 or English 182, 281, 381	(4)	_____

GENERAL ENGINEERING:
Required (31 cr.)

ME 123	(4)	_____
*CSE 142	(4)	_____
MSE 170	(4)	_____
*AA 210	(4)	_____
EE 215	(4)	_____
*CEE 220	(4)	_____
*ME 230	(4)	_____
IND E 315 or MATH 390	(3)	_____

ME OPTIONS:
Required (19 cr.)

_____	( )	_____
_____	( )	_____
_____	( )	_____
_____	( )	_____
_____	( )	_____
_____	( )	_____
_____	( )	_____

VISUAL, LITERARY, and PERFORMING ARTS (VLPA) 24 Credits REQUIRED

Visual, Literary, and Performing Arts (VLPA)
formerly Humanities
(10 cr. min.)

_____	( )	_____
_____	( )	_____
_____	( )	_____
_____	( )	_____
_____	( )	_____

Individuals and Societies (I&S)
formerly Social Sciences
(10 cr. min.)

_____	( )	_____
_____	( )	_____
_____	( )	_____
_____	( )	_____
_____	( )	_____

**Courses required for admission to the Department of Mechanical Engineering*
♦Recommended for admission to the Department of Mechanical Engineering