IOWA STATE UNIVERSITY

MECHANICAL ENGINEERING

ABET EC2006 Self-Study Report

June 30, 2006

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APPENDICES:

Program Self-Study Report
For Mechanical Engineering

This report and additional supporting documentation may be found on the Internet at

www.me.iastate.edu/accreditation.asp

A. Background Information

1. Degree Titles

Bachelor of Science in Mechanical Engineering
Master of Science in Mechanical Engineering
Doctor of Philosophy in Mechanical Engineering

2. Program Modes

Day, with optional opportunities in Cooperative Education and Internships

3. Actions to Correct Previous Deficiencies

No deficiencies noted in report following last ABET visit.

4. Contact Information

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B. Accreditation Summary

1. Students

Students entering the Department of Mechanical Engineering meet all admissions criteria described in Appendix II under *Admissions and Graduation Requirements, Basic Program*. A more rigorous background than the minimum expected for admission to Iowa State University is advised for prospective students expressing an interest in mechanical engineering.

Once admitted, mechanical engineering students receive academic advisement through services and resources provided by two full-time academic advisors, one support staff member and a lecturer who serves as an Advising Center Director. In addition to directing the Advising Center, the Director advises students and acts as a liaison between the center, the faculty, the department chair, the college and other advising related organizations on campus. The Director has a PhD in Mechanical Engineering and teaches one undergraduate course each semester.

Students are assigned an advisor at the time of their entry into the mechanical engineering program and each student retains the same advisor throughout his or her tenure as a mechanical engineering student (i.e., from entry to graduation). Advisor assignments are made on a rotating basis, i.e., an advisor is assigned every third student entering the program. Additionally, students are not required to see their formally assigned advisor—they may visit with any advisor on advising duty or they may request a change of their advisor of record at any time.

Advisors are responsible for monitoring the progress of the student using a "degree audit" produced twice annually. The **D**egree **A**udit **R**eporting **S**ystem (DARS) is maintained by the Registrar and a paper copy of the audit is provided to students and advisors. All graduation requirements are indicated on the audit with completed requirements specified along with courses currently scheduled. Thus, the student and advisor can easily see which requirements remain for graduation. Student progress is also monitored during the registration period when advisors review each student's plans for the subsequent semester. If a student's plans are consistent with graduation requirements (i.e., pre-requisites are satisfied, co-requisites satisfied), the student is approved to register. If the student's plans are not consistent with graduation requirements, the student is asked to visit with an advisor. Students receive curriculum information, policy change notices, and important announcements in the following curriculum planning courses:

Engr 101 cr (R):
Required for graduation and geared primarily for first year students. Opportunities within the profession of mechanical engineering are discussed as well as the requirements for a mechanical engineering degree. Strategies for succeeding as an engineering student are described, including study skills, team work skills, and written and verbal communication skills.

ME 102 cr(R):
Required for graduation and geared for students t in their first semester; students are required to complete ME 102 as part of their requirements for a B.S.M.E. Cooperative education and internship programs are described for students; representatives of industry visit with the class, degree requirements and degree audits are explained.

ME 190 cr (1):
Learning Community Seminars are one credit required courses for mechanical engineering students enrolled in the mechanical engineering learning community program. Students who successfully complete two semesters of ME 190 are not required to complete Engr 101 or ME 102 since the content of ME 190 includes that of Engr 101 and ME 102; ME 190 content parallels content of either Engr 101 or ME 102 depending on the set of courses taken in the learning community. Seminar activities include review of math, chemistry, and physics and spring learning communities participate in a problem solving activity.

ME 202 cr(R):
Required for graduation and geared primarily for students about to enter junior level ME courses, the focus of ME 202 is on the relationship between the student's academic and professional careers. Personal, academic, and professional strategic planning are among topics discussed, and students are required to submit a plan for graduation that includes preliminary selection of technical electives. Opportunities within mechanical engineering as either a practitioner or graduate student are presented by guest lecturers from industry and/or faculty. Additionally, faculty summarize research opportunities in the thermal and mechanical systems areas. The ASME canon of ethics is discussed and applied to an ethics case.

Students unable to attend a curriculum planning class (for example, cooperative education students, students studying abroad, students with intractable scheduling problems) are notified of curriculum information, policy changes, and important announcements via mass e-mail to ME undergraduate students and by postings on the ME Advising Center web site.

Additionally, students can access the ME Undergraduate Handbook on the ME homepage. The Mechanical Engineering Undergraduate Handbook lists all degree requirements and contains lists of acceptable general education, technical electives and course options for the major design experience course. Note: ISU-ME offers four courses at the senior level that fulfill the requirement for a major design experience course: Mechanical Design (ME 415), Heating and Air Conditioning Design (ME 442), Power Plant Design (ME 446) and Internal Combustion Engine Design (ME 449). At the time of their entry into the University, students are also given a University bulletin, which outlines requirements of the Department, the College, and the University. Each student in Mechanical Engineering has access to the departmental computers, which enables him or her to access each of the aforementioned documents on the World Wide Web.

Transfer Students

Upon entry into the University, the office of Admissions requires students to submit transcripts from all previously attended two and/or four year institutions. At the time transcripts arrive, an Admissions transfer credit evaluator reviews all previously completed course work and evaluates the courses in one of two ways:

1. the course is equivalent to an Iowa State course or
2. the course evaluation may require refinement (these courses are referred to as "generic").

If the course is determined by Admissions to be equivalent to a course offered by Iowa State, and if the grade in that course is at least a C minus, no further action is required; the equivalent course is applied toward completion of the student’s degree.

If the course is determined to be a generic course, the student is required to have refinements in evaluation made by the department offering a possible equivalent or appropriate substitution. Faculty (usually the course coordinator) in the offering department determine, based on information and resources provided by the student, whether or not the transfer course is equivalent to, or an appropriate substitute for, an ISU course. Appropriate resources for the student to provide the evaluating department are dictated by the faculty evaluator and generally include a course syllabus, the name of the course text in addition to a brief interview about topics covered in the course. If the transfer course is determined to be an equivalent or appropriate substitution, the student's degree audit is submitted with the evaluator's recommendation for approval and the graduation requirement is subsequently shown as having been met. If the evaluator determines that the student has not had sufficient coverage of material for the course to be counted toward graduation, the student is advised of the appropriate Iowa State course to take in order to meet graduation requirements.

If credit deficiencies occur because the transferred course was offered for fewer credits than required by Iowa State, the student is required to satisfy these deficiencies by adding credits to the total technical elective amount. However, if there is a credit shortage in the first year, other first year calculus, chemistry or calculus-based physics courses may be used to offset credit shortages. English credit deficiencies may be waived only by the Department of English, and any and all English credit deficits are satisfied through completion of additional approved general education courses.

Exceptions and/or Alternatives to Policies and Curriculum Requirements

Students may petition the Department to have a policy waived, or a graduation requirement satisfied in alternative ways. The petitioning process requires students to submit their appeals to the Mechanical Engineering Academic Standards Committee stating rationale for approval.

Advisors assist students with the petitioning process and advise them based on rulings of the Committee.

If a petition is approved by the Mechanical Engineering Academic Standards Committee, the petition is forwarded, along with the student's degree audit, to the office of Engineering Undergraduate Programs (EUP). The EUP officer updates the student's permanent record and degree audit so that the relevant degree requirement reflects the Committee's ruling.

In cases where the ruling on a petition may impact a significant number of students, an Advisor may ask the Committee to state whether or not the ruling should be considered a precedent. In such cases, the Mechanical Engineering Academic Standards Committee may vote or ask the departmental Curriculum Committee to recommend action by the faculty.

Rulings made by the Mechanical Engineering Academic Standards Committee are summarized by the chairperson of the committee at the close of each academic year and forwarded to the Advising Center.

Honors Program

Entering freshmen with outstanding high school records and academic ability may be eligible to participate in the Freshman Honors Program. To be invited to apply students need an ACT English score of 24 or above and meet at least one of these criteria:

- Be in the upper five percent of their high school graduating class
- Have an ACT composite of 30 or higher
- Be a National Merit or National Achievement Finalist

Admission to the Freshman Honors Program is limited and by invitation, and is based on past academic achievement, potential, and interest in an honors education. The College of Engineering routinely has 150 to 200 students participating in the Freshman Honors Program. These students are advised by freshman honors advisers in each department and are encouraged to pursue full membership in the University Honors Program.

Students interested in the Honors Program beyond the first year have two different membership options—Full and Associate. As an associate member they must

- Have earned a minimum 3.35 cumulative grade point average at Iowa State.
- Have at least one semester of residence and at least 48 credits remaining before graduation.

As a full member they must:

- Maintain a minimum 3.35 cumulative grade point average.
- Submit a program of study plan leading to a bachelor’s degree, approved by the student’s college honors committee.

The committee reviews the program for honors content. Honors content is very individual and focuses on meeting the academic goals described in the student’s educational objective statement. This may be accomplished by taking technical courses beyond the minimum required for the degree, becoming involved in research activities, adding an honors component to a non-honors course, enrolling in a number of honors seminars and courses offered by the institution, expanding social science and humanities electives normally required, etc.

International Opportunities

Mechanical engineering students may also choose to work and/or study abroad. ISU mechanical engineering students have worked and/or studied in Scotland, Australia, Germany, Austria, Italy, Spain, Mexico, Canada, Brazil, Bolivia, Sweden, Singapore, Tasmania, Taiwan, England, Wales, and France. The percentage of mechanical engineering students participating in exchange or study abroad opportunities has remained at approximately 10% over the span of the last 4 years. Furthermore, there are 12 mechanical engineering students in the Learning and Cultures Program (LCP) for the professions. The LCP program focuses on technical and business terms of a foreign language and requires all participating students to work abroad. Issues related to globalization in the context of engineering are covered in a new elective, ME 484x, and development and use of sustainable energy in the third world is covered in second new course, ME 388x.

Learning Communities

The Department currently offers eight different Learning Communities for M. E. students. A Learning Community is an academic unit made up of approximately 16 students taking the same set of two or three courses. Learning Communities within the department are targeted primarily for first year and sophomore students. The primary objective is to have students meet and work together as early as possible in their academic careers. Once weekly the community meets with an upper division mechanical engineering student (*peer mentor*) and discusses with him or her homework problems, exam preparation, the profession of mechanical engineering, or a special project. Occasionally, the community meets to enjoy a departmentally sponsored social function.

Cooperative Education and Internships

Co-operative education and Internship experiential opportunities are available to all students who have completed the Basic Program. Students typically indicate interest in experiential education by signing up for interviews with Engineering Career Services. Students who have been offered a job by a company with a signed co-op or intern agreement on file with Engineering Career Services enroll in one of five possible experiential courses: ME 396(summer work), ME 397 (internship), ME 298(Sophomore co-op), ME 398 (Junior co-op), or ME 498 (Senior co-op). Which course the student is advised to enroll in depends upon the duration of the work experience. Internships are for at least one semester, and co-ops are at least one year, with an alternating period of study incorporated within the year. Although students are considered full time students, they do not pay tuition nor do they receive credit for the experiential courses.

Table 1.1 Cooperative Education and Internships

Academic Year	Graduates	Coop/Internship
2001-2002	167	140 (84%)
2002-2003	176	136 (77%)
2003-2004	186	154 (83%)
2004-2005	187	150 (80%)

Student Chapters of Engineering Professional Organizations

Mechanical engineering students at Iowa State University have the opportunity to participate in a number of student chapters of relevant engineering professional organizations. These include ASME, SAE, and ASHRAE.

The student section of ASME is extremely active with university and professional functions, as well as philanthropy. The ISU chapter won second place (2004) and first place (2005) in the Ingersoll-Rand competition, which is a point-based system to determine how active a section is. Every year the professionals of the ASME Central Iowa Section team up with the ASME-ISU students and host a dinner/seminar meeting; these meetings generally coincide with Engineer's Week. The students also help the community by volunteering to judge projects made by the local middle school and high school for the Science Olympiad. In addition, the students attend the ASME leadership seminar (fall semesters) and regional conference (spring semesters). Participation in these organizations and attendance at national and international meetings provide our students with excellent opportunities to learn about professional practice in engineering.

The student chapter of ASHRAE is strongly supported by the sponsoring Iowa Chapter of ASHRAE located in Des Moines. Support comes in the form of rebates to student members who purchase ASHRAE handbooks, free meals for students who attend local ASHRAE dinner meetings, and travel assistance for students who traveled to the ASHRAE winter meeting in Chicago (January 2006). The local chapter helps coordinate student branch activities such as panel discussions on ASHRAE related career paths, providing guest speakers and arranging tours of various facilities to see and understand the HVAC systems used. Several ISU graduates who have participated in the student branch of ASHRAE are now design professionals for HVAC firms. Many of these former students are now active members of ASHRAE.

2. Program Educational Objectives

Upon first instituting new ABET accreditation criteria in 2000, there was some confusion on the differences between Program Educational Objectives and Program Outcomes. Accordingly, our original Program Educational Objectives more closely resembled Program Outcomes in their relatively short horizon. About three years ago, we recognized that Program Educational Objectives are intended to have a longer term perspective and we initiated changes in our Program Educational Objectives and how we assess them.

During a retreat in 2003, the Mechanical Engineering faculty drafted a new set of Program Educational Objectives that focus on the expected accomplishments of our students in their careers. These draft objectives were presented to our ME Students Advisory Board (MESAB) and the ME Advisory Council (MEAC) for discussion and revision. (See Table 2.1 Members of the Mechanical Engineering Advisory Council, 2001-2006 and Table 2.2 Members of MESAB). The result of this process was the following Program Educational Objectives, which were accepted by the faculty in spring of 2004:

1. The department provides a sound foundation for graduates to pursue a variety of careers. Most graduates will find immediate employment in industry, government laboratories or consulting, but some will pursue graduate or professional studies in such fields as engineering, business, law or medicine.
2. Graduates will apply the problem solving skills they have learned at Iowa State University to meet the challenging demands and increasing responsibilities of a successful career.
3. Graduates will continue to learn as they grow in their profession, using modern technology and communication skills to contribute as team members or leaders in solving important problems for their employers and for society.

Table 2.1 Members of the Mechanical Engineering Advisory Council, 2001-2006

Name	Company	Alumni Status
Brett Anderson*	The Boeing Company	ISU/BSAE, Wichita State/MBA
Bruce Baier	Pella Corporation	ISU/BSME, Drake/MBA
Marv Bigbee	Retired, John Deere Des Moines Works	ISU/BS Ag Eng.
William P. Binger	Retired, Shell Oil	ISU/BSME
Larry Bodensteiner*	IBM Mechanical Design & Integration	ISU/BSEE, Lehigh/MS
Jayne Busche	IBM	ISU/BSME, U of Minn./MS Mgmt.
Craig Connell*	Black & Veatch	ISU/BSME, Univ. Kansas/MS
Jim Davis	Proctor & Gamble	ISU/BSME
W. Gary Gates*	Omaha Public Power	ISU/BSES, Nebraska/MSIE, Creighton/MS Bus. Adm.
Bruce Gibson*	Retired, Air Products & Chemicals, Inc.	ISU/BSME, Univ. Michigan/MSME, Lehigh/MBA
Mike Hilby*	John Deere Des Moines	ISU/BSME
Cynthia J. Lord*	Alliant Energy	ISU/BSME, Baruch/MBA
Susan Mantell*	University of Minnesota-Minneapolis	Stanford/BSME, Northeastern Univ/MSME, Stanford/Ph.DME
Richard W. McGaughy	Retired, IES Utilities	US Naval Academy/BS
Susan Oltrogge	Brooks, Borg, & Skiles Architects & Engineers	ISU/BSME, U of I/MS Bus. Adm
Mark Pearson*	GE Transportation- Aircraft Engines	ISU/BSME, Univ. Cincinnati/MSAE
Larry Pithan*	KJWW Engineering Consultants	ISU/BSME
Frederick H. Rixe	Retired, Williams Bros. Engr. Co	ISU/BSME, Ok. State/MSME
Bob Sutton*	Caterpillar, Inc.	Univ. of Illinois/BS Ag Eng., Massachusetts Institute of Technology/MSME
Jeff Trom	Engineering Animation Inc.	U of I/BSME, MSME, ISU/PhDME
Sheryl Wreghitt*	SLW Quality Consulting, LLC	ISU/BSME

Table 2.2 Members of the Mechanical Engineering Student Advisory Board

Member	Classification	Organization Representation
Andrew Koehring	Senior	Chair
Ben A'Hearn	Senior	ASHRAE
Clayton Neumann	Senior	Pi Tau Sigma
Kurt Olsen	Junior	SAE
Dinesh Kalyan	Graduate	Graduate College
Yilei Zhang	Graduate	Graduate College
Tyler Dorin	Sophomore	At Large Member

These objectives are published on the department's web site at http://www.me.iastate.edu/accreditation.asp and in the university catalog, which is on the web at http://www.iastate.edu/~catalog/2005-07/courses/me.html.

Formal assessment of the Program Educational Objectives is in the form of an Alumni Survey of our former students three years after their graduation. The survey, which is conducted every other year, asks the alumni how well our curriculum prepared them to meet our Program Educational Objectives and asks them to describe some of their accomplishments after graduation. This assessment process and the results from it are detailed in Section 3. We also get a less formal assessment of our Program Educational Objectives through discussions with our ME Advisory Council.

These formal and informal assessments provide the basis for implementing more broadly based changes in our curriculum than often result from the Program Outcomes assessment, which are more likely to be incremental improvements in the program. For example, in our effort to meet Program Educational Objective 1, we recognize that students seeking careers in business, law, medicine, or even engineering disciplines quite different from Mechanical Engineering would benefit from more flexibility in the kinds of technical electives they can take. Therefore, we began discussions on the benefits and costs of allowing students more freedom in their choice of technical electives. This idea was endorsed by the Mechanical Engineering Advisory Council, which led to the drafting of a motion to replace the current requirement of 9 hours of ME technical elective and 6 hours of non-ME technical elective with a new requirement of 15 hours of either ME or non-ME technical elective. This motion was approved by the faculty during Fall 2005.

From the feedback we received from the Alumni Survey, we added some business considerations to the ME 270 (sophomore design course) by asking the students to perform market research and make a business case for their product. We also had several discussions in faculty meetings concerning the need to bring many diverse aspects of product design, especially environmental, ethical, and societal implications, into the major design experience courses.

Some of these changes in the curriculum relate to more than one Program Educational Objective. For example, the ME Advisory Council has advised us to take seriously the idea that our students are likely, in due time, to have international responsibilities. This relates to Objective 2, which focuses on the increasing responsibilities of a successful career, and Objective 3, which calls for our graduates to contribute to solving important problems for society. In response, we have initiated a new elective course in cooperation with the Department of Foreign Languages: Technology, Globalization and Culture, ME/FLL 484/584, which is offered each spring semester (http://www.me.iastate.edu/me484/). As the course web site indicates, Cargill and Deere provide support that allows us to bring in two speakers each week, so we are able to range wide in our consideration of the problems and challenges of globalization. Sixty-eight ME students took the most recent offering of the course. The lectures are open to the campus community and posted on the course web site, so the influence of the course extends well beyond the course attendees.

These program objectives also influence faculty hiring decisions in the department. For example, we interpret Objective 3, which calls for using modern technology, as a call to add to our department faculty members with expertise in emerging fields. As a result, hires in recent years have included experts in microfluidics and nanotechnology. We have clear continuing challenges to balance new technology with the body of knowledge traditionally associated with mechanical engineers and with the need for international exposure for our students. We will continue to address these challenges, and new ones, in light of our Program Educational Objectives.

3. Program Outcomes and Assessment

This section describes how the Mechanical Engineering Department assesses its undergraduate program and implements continuous quality improvement.

Program Outcomes

Four major program outcomes were developed to achieve ABET Criterion 3 (a) - (k).[1] These were further defined by delineating dimensions of each program outcome. Each dimension of the each program outcome is mapped to one or more ABET Criterion 3 (a) – (k).

The four program outcomes (PO) include:
PO1: fundamental knowledge,
PO2: engineering skills,
PO3: career success, and
PO4: social awareness.

Dimensions of PO1: fundamental knowledge are:
a. mathematics,
b. physics, and
c. chemistry.

Dimensions of PO2: engineering skills are:
a. analysis,
b. synthesis, and
c. experiment.

Dimensions of PO3: career success are:
a. team work,
b. communication, and
c. life-long learning.

Dimensions of PO4: social awareness are:
a. contemporary issues and
b. professional responsibilities.

The dimensions of our four program outcomes also encompass the mechanical engineering ABET Criterion 8:

ME1. knowledge of chemistry and calculus-based physics with depth in at least one.
ME2. the ability to apply advanced mathematics through multivariate calculus and differential equations.
ME3. familiarity with statistics and linear algebra.
ME4. the ability to work professionally in both thermal and mechanical systems areas including the design and realization of such systems.

Table 3.1 defines each of these dimensions and identifies the map from program outcomes to ABET Criterion 3 (a) - (k) and Criterion 8.

[1] Criteria for Accrediting Engineering Programs, Engineering Accreditation Commission, ABET, Inc., Baltimore, MD, October 29, 2005.

Table 3.1 Program Outcomes for the Mechanical Engineering Department at Iowa State University

	Title of PO	Dimensions	Definition	ABET Criterion 3	ABET Criterion 8
PO1	Fundamental Knowledge	a. Mathematics	An ability to apply knowledge of mathematics, including calculus, linear algebra, and statistics	(a)	ME2, ME3
		b. Physics	An ability to apply knowledge of physics	(a)	ME1
		c. Chemistry	An ability to apply knowledge of chemistry	(a)	ME1
PO2	Engineering Skills	a. Analysis	An ability to identify, formulate, and solve problems in thermal and mechanical systems using techniques, skills, and modern tools of the engineering profession	(e, k)	ME4
		b. Synthesis	An ability to design a system, component, or process associated with thermal and mechanical systems using techniques, skills, and modern tools of the engineering profession	(c)	ME4
		c. Experiment	An ability to design and conduct experiments and to analyze and interpret the data associated with thermal and mechanical systems using techniques, skills, and modern tools of the engineering profession	(b)	ME4
PO3	Career Success	a. Team work	The ability to develop sufficient synergy in a group to produce quality projects & presentations.	(d)	
		b. Communication	Communication skills reflect professionalism of the student through use of proper grammar, appropriate mannerisms or writing style, and skillful use of visual aids.	(g)	
		c. Life-long learning	Shows initiative in use of information resources, explores and implements new engineering practices, and actively seeks new learning.	(i)	
PO4	Social Awareness	a. Contemporary issues	An appreciation of contemporary issues*	(h, j)	
		b. Professional responsibilities	Understanding the ethical and professional responsibilities of the ME profession	(f)	

* Contemporary issues: topics that challenge modern society and occupy the attention of citizens who are well informed about their nation and the world. Students should be especially cognizant of the interplay of technological, social, and political factors in resolving or exacerbating problems facing society.

Course Objectives

The program outcomes were the basis for a comprehensive rewriting of course objectives for each of the core courses and the four major design experience courses in our curriculum. These course objectives are detailed in the course descriptions found in Appendix I- B of this document. Effective assessment of program outcomes and implementation of curriculum improvements require a careful mapping between program outcomes and course objectives. An example of such a mapping is shown for ME 436 in Table 3.2. A summary of this mapping for the Mechanical Engineering curriculum is found in Table 3.3 while a complete collection of these mappings for all core and major design experience courses is found in Appendix I-D.2.

Table 3.2 Example of mapping between course objectives and program outcomes (illustrated for ME 436)

Course Objectives Matched to Program Outcomes
Course Number and Name ME 436 Heat Transfer
Matching Adjusted to PO List by Battaglia, Heindel and Pate Date 10/13/05

	Program Outcomes (Adopted Spring 2001)										
Course Objectives Number	*Fundamental Knowledge*			*Engineering Skills*			*Career Success*			*Social Awareness*	
	Math PO1a	Physics PO1b	Chemistry PO1c	Analysis PO2a	Synthesis PO2b	Experi-ment PO2c	Team Work PO3a	Communi-cation PO3b	Life-Long Learning PO3c	Contemp-orary Issues PO4a	Profession-al Respons-ibilities PO4b
1	✓	✓		✓		✓	✓				
2	✓	✓		✓							
3	✓	✓		✓							
4	✓	✓		✓		✓	✓				
5	✓	✓		✓							
6	✓	✓		✓		✓	✓				
7	✓	✓		✓							
8	✓	✓		✓							
9	✓	✓		✓							
10	✓	✓		✓	✓						
11	✓	✓		✓							
12	✓	✓		✓		✓	✓				
13										✓	
14											
15											
16											
17											

Table 3.3 ME Curriculum Coverage of Program Outcomes: (a) Core Courses (b) Major Design Experience Courses

	ME Core Courses										ME Major Design Courses			
PROGRAM OUTCOMES	ME 102	ME 270	ME 231	ME 324	ME 325	ME 332	ME 335	ME 370	ME 421	ME 436	ME 415	ME 442	ME 446	ME 449
PO1 Fundamental Knowledge a. Mathematics		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
PO1 Fundamental Knowledge b. Physics		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
PO1 Fundamental Knowledge c. Chemistry			✓	✓		✓							✓	✓
PO2 Engineering Skills a. Analysis		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PO2 Engineering Skills b. Synthesis		✓			✓	✓	✓		✓	✓	✓	✓	✓	✓
PO2 Engineering Skills c. Experiment		✓		✓	✓		✓	✓	✓	✓				
PO3 Career Success a. Team Work		✓		✓	✓		✓	✓	✓		✓	✓	✓	✓
PO3 Career Success b. Communication		✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
PO3 Career Success c. Life-long learning		✓									✓	✓	✓	✓
PO4 Social Awareness a. Contemporary issues		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PO4 Social Awareness b. Professional responsibility		✓									✓	✓	✓	✓

(modified on 12/6/05)

Program Assessment

A plan for assessing our program objectives was first formulated in 1998 with the following guiding principles:

- Assessment is understood to target the program rather than evaluating performance of individual students, faculty, and courses.
- At least two independent assessments of each student outcome will be performed
- All faculty will participate - shared responsibility is critical to success of assessment
- Participation will include all program constituents (students, alumni, and industry)
- Flexible execution within a standardized framework will encourage faculty participation

Although the tools of assessment have changed in the intervening years, these principles continue to guide our assessment process. Table 3.4 compares the current assessment tools with those originally formulated in 1998. The following paragraphs describe each of these assessment tools while Appendix I-D contains all the official instructions and templates used by the department to administer these assessments.

Table 3.4 Comparison of assessment tools in 1998 and 2006

Original Assessment Tools (1998)	**Current Assessment Tools (2006)**	**Nature of Assessment**
Student assessments	Student assessments	Indirect measure, qualitative
Design assessments	Design assessments	Direct measure, qualitative
Senior surveys	Senior surveys	Indirect measure, qualitative
Target assessments	Course objectives assessment	Direct measure, quantitative
Alumni surveys	Alumni surveys	Indirect measure, qualitative

Student assessments are surveys filled out at the end of each semester in each ME core or major design experience course. (Note: Students also complete the traditional course and instructor evaluations at the end of each semester.) These student assessments are intended to provide the students' views of their *opportunities* to master our program outcomes. We do not expect every class to impact all program outcomes. Rather, these surveys help us assess the mapping called for by Table 3.3. Instructions for conducting the student assessments are found in Appendix I-D.3. The student assessment form can be found in Appendix I-D.4

Design assessments are conducted by the *design panel* which consists of several faculty, students, alumni, and members of our ME Advisory Council. Their responsibility is to judge student design project reports assembled from the course sequence of Engr 170, ME 270, and courses with major design experience. Each semester, instructors in these design-oriented courses have students turn in two copies of a report on a major design project. The course instructor, as part of the student's evaluation, grades one report. The other copy, with the student's name removed, is retained in a departmental archive. The design panel convenes once per year to evaluate a random sample of student project reports. The panel has the option of using standard rubrics (found in Appendix I-B) to quantitatively score student success in mastering program outcomes or using discussion and consensus to prepare a qualitative written assessment (the latter was adopted during the 2005 design assessment). Instructions and forms for conducting the design panel assessment are found in Appendix I-B.

Course objectives assessments are performed every semester in every core and major design experience course to determine how many students are mastering the objectives of these courses. Since course objectives are specific to each course, we encourage faculty to customize this assessment to their class. Instructors are responsible for preparing a *plan for assessment* for their sections of a course. The plan explains the methodology for assessment and the basis for judging whether a student has mastered each course objective. Some faculty may use a fairly conventional approach of using quizzes or exams to determine how well their students are mastering course objectives while others may use group projects, class discussion, and other forms of feedback from students to gather the necessary data to make this assessment. An instructor is responsible for completing the course objectives assessment before the end of the semester in which the course is taught. Instructors are expected to prepare a table showing the *percent* of students judged to have mastered each course objective. Instructions for conducting the course objectives assessments are found in Appendix I-B.

Senior surveys are performed each semester. This is a long-standing tradition in the Department of Mechanical Engineering. A survey, which includes questions related to ABET Criterion 3, is distributed to each graduating senior and the results tabulated and distributed to faculty. This survey is included in Appendix I-D.9. In addition, each semester, the Chair invites graduating seniors to provide feedback on their educational experience at Iowa State University. This discussion includes all topics, including perception of teachers, problems with courses and labs, and evaluation of advising experiences.

Alumni surveys are an assessment of Program Educational Objectives which are conducted every other year. The Department contacts alumni three years after their graduation and asks them to assess their educational experience at Iowa State University. Instructions and forms for conducting the alumni survey are found in Appendix I-D.10.

Continuous Program Improvement

Figure 3.1 diagrams the committees and structure which are used to perform continuous assessment/improvement of learning in the ME department. The Program Improvement Coordinating Committee (PICC) makes sure all the committees interact effectively and get their jobs done correctly. The Mechanical Engineering Curriculum Committee (MECC) is responsible for integrating changes into the curriculum, both course objectives and curriculum coverage of program outcomes. The Mechanical Engineering Academic Standards and Assessment Committee (MEASAC) develops assessment tools, makes sure they are administered by the faculty, and tabulates results for distribution to Curriculum Development Committees (CDCs) or, in the case of alumni surveys, distributing program objectives assessments to MECC. MEASAC is also responsible for reviewing student petitions for changes in their programs of study which is not a formal part of the assessment process, but these decisions do affect the quality of the program. The Laboratory Committee is responsible for coordinating laboratory undergraduate facilities in the department. The Mechanical Engineering Graduate Studies Committee (MEGSC) is responsible for curriculum matters at the graduate level.

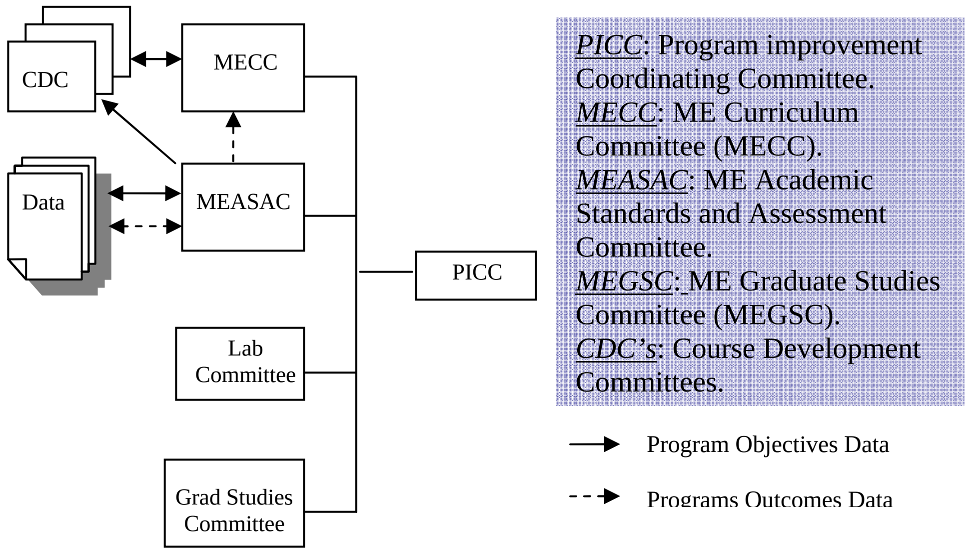

Figure 3.1 Organization of the faculty for continuous program improvement

At the heart of our continuous program improvement efforts are the Curriculum Development Committees. Each core and major design experience course has a CDC consisting of two or three faculty members who regularly teach the course (the exceptions are ME 231 and ME 332, which are handled by a single CDC because of the close relationship between these courses, and the major design experience courses, which are handled by a single CDC). Each CDC is responsible for preparing a course description and course objectives. Each CDC annually reviews assessment results for its course(s) and makes recommendations to MECC for improving the course, including changes to course objectives and the organization of the course. These proposed changes are submitted as an annual CDC report to MECC, which prepares a summary report for review by the ME Advisory Council and subsequent approval by the ME faculty. Detailed methodology for performing continuous quality improvement is found in Appendix I-D.11.

Results from Recent Assessments (2005)

Student Assessment

Student assessments are performed every semester. For each course the average score, standard deviation, and 95% confidence interval is reported for each program outcomes. On a scale of 1-5 a score of 3.0 is considered an average (acceptable) result. More important are semester to semester comparisons, for which the inclusion of confidence intervals allow trends to be evaluated. Results for Spring 2005 are summarized in Appendix I-E.1.

Course Objectives Assessments

This assessment asks each course instructor to assess what percentage of students in their course has achieved minimally acceptable mastery of each course objective. Composite data from the Course Objectives Assessments are presented in Appendix I-E.2.

Design Panel

Design panel assessments are held annually. Results from the Spring 2005 design panel assessment can be found in Appendix I-E.3.

Senior Survey

The results of the senior survey from Spring 2005 are detailed in Appendix I-E.4.

Alumni Survey

The results of the alumni survey from Spring 2005 are detailed in Appendix I-E.5.

Program Changes Resulting From Outcomes Assessment (Prior to 2005-6 academic year)

Each CDC committee is responsible for reviewing the results from each assessment tool and preparing a CDC Summary Report that addresses the following:

1. Deficiencies in student readiness for the course
2. Program outcomes not being adequately met by the course
3. Plans for improving the course

The following is a summary from these reports between 2001 and 2005.

1. Deficiencies in student readiness for the course:
    - Weak in calculus; math skills in general (ME 231, ME 335, ME 421)
    - Intimidated by chemistry (ME 332)
    - Do not remember ME 231 material (co-ops, long breaks) (ME 332)
    - Retention of prerequisite courses is lacking (ME 436)
    - Lacking computer skills (ME 335)
    - Lack mechanics and materials fundamentals (ME 324)
    - How to model and realize a real-world product
    - simple concepts like free body diagrams
    - electrical circuits
    - statistics
    - finite element analysis to determine stress distribution in parts (prereq not required)
    - how each subsystem works and how to assess its performance

2. Program outcomes not being adequately met by the course:
    - Math (ME 231)
    - Chemistry (ME 324, ME 332) - it is surprising that students do not think that they have covered chemistry, since combustion is taught in this course.
    - Experimental skills (ME 270, ME 324, ME 325, ME 421)
    - Synthesis (ME 335, 421)
    - Team work (ME 335, ME 421)
    - Contemporary issues (ME 231, 332, 324, 325, 335, 370, 436) - Contemporary Issues needs improvement, although this is mainly an issue of emphasis, not content; i.e., unless a topic is specifically introduced as having contemporary importance, students may not recognize it as such.
    - Professional responsibility (ME 335)
    - Students think they are receiving adequate opportunities in ME 270 but the design panels do not think the outcomes are being met (see last bullet of this section).
    - Senior surveys find large discrepancies among our courses in the number of students ranking them excellent:
        - Thermofluids: 68%
        - Machine elements: 45%
        - Materials and manufacturing: 11%
        - ME 370: 5%
    - The Design Assessment Panel found a large number of deficiencies in the performance of students in our major design experience courses. These concerns were serious enough that MECC asked the ME Department chair to convene the Design CDC to consider how to correct these deficiencies.

3. The following changes have been made to the curriculum due to CDC recommendations:
    - ME 231: No longer requires design as part of the Course Objectives. Instructors are being encouraged to bring more contemporary issues into the classroom and identify them as such (the latest Moran and Shapiro textbook will explicitly bring in contemporary issues).
    - ME 270: Work on uniformity and consistency among instructors; discourage students from enrolling prematurely in this course; apply physics and math fundamentals to rudimentary analysis. Possibly this cornerstone design course should not be judged by the same panel as those that judge the courses with major design experiences. The experimental program outcome should be removed. To address the deficiency in analysis a two part strategy is being proposed: (1) adding 2-3 new lectures addressing basic modeling and development of abstraction skills and (2) coordinating with providers of our non-ME core courses (e.g., statics, dynamics, physics, etc.) to communicate our needs and encourage more real-world motivation. ME 270 should present machining; the ME 270 CDC should select TA's for this course.
    - ME 324: one credit of laboratory should be added to the existing 2-credits materials science and delete the word "design" in the catalog description and replace it with "product realization;" prerequisites should include ME 270 and ME 370; present more contemporary issues in class.
    - ME 325: CDC claims that a Program Objective in Experimental Skills still appears in the official course objectives summary (this does not appear to be the case; see Assessment Web page documentation). A written assignment related to contemporary issues is recommended. Since total credits were reduced to three in Fall 2003 the course objectives were completely rewritten.
    - ME 325: Eliminated mechanisms from the course and reduced credit hours from 4 to 3. The course objectives were completely rewritten because of these changes.
    - ME 332: CDC noted that this course received relatively high rankings in design and contemporary issues. Nevertheless, recommended more uniformity among syllabi of different instructors. Allow faculty teaching 2 sections of this course to combine the sections.
    - ME 335: Revise laboratories to include a "creativity" lab and a "design of experiment lab" to improve teamwork and design skills. Laboratories were upgraded with new stations and experiments with a completion date of Fall 2006. Gas dynamics would be a more natural fit in fluids than thermodynamics. The CDC would like to discuss adding this topic to ME 335, perhaps by transferring ½ to 1 credit from ME 332 to ME 335. The ME 335 CDC would like to drop the ME 370 prerequisite. The instrumentation in the fluids lab is not complex enough to justify this prerequisite, and it only serves to create scheduling problems for students.
    - ME 370: Revamping instruction of this course with support from Miller Fellowship. All sections will be combined; dedicated TA to revamp labs. Essay will be incorporated to improve contemporary issues.
    - ME 415: More time will be devoted to fundamentals of finite element analysis. More guest speakers from industry will be invited so students can learn how design is achieved in different companies. More focus will be put on advanced techniques used in the design process.
    - ME 421: Substantial revisions were made to the Course Objectives to conform with the needs to assess each course objective (original objectives were deemed too specific for practical assessment). A new lab is being devised in the area of fundamental concepts in dynamic modeling. Implementation of new laboratory material will give the students the opportunity to implement and analyze closed loop control. The faculty member in charge of laboratories will visit each lab section to emphasize the team nature of the labs. We have also asked the Teaching

Assistants to rotate the student lab partners within each lab, to allow more contact among the students in each lab section.

- ME 442: Current design practices, codes and standards will be reviewed to assure they are incorporated in the course. Course objectives revised to assure that students will work in design teams.
- ME 449: More detail of each subsystem will be provided for background knowledge of how the subsystem works and how to analyze it. More focus will be put on the implication of subsystem performance and impact on overall engine performance.
- Major Design Experience Courses: The Design CDC does not believe problems identified by one of the Design Assessment Panels are the result of technical deficiencies among the students. Rather, more emphasis on communication skills is required in the major design experience courses. Better communication with the Design Panel also appears to be a concern as the Design CDC recommends the inclusion of the following material with each design project submitted to the panel: statement of design problems and constraints; objectives of the assignment; summary of design report.
- For all courses for which chemistry is an outcome, faculty should either add more of chemistry to their courses or let students know when chemistry is involved in a problem. For all courses for which contemporary issues is an outcome, faculty should either let students know when they are discussing contemporary issues or add more of these subjects to their sections.
- PO3: Career Success and Life-long learning will be evaluated only through the student assessment survey and the graduating senior survey.
- Add a new assessment tool that corresponds to the course objectives to ensure that the assessment directly relates to each course.

Fundamentals of Engineering Exam Results

One set of standardized exam results that are available for a number of the ME graduates are the Fundamentals of Engineering exam scores. While not all graduates of the ISU ME department take the FE exam, in recent years over one-third of the graduating seniors do take it. The results from these graduates can be used as an indication of the available opportunities for students to learn subject matter covered from a more conventional stand point. ME graduates have an excellent record of performance on this exam with almost 100% of the students taking the exam receiving passing grades. Results for the past four and one-half years are shown below in Figure

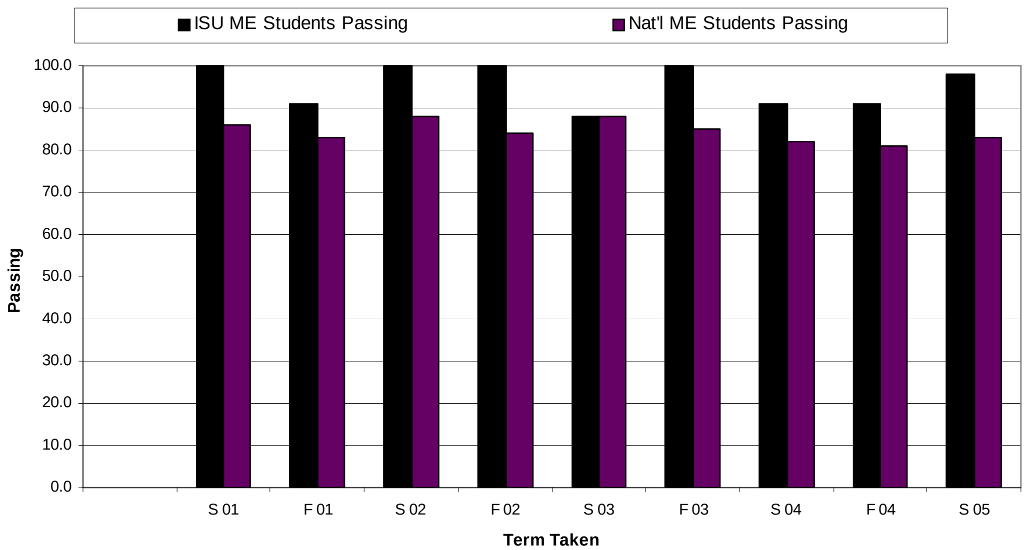

Figure 3.2 Graduate Placement Results

Graduate Placement Statistics

Graduate placement is also an important indicator of performance. Below are data collected by the ISU Engineering Career Services office for students completing an undergraduate degree in mechanical engineering. The data indicate that at least 60% of students have accepted employment at the time of graduation in most semesters. Within 6 months after graduation, approximately 90% of all graduating seniors have accepted employment. Placement data for

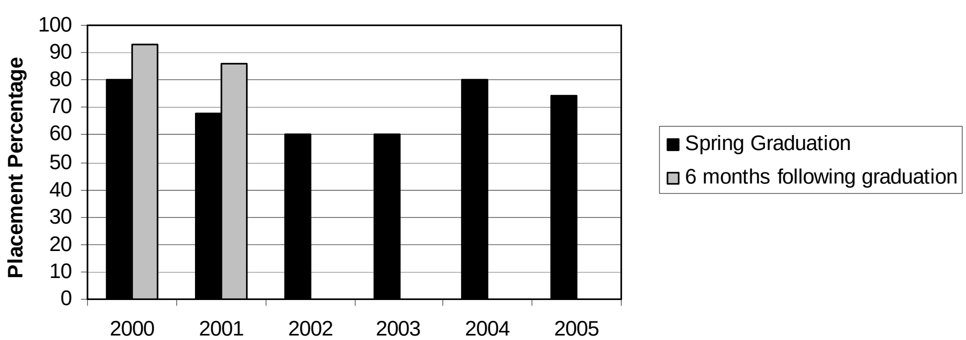

Figure 3.1 Fundamentals of Engineering Exam Results

students 6 months following graduation were not available for 2003-2005. As can be seen in Figure 3.2, placement for mechanical engineering students over the past two academic years has been especially strong.

4. Professional Component

As shown in the Basic-Level Curriculum of Table 1 in Appendix I-A, and the 2005-2007 Iowa State University Bulletin, the Bachelor of Science degree in mechanical engineering requires a total of 128.5 credits.

Math and Basic Science

In the "Math and Basic Science" area, students must take sixteen credits of mathematics through differential equations as well as a three-credit course in statistics. A four-credit chemistry course accompanied by a one-credit lab is also required. Furthermore, all mechanical engineering students take 2 five- credit, calculus-based, physics courses. This provides the depth called for in the Mechanical Engineering Program Criteria.

Engineering Topics

The bulk of the curriculum addresses engineering topics, including engineering science and engineering design. ME students are required to take supporting courses from other engineering departments, including Materials Science and Engineering, Aerospace Engineering and Engineering Mechanics, and Electrical and Computer Engineering. These courses are:

MAT E 272	Principles of Materials Science and Engineering
EM 274	Statics of Engineering
EM 324	Mechanics of Materials
EM 345	Dynamics
EE 442	Introduction to Circuits and Instruments
EE 448	Introduction to AC Circuits and Motors

Students also take a series of three courses specifically targeting design. In their first year they take ENGR 170, Engineering Graphics and Introductory Design. In this course they learn to use AutoCAD with Mechanical Desktop, and they work on a team with students from other departments on a design project. They present their work in a design report and an oral presentation at the end of the semester.

In the sophomore year they take a second design course, ME 270, Introduction to Mechanical Engineering Design. In this course students build on the first year course, working in groups to address design problems. The design projects are selected to embody both thermal and mechanical elements, and students are expected to build a prototype of their design. They submit a design report and give an oral presentation at the end of the semester. Students also learn about intellectual property, engineering ethics and professionalism in this course.

ME 270 is designed to introduce sophomore level students to basic mechanical engineering topics in the context of a design project. By that experience students become aware of the importance of the various specialty fields within mechanical engineering. After taking this course in the sophomore year, they will understand the need to study such topics as heat transfer and design of machine elements in greater depth later in the curriculum.

In addition, ME 270 is designed to provide a bridge between the introductory level design course that students take in the first year and the major design experience course they take in the senior year. ME 270 provides the vertical integration needed within the curriculum that allows students to develop their teamwork skills to complete a project that meets pre-determined design objectives subject to realistic constraints.

Finally in the senior year, each student must select a design elective course from among the four major design experience courses offered in the department.

ME 415 Mechanical Systems Design
ME 442 Heating and Air Conditioning Design
ME 446 Power Plant Design
ME 449 Internal Combustion Engine Design

About 55% of the students select ME 415. A few students elect to take more than one of these courses. In those instances, one of the courses meets the design elective requirement, and the other is counted as a technical elective.

In every case, students work in teams to complete one or two major design projects that depend heavily upon earlier course work. Many projects are drawn from industry and many specifically incorporate issues related to engineering standards. Each project must include realistic constraints which encompass most of the following considerations: economic, environmental, sustainability, manufacturability, ethical, health and safety, social, and political. Students are required to submit a complete design project report and give an oral presentation at the end of the term. Often, representatives from industry are present for the oral presentations and they actively participate in critiquing the students' work.

According to the Program Criteria for Mechanical Engineering, mechanical engineering graduates must have the ability to work professionally in both thermal and mechanical systems areas. Thus the ME curriculum includes a series of courses in each of these major stems. In the thermal systems area students are required to take:

ME 231 Engineering Thermodynamics I
ME 332 Engineering Thermodynamics II
ME 335 Fluid Flow
ME 436 Heat Transfer

In the mechanical systems area, three courses are required:

ME 324 Manufacturing Engineering
ME 325 Mechanism and Machine Design
ME 421 Mechanical Systems and Control

Students also take ME 370, Engineering Measurements and Instrumentation. In this course students learn how to design and conduct experiments. They also learn how to collect information using computer-based data acquisition systems, and they analyze and interpret the data using statistical-based methods.

In addition to the required courses in the area of "Engineering Topics," students choose at least fifteen credits of technical elective courses. All courses used to satisfy these requirements are selected from department lists and include ME and non -ME courses. These courses introduce a degree of flexibility into the curriculum, giving students an opportunity to tailor their academic experience to meet their unique educational goals, whether they include immediate entry into industry or further study at the graduate level.

General Education

Students are required to take nine credits of English courses to develop their written communication skills. These include:

ENGL 104 First-Year Composition I
ENGL 105 First-Year Composition II
ENGL 314 Technical Communication

The first two courses are required for all students seeking degrees from Iowa State University, and the last is specifically designed to help students in technical disciplines learn to write effective proposals, reports, papers and other documents.

For international students enrolling at Iowa State University, the following policy stated on page 50 of the 2005-2007 Iowa State University Bulletin applies:

"International students whose first language is not English must demonstrate ability to study in this English-speaking university. Such students—beginning as well as those who transfer from other institutions—must take an English placement test when they arrive on campus. The test is administered by the English Department and is offered at the opening of each semester.

Students whose performance on this placement examination is satisfactory will follow the regular English requirements of their major department. Students who have deficiencies will enroll in special English classes, as determined by the test results."

The following "English Proficiency Policy" is used in the Mechanical Engineering Department:

1. The student must earn at least a 2.00 average (on a 4.00 point system) in the English 104 and 105 sequence. A minimum grade of C- is required in each course.
2. If the student doesn't meet the requirements in (1) above, he or she will be required to retake one or both of the courses until the requirements are met.
3. As an alternative to (2), a student may be allowed to take another writing course to make up any deficiency in meeting the requirements of (2) above. The Mechanical Engineering Academic Standards Committee must approve this alternative.

The mechanical engineering curriculum also requires students to select fifteen credits of general education elective courses. These courses, which are selected from department and university approved lists, are designed to meet several requirements important for mechanical engineering graduates.

All students are required to take either ECON 101, Principles of Microeconomics, or ECON 102, Principles of Macroeconomics. Either of these courses (ECON 101 or 102) counts as three credits of social science electives. Furthermore, students must select a minimum of six credits in the humanities and an additional three credits of social science.

The general education electives must also include courses that satisfy the diversity and international perspectives requirements of the university. As stated on page 51 of the 2005-2007 Iowa State University Bulletin:

"One of Iowa State University's goals is to prepare its students to meet the challenges of responsible citizenship and effective professional roles in a culturally diverse global community. To help achieve this goal, all undergraduate students must fulfill graduation requirements in two areas: U.S. Diversity and International Perspectives. The specific standards used to certify students' fulfillment of these requirements vary from major to major, but all require three credits of course work (or the equivalent in some alternative academic experience) for each of the requirements. In most cases, courses used to meet the U.S. Diversity and International Perspectives requirements can also be used to fulfill general education requirements of the student's college or requirements of the student's major."

In mechanical engineering, students meet the U.S. Diversity and International Perspectives requirements by selecting one course from each of the respective lists approved by the university for the two requirements.

Engineering Employment Opportunities

Undergraduate mechanical engineering students also have the opportunity to gain valuable work experience through employment in laboratories and centers on campus. The Virtual Reality Applications Center (VRAC), and the Industrial Assessment Center (IAC) routinely employ undergraduate mechanical engineering students. VRAC employs 30 to 35 undergraduate engineering and computer science students each semester. These students work on industry and government sponsored projects employing state-of-the-art computer visualization techniques for a variety of industrial and research applications. The IAC employs 5 to 10 undergraduate mechanical engineering students each semester. These students work on teams consisting of faculty, graduate students and undergraduates. The teams travel to industrial clients in

Iowa, Minnesota, and Nebraska to complete industrial assessments of energy consumption, waste production, and productivity. Each center provides the opportunity for students to develop teamwork, problem solving, creative thinking, communication, presentation, time management, and leadership skills that augment the professional component of the mechanical engineering curriculum. In addition, several faculty employ undergraduates to work in research laboratories.

5. Faculty

Coverage of Curricular Areas

There are 14 Mechanical Engineering faculty who teach the thermal systems technical electives and these core thermal systems courses:

ME 231 Engineering Thermodynamics I
ME 332 Engineering Thermodynamics II
ME 335 Fluid Flow
ME 436 Heat Transfer

There are 18 Mechanical Engineering faculty who teach the mechanical systems technical electives and the three required mechanical systems core courses:

ME 324 Manufacturing Engineering
ME 325 Mechanism and Machine Design
ME 421 Mechanical Systems and Control

Departmental design courses begin with ME 270 – Introduction to Mechanical Engineering Design, which draws on all the faculty in the department. The Department's major design experience course offerings include ME 415-Mechanical Systems Design taught by the mechanical systems faculty, and ME 442-Heating and Air Conditioning Design, ME 446-Power Plant Design, and ME 449-Internal Combustion Engine Design which are taught by the thermal systems faculty. Faculty in thermal systems and mechanical systems with experimental programs serve as instructors for ME 370-Engineering Measurements and Instrumentation.

Interactions with Students

The Department of Mechanical Engineering staffs an Advising Center which has 2 full time professional advisors, a lecturer who serves as coordinator and a full time secretary. The Advising Center Coordinator is evaluated by the Department Chair and serves as an ex-officio member of the Mechanical Engineering Curriculum Committee. All faculty members are available to students for advice on professional growth, direction, and success strategies.

ME faculty members serve as advisors to the following student technical societies that are based in Mechanical Engineering: ASME, ASHRAE, and SAE. ME faculty also serve as advisors for the ME honor society Pi Tau Sigma and the engineering honor society Tau Beta Pi. The range of professional and service activities that these organizations provide include plant trips and design and build teams for car competitions.

The Mechanical Engineering Student Advisory Board (MESAB) has the mission of facilitating effective communications between students and faculty. There are a maximum of 12 undergraduate and graduate mechanical engineering student members, and the Department Chair is an ex officio member of this board. Continuing projects that the MESAB manages are: early semester course evaluations that provide early feedback to instructors and a web page for student feedback and suggestions that are brought to the Department Chair for action or resolution. The MESAB identified student members to serve on curriculum teams during academic year, 2005-2006 and also was asked to assess and review the ME program objectives and the Draft ABET self-study. This group plays a major role in representing the Department's major constituency - students.

Adequacy of Faculty Size

Since the last ABET visit, seven tenure-track faculty left ISU, three retired and eleven new faculty were hired for a net gain of one faculty position. During the same period, undergraduate enrollment increased 35% from 797 students (F99) to 1075 students (F05). With limited funds to support hiring of temporary faculty and teaching assistants, we have seen a dramatic increase in our core course class sizes from approximately 30 students in academic year 99/00 to 55 students currently. We have the highest student to faculty ratio (S/F) among our peer institutions at 30.9. Table 5.1 presents comparison data from our peer institutions. Student enrollment figures from these institutions include undergraduate majors in all classifications from freshman through senior.

Table 5.1 Mechanical Engineering Department Statistics[2]

Institution	Undergraduate Students	Teaching, Tenure track Faculty
Iowa State University	1075[3]	31
Texas A&M	1059	47
Ohio State University	865	45
University of Minnesota	746	41

6. Facilities

The Mechanical Engineering Department is located in the Henry M. Black Engineering Building at Iowa State University. This building also houses the Industrial and Manufacturing Systems Engineering Department. The Mechanical Engineering Department is allocated a total of 38,938 square feet of space in the building with an additional 6,403 square feet shared with the IMSE Department. In the summer of 2004, the new Hoover Engineering building was occupied giving the department an additional 6,400 square feet of additional space for undergraduate activities. Table 6.1 presents a listing of facilities available to the Mechanical Engineering program.

All active teaching faculty have their offices in Black Engineering, except for two who are located in nearby Howe Hall, a new building just opened in the fall of 1999. The two are involved in research of the Virtual Reality Applications Center located in Howe Hall.

All teaching laboratories for the M.E. Department are located in Black and Hoover and are scheduled by department personnel. General classrooms in the buildings, though, are under the control of the Facilities Planning and Management Unit and classrooms are assigned by Room Scheduling.

Teaching laboratories, both their operation and development, are considered a priority in the department. The M.E. Department has made an effort to integrate laboratory work with classroom instruction whenever possible. The Boyd Lab (ME 270), Engel Lab (ME 324), Fluids Lab (ME 335), Instrumentation and Measurements Lab (ME 370), Controls Lab (ME 421), and the Heat Transfer Lab (ME 436) are evidence of this fact.

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[2] Data from: *2005 ASEE Profiles of Engineering and Engineering Technology Colleges*

[3] Although the *2005 ASEE Profiles of Engineering and Engineering Technology Colleges* list the ME undergraduate enrollment at ISU as 958 in Fall 2005, the actual enrollment was 1075.

ME 270, Introduction to Mechanical Engineering Design, utilizes the Boyd Lab facilities located in a new 2931 square foot facility in Hoover Hall. Since moving into this facility, over $412,000 has been spent on new equipment ranging from three high tech 4 axis Milltronics vertical mills to everyday hand tools such as saws and hammers. The facility is supported by one fulltime technician.

The Instrumentation and Measurements course (ME 370) utilizes a lab well equipped with computers, data acquisition systems, (both high speed and steady) calibration equipment, readout devices (scopes, counters, timers, graph recorders, etc.), and sensors including strain gauges, monitoring LVDT's, pressure transducers, thermocouples and thermistors. The lab has gone through an extensive revamping in the last two years with the addition of over $60,000 worth of new equipment, funded from the Mechanical Engineering Department, Engineering College, and Miller Faculty Fellowship Grant.

Modern engineering is well supported in both the Controls Lab (ME 421) and the Mechatronics Lab (ME 410). These labs are equipped with a wide variety of computer systems integrated with control hardware including servos, motors, breadboards, feedback systems, analog hardware and digital hardware. In the spring of 2006 the Mechatronics Lab was outfitted with eight new hydraulic trainers thanks in part to a grant from Caterpillar. The lab is located in room 1330 Hoover hall in a new facility of 1621 square feet.

The labs for Heat Transfer and for Fluids (ME 436 and ME 335) each constitute 1 credit of these 4 credit courses, and each lab has been outfitted with instruments and equipment to perform up to ten different experiments during the semester. Both laboratories have undergone extensive improvement in both equipment and content in the past few years.

The computer facilities located in Room 1012 and Room 1020 support both the overall ME student population and also those students enrolled in the senior design lab. For general student use there are 70 PC computers along with a wide range of software packages. All the systems support high end graphics programs such as Solid Works, Pro-Engineering and Autocad.

Mechanical Engineering students take a first year course to learn computer programming in either FORTRAN (ENGR 160) or C (ENGR 161). They also take a first year course, (ENGR 170), where they receive an introduction to Computer-Aided-Design and solid modeling using AutoCAD and Mechanical Desktop. In the junior level instrumentation course (ME 370) they become familiar with LABVIEW for data acquisition.

Students utilize various popular computer packages as needed throughout the curriculum including word processing and spreadsheet software. Other packages, such as EES (Engineering Equation Solver), MATLAB, MATHCAD, Techplot, LabView, Fluent, and Working Model are used in specific courses as well.

Table 6.1 Facilities

Physical Facility Building And Room Number	Purpose of Laboratory, Including Courses Taught	Condition of Laboratory	Adequacy for Instruction	Number of Stations (Students)	Area sq. ft.	Comments
0047 Black Engineering	ME Fabrication Shop All classes requiring machining	Good	Good	1 (6 Students)	913	
1012 Black Engineering	Computer Room All courses that use computers	Good	N/A	50	1743	
1020 Black Engineering	Senior Design Lab ME 415, ME 419, ME 442	Excellent	Excellent	20	873	
1051 Black Engineering	Engel Lab ME 522, ME 324	Excellent	Excellent	1 (6 Students)	1073	
1055 Black Engineering	Control Room for 1057 ME 445	Excellent	Excellent	1 (8 Students)	246	
1056 Black Engineering	Chassis Dynamometer Area ME 445	Excellent	Excellent	1	1386	
1057 Black Engineering	Internal Combustion Engine Lab ME 445	Excellent	Excellent	1 (8 Students)	574	
1070 Black Engineering	Machining Center ME 270, ME 324	Good	Good	1 (6 Students)	1170	Joint Room with IMSE
1072 Black Engineering	Metal Working & Grinding Rm ME 270, ME 324	Good	Good	1 (4 Students)	602	Joint Room with IMSE
1086 Black Engineering	Metalurgical Lab/Polishing ME 324	Excellent	Excellent	1 (6 Students)	481	Teaching and Teaching Lab
1092 Black Engineering	Material Testing - Welding Area ME 324	Excellent	Excellent	1 (6 Students)	890	Joint Room With IMSE
1095 Black Engineering	Heat Treatment – Injection Molding ME 324	Excellent	Excellent	1 (6 Students)	515	Joint Room with IMSE
1098 Black Engineering	Foundry Area ME 324	Excellent	Excellent	1 (6 Students)	872	Joint Room with IMSE
1103 Black Engineering	Laser Lab ME 332, ME 529	Excellent	Excellent	1 (6 Students)	1273	Teaching and Research Lab
1118 Black Engineering	Heat Transfer ME 436	Excellent	Excellent	3 (12 Students)	518	
1119 Black Engineering	Fluid Flow Lab ME 335	Good	Good	3 (9 Students)	600	

Physical Facility Building and Room Number	Purpose of Laboratory, Including Courses Taught	Condition of Laboratory	Adequacy for Instruction	Number of Stations (Students)	Area sq. ft.	Comments
1120 Black Engineering	Air Solutions Lab ME 443	Excellent	Excellent	1 (6 Students)	530	
2081 Black Engineering	Instrumentation & Measurement ME 370	Excellent	Excellent	6 (12 Students)	643	
2072 Black Engineering	Open Computer Lab	Excellent	Excellent	5	118	
2073 Black Engineering	Student Media Center for all students	Excellent	Excellent	1	404	Shared with Department Computer repair
2095 Black Engineering	Computer Lab Open to all students 24/7	Good	Good	12 Stations	600	
2103 Black Engineering	HVAC Systems ME 442	Excellent	Excellent	1 (6 Students)	650	Teaching and Research Lab
1233 Hoover Hall	Team Assembly Room ME 270, ME 415	Excellent	Excellent	36	819	
1237 Hoover Hall	Assembly Room ME 270, ME 415, ME 446	Excellent	Excellent	15 Students	822	
1243 Hoover Hall	Computer - Study ME 270, ME 415	Excellent	Excellent	1 (5 Students)	138	
1245 Hoover Hall	Computer – Study ME 270, ME 415	Excellent	Excellent	1 (5 Students)	138	
1260 Hoover Hall	Computer – Study ME 270, ME 415	Excellent	Excellent	1 (5 Students)	138	
1337 Hoover Hall	Manufacturing Lab	Excellent	Excellent	20	2931	
1343 Hoover Hall	Computer – Study ME 270, ME 415	Excellent	Excellent	1 (5 Students)	138	
1345 Hoover Hall	Computer – Study ME 270, ME 415	Excellent	Excellent	1 (5 Students)	138	
1348 Hoover Hall	Computer – Study ME 270, ME 415	Excellent	Excellent	1 (5 Students)	138	
1360 Hoover Hall	Student Project Storage ME 270	Excellent	Excellent	40 Lockers	198	Project Storage
	Mechatronics Lab ME 410	Excellent	Excellent	8 (16 Students)	1621	Shared with ABE

7. Institutional Support and Financial Resources

The process used to determine the budget for the department is based on past and present expenditures and a projection of future expenditures. In the spring, the Department Chair presents the financial needs of the department for the next fiscal year to the Dean. When the Board of Regents approves the university budget and the funding for the College of Engineering is known, then funds are allocated to the department by the Dean's office staff.

Funds allocated by the state for "current expense" items such as telephone service, copying, expendable supplies, etc. are never adequate. We assume this problem is not unique to Iowa State University and is typical nationwide. Our strategy for solving this problem of insufficient funding is to use moneys otherwise available from gifts, endowment earnings, salary savings from research, or open positions to meet the shortfall.

A major portion of the department resources is used for faculty startup packages. These funds are used by the new faculty member for the purchase of equipment, support of graduate students and summer support. The primary use of startup funds is to supplement the individual faculty member's grant funding and to assist the faculty member in securing contracts and grants through matches or cost sharing. These funds are available to the new faculty member on a prorated basis spread over the first three years of their employment. Any funds remaining at the end of the designated time are returned to the department.

In addition to the funding allocated from the state, the department receives limited funds from other sources such as gifts from individuals and industry. Gift funds given by private individuals or organizations are used according to the request of the individual or organization. Other undesignated gifts are added to the department's Black-Hilstrom Endowment fund. The increase in our state budget has not kept pace with our increased enrollment. In order to maintain quality education, we have hired additional teaching assistants and lecturers to assist students in the classroom. The funds to cover these expenses have generally come from our state allocation for current expense and our gift funds. Occasionally we use gift funds to purchase new cutting-edge equipment that is used in the teaching labs where the students receive practical training to prepare them for the workplace.

The department currently has five technical support staff servicing the faculty and the department teaching and research facilities. In addition, there are five clerical support staff, an administrative assistant and several student hourly employees. The combined duties of these personnel serve to assist the students in the areas of technical support such as computer purchase and maintenance, lab equipment operation and maintenance, and supplemental instruction in laboratories, clerical support necessary for making outside purchase of necessary supplies and equipment. Services are also available outside the department for additional computer support, publications and grant preparation and other technical services. Many of these services are utilized throughout the year as the individual needs arise.

8. Program Criteria

The program criteria for Mechanical Engineering requires that graduates have:

- Knowledge of chemistry and calculus-based physics with depth in at least one.
- The ability to apply advanced mathematics through multivariate calculus and differential equations.
- Familiarity with statistics and linear algebra.
- The ability to work professionally in both thermal and mechanical systems areas including the design and realization of such systems.

Mechanical Engineering students at ISU receive a solid foundation in chemistry and calculus-based physics. They are required to take a basic chemistry course with an accompanying lab, and they are also required to take a two-course sequence in physics:

Chem 167 (4 credits) General Chemistry for Engineering Students
Chem 167L (1 credit) Laboratory in General Chemistry for Engineering Students
Phys 221 (5 credits) Introduction to Classical Physics I
Phys 222 (5 credits) Introduction to Classical Physics II

Understanding of basic principles of chemistry provides the basis for subsequent study of materials and manufacturing as well as for the thermal systems courses within the mechanical engineering curriculum

ISU students are also required to take a four course sequence in mathematics including three calculus courses and a course in differential equations that includes Laplace transforms:

Math 165 (4 credits) Calculus I
Math 166 (4 credits) Calculus II
Math 265 (4 credits) Calculus III
Math 267 (4 credits) Elementary Differential Equations and Laplace Transforms

Mathematical principles learned in these courses are used in courses that occur later in the curriculum. In particular, topics including multivariate calculus and differential equations are useful for the study of ME 335 Fluid Flow, ME 421 Mechanical Systems and Control, and ME 436 Heat Transfer.

The ME curriculum requires that students take a course in statistics, Stat 305 (3 credits) Engineering Statistics, and they receive an introduction to matrices and linear algebra in Math 166 and Math 267. Statistics is later used in the required instrumentation course, ME 370 Engineering Measurements and Instrumentation, and in the laboratory components associated with ME 324 Manufacturing Engineering, ME 335 Fluid Flow, ME 421 Mechanical Systems and Control, and ME 436 Heat Transfer. It is also important in understanding the statistical distribution of material properties and applied machine loads as well as the failure distribution for ball and roller bearings. These topics are addressed in ME 325 Mechanism and Machine Design. Linear algebra is used in other courses as well, most notably in ME 421 Mechanical Systems and Control.

ISU mechanical engineering students take a rigorous sequence of courses in both thermal systems and mechanical systems areas. In thermal systems they are required to take:

ME 231 (3 credits) Engineering Thermodynamics I
ME 332 (3 credits) Engineering Thermodynamics II
ME 335 (4 credits) Fluid Flow
ME 436 (4 credits) Heat Transfer

They are also required to take the following mechanical systems courses:

ME 324 (4 credits) Manufacturing Engineering

ME 325 (3 credits) Mechanism and Machine Design
ME 421 (4 credits) Mechanical Systems and Control

These two sequences, along with ME 370 Engineering Measurements and Instrumentation, ensure that ISU mechanical engineering graduates are able to work professionally in both thermal and mechanical systems areas.

Furthermore, they develop design skills along the way that apply to both thermal and mechanical systems. There are assignments that include significant design content in most of the thermal and mechanical courses listed above (see the Basic-Level Curriculum in Appendix IA, Table 1). Also, the students take a sequence of design courses starting with the first year and culminating with a senior major design experience course. The first two courses include:

Engr 170 (3 credits) Engineering Graphics and Introductory Design
ME 270 (3 credits) Introduction to Mechanical Engineering Design

In Engr 170, the students work in teams with other mechanical engineering students and students from Agricultural Engineering to complete a basic design project. They are required to submit a written report on their design and make an oral presentation. They might also build a prototype of their design.

In ME 270, sophomore mechanical engineering students work in large teams to design a product. The students are placed into a "virtual" company. Their team is responsible for all aspects of the product. This includes mechanical, thermal, fluids, and manufacturing elements as well as marketing and costing information. Students in this course are also required to complete a written report and make an oral presentation, and they are expected to compete against other teams taking the course to see which of the designs works best.

Students must take at least one major design experience course from among the following offerings:

ME 415 Mechanical Systems Design
ME 442 Heating and Air Conditioning Design
ME 446 Power Plant Design
ME 449 Internal Combustion Engine Design

Design projects in ME 415 are predominantly mechanical systems based projects, while projects in ME 442, 446 and 449 are primarily oriented toward thermal systems. However, specific projects in any of the courses might well include elements related to both thermal and mechanical systems. Furthermore, the design process required in each of the courses includes many common elements. So, for example, a student completing a mechanical systems design project in ME 415, could certainly do very well in a design position with a company that manufactures air conditioning products. Also, some students elect to take two or more of these courses, counting the additional course(s) as an ME technical elective credit.

All faculty involved in the upper-level courses are active professionally in a number of ways. These include research, publication of scholarly work, consulting, graduate student advising, professional and scientific society involvement, and participation in undergraduate extracurricular activities. Not all members of the faculty are involved in all of these areas, but each contributes to the department in one or more.

Appendix I-A

Tabular Data for Mechanical Engineering Program

MECHANICAL ENGINEERING

Table 1 Basic-Level Curriculum Mechanical Engineering

Year; Semester or Quarter	Course (Department, Number, Title)	Category (Credit Hours)			
		Math & Basic Sciences	Engineering Topics Check if Contains Design (✓)	General Education	Other
First Year Fall	Chem 167 - General Chemistry for Engineering Students	4			
	Chem 167L - Laboratory in General Chemistry for Engineering	1			
	Engr 101 - Engineering Orientation				R
	Math 165 - Calculus I	4			
	Engl 104 - First-Year Composition I			3	
	Engr 170 - Graphics & Introductory Design		3 (✓)		
First Year Spring	Lib 160 - Library Instruction				0.5
	ME 102 - Mechanical Engineering Orientation				R
	Engr 160 - Engineering Problems with Computational Laboratory in Visual Basic		3		
	Math 166 - Calculus II	4			
	Phys 221 - Introduction to Classical Physics I	5			
	Engl 105 - First-Year Composition II			3	
Sophomore Fall	Stat 305 – Engineering Statistics		3		
	Mat E 272 - Principles of Materials Science & Engineering		2		
	E M 274 - Statics		3		
	Phys 222 - Introduction to Classical Physics II	5			
	Math 265 - Calculus III	4			
Sophomore Spring	M E 202 Mechanical Engineering Seminar				R
	E M 324 Strength of Materials		3		
	EM 345 - Dynamics		3		
	Math 267 - Elementary Differential Equations and Laplace Transforms	4			
	ME 231 - Engineering Thermodynamics I		3 (✓)		
	ME 270 - Introduction to Mechanical Engineering Design		3 (✓)		

Year; Semester or Quarter	Course (Department, Number, Title)	Category (Credit Hours)			
		Math & Basic Sciences	Engineering Topics Check if Contains Design (✓)	General Education	Other
Junior Fall	ME 324 - Manufacturing Engineering		4 (✓)		
	Econ 101/102 – Principles of Micro/Macro Economics			3	
	EE 442 - Introduction to Circuits & Instruments		2		
	EE 448 - Introduction to AC Circuits & Motors		2		
	ME 332 - Engineering Thermodynamics II		3 (✓)		
	Engl 314 - Technical Communication			3	
Junior Spring	ME 325 - Mechanism & Machine Design		3 (✓)		
	ME 370 - Engineering Measurements & Instrumentation		3 (✓)		
	ME 335 - Fluid Flow		4		
	Tech Elective - Non ME		3		
	General Education Elective			3	
Senior Fall	ME 421 - Mechanical Systems & Control		4 (✓)		
	ME 436 - Heat Transfer		4 (✓)		
	Technical Electives - ME		6		
	General Education Elective			3	
Senior Spring	Technical Electives - Non ME		6		
	Design Elective		3 (✓)		
	General Education Elective			6	
TOTALS-ABET BASIC-LEVEL REQUIREMENTS		31	73	24	0.5
OVERALL TOTAL FOR DEGREE		128.5	128.5	128.5	128.5
PERCENT OF TOTAL		24.1%	56.8%	18.7%	0.4%

Table 2 Course and Section Size Summary Mechanical Engineering

Course No.	Title	No. of Sections offered in Current Year	Avg. Section Enrollment	Type of Class (1)			
				Lecture	Laboratory	Recitation	Other
102	Mechanical Engineering Orientation	2	102	100			
190	Learning Communities	14	14			100	
202	Mechanical Engineering – Professional Planning	2	120	100			
231	Engineering Thermodynamics I	6	43	100			
270	Introduction to Mechanical Engineering Design	7	34	33	67		
280	Introduction to History of Science I	1	4	100			
281	Introduction to History of Science II	1	2	100			
284	Introduction to the History of Technology and Engineering I	1	3	100			
285	Introduction to the History of Technology and Engineering II	1	3	100			
298	Cooperative Education	2	2				100
324	Manufacturing Engineering	4	56	75	25		
325	Machine Design	4	53	100			
330	Thermodynamics	4	42	100			
332	Engineering Thermodynamics II	4	58	100			
335	Fluid Flow	4	55	75	25		

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

Course No.	Title	No. of Sections Offered in Current	Avg. Section	Type of Class (1)			
				Lecture	Laboratory	Recitation	Other
370	Engineering Measurements and Instrumentation	21	11	67	33		
388X	Sustainable Engineering and International Development	1	15	67	33		
396	Summer Internship	1	110				100
397	Engineering Internship	2	55				100
398	Cooperative Education	2	4				100
410	Mechanical Engineering Applications of Mechatronics	3	6	67	33		
411	Automatic Controls	3	8	67	33		
413	Fluid Power Engineering	1	3	67	33		
414	Hydraulic Systems and Control	1	13	100			
415	Mechanical Systems Design	5	26		100		
417	Advanced Machine Design I	1	45	100			
418	Mechanical Considerations in Robotics	1	15	67	33		
421	Mechanical Systems and Control	1	126	75	25		
425X	Mechanical System Optimization I	1	6	100			
428X	Analysis and Design of Mechanisms	1	24	100			
433	Alternative Energy Conversion	1	99	100			
436	Heat Transfer	4	54	75	25		
441	Fundamentals of Heating, Ventilating, and Air Conditioning	1	36	100			

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

Course No.	Title	No. of Sections Offered in Current Year	Avg. Section Enrollment	Type of Class (1)			
				Lecture	Laboratory	Recitation	Other
442	Heating and Air Conditioning Design	1	20	33	67		
443	Compressed Air Systems		76	100			
445	Internal Combustion Engines	4	11	67	33		
446	Power Plant Design	1	43	50		50	
449	Internal Combustion Engine Design	1	15	33	67		
451	Engineering Acoustics	1	15	67	33		
466	Multidisciplinary Engineering Design	1	13	33	67		
484X	Technology, Globalization, and Culture	1	86	100			
490	Independent Study	2	5				100
498	Cooperative Education	1	2				100
511	Advanced Control Design	1	6	100			
515	Advanced Machine Design II	1	13	100			
516	Kinematic Analysis and Synthesis of Mechanisms	1	17	100			
517	Contemporary Issues in Computer-Aided Engineering	1	0	100			
520	Material and Manufacturing Considerations in Design	1	21	100			

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

Course No.	Title	No. of Sections Offered in Current Year	Avg. Section Enrollment	Type of Class (1)			
				Lecture	Laboratory	Recitation	Other
521	Mechanical Behavior and Manufacturing of Polymers and Composites	1	0	100			
527	Mechanics of Machining and Finishing Processes	1	11	100			
528	Micro/Nanomanufacturing	1	12	100			
530	Advanced Thermodynamics	2	9	100			
532	Compressible Fluid Flow	1	3	100			
536	Advanced Heat Transfer	2	10	100			
538	Advanced Fluid Flow	2	8	100			
539	Fluidized Bed Processes	1	16	100			
542	Advanced Combustion	1	11	100			
545	Thermal Systems Design	1	22	100			
546	Computational Fluid Mechanics and Heat Transfer I	1	17	100			
547	Computational Fluid Mechanics and Heat Transfer II	1	5	100			
549	Vehicle Dynamics	1	39	100			
557	Computer Graphics and Geometric Modeling	1	11	100			
563X	Micro and Nana Scale Mechanics	1	16	100			
573	Random Signal Analysis and Kalman Filtering	1	3	100			
574	Optimal Control	1	1	100			

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

Course No.	Title	No. of Sections Offered in Current Year	Avg. Section Enrollment	Type of Class (1)			
				Lecture	Laboratory	Recitation	Other
576	Digital Feedback Control Systems	1	2	100			
578	Nonlinear Systems	1	7	100			
600	Seminar	2	16			100	
625	Surface Modeling	1	7	100			
639	Two-Phase Flow and Heat Transfer	1	10	100			
647	Advanced High Speed Computational Fluid Dynamics	1	0	100			

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

Table 3 Faculty Workload Summary Mechanical Engineering

Faculty Member (Name)	FT or PT	Classes Taught (Course No./Credit Hrs.) F = Fall 05 S = Spring 06 SS = Summer 06	Total Activity Distribution			
			Teaching	Research	Service	Other
Bahadur, Shyam	PT	S: 324C[1] (2 sections) 3 cr.	40	40	20	
Bathie, William	PT	F: 332 3 cr. S: 332 3 cr.	100			
Battaglia, Francine	FT	F: 231 3 cr.; 436L[1] 1 cr. S: 536 3 cr.; 436L[1] 1 cr.	40	40	20	
Bernard, James	FT	F: 549 3 cr. S: 484X/584X 3 cr.	40	40	20	
Brown, Robert	FT	F: 539 3 cr.	40	40	20	
Bryden, Mark	FT	F: 388X 3 cr.; 397 R cr.; 398 R cr.; 446 3 cr. S: 231 3 cr.; 298 R cr.; 397 R cr.; 398 R cr.; 542 3 cr. SS: 396 R cr.	40	40	20	
Cao, Li	FT	F: 324C[1] 3 cr.	40	40	20	
Chandra, Abhijit	FT	F: 324C[1] 3 cr.; 324L[1] 1 cr. S: 527 3 cr.	40	40	20	
Colver, Gerald	FT	F: 330 (2 sections) 3 cr.	40	40	20	Retired in Spring
DeVries, Warren	FT				100	
Flugrad, Donald	FT	F: 415 (2 Sections) 3 cr. S: 415 3 cr.	24	40	36	
Gassman, Max	PT	S: 414 3 cr.	100			
Heindel, Ted	FT	F: 538 3 cr. S: 436C[1] (2 sections) 3 cr.	40	40	20	
Kelkar, Atul	FT	F: 421C[1] 3 cr. S: 418 3 cr.	40	40	20	
Kong, Song-Charng	FT	F: 445 3 cr. S: 449 3 cr.	40	50	10	

1. ME 324, 335, 421, and 436 are 3 credits of class room instruction and 1 credit of lab. For example ME 324 is shown as 324C 3 cr. and ME 324L.

Faculty Member (Name)	FT or PT	Classes Taught (Course No./Credit Hrs.) F = Fall 05 S = Spring 06 SS = Summer 06	Total Activity Distribution			
			Teaching	Research	Service	Other
Luecke, Greg	FT	F: 411 3 cr. S: 410 3 cr.; 421L 1 cr.	40	40	20	
Mann, Adin	FT	F: 600 R cr. S: 421C[1] 3 cr.; 451 3 cr.; 600 R cr.	26	40	34	
Maxwell, Greg	FT	F: 270 3 cr.; 441 3 cr. S: 270 3 cr.; 442 3 cr.	40	40	20	
Molian, Palaniappa	FT	F: 325 3 cr.; 520 3 cr. S: 325 3 cr.; 528 3 cr.	40	40	20	
Nelson, Ron	FT	F: 530 3 cr.; 545 3 cr. S: 231 (2 sections) 3 cr.	40	40	20	
Okiishi, Theodore	FT				100	
Oliver, James	FT	S: 625 3 cr.;	40	40	20	
Olsen, Michael	FT	F: 335L[1] 1 cr. S: 335C[1] 3 cr.; 335L[1] 1 cr.	40	40	20	
Pate, Michael	FT	F: 433 3 cr.; 436C[1] 3 cr. S: 443 3 cr.; 639 3 cr.	40	40	20	
Pletcher, Richard	PT	S: 547 3 cr.	40	40	20	
Shrotriya, Pranav	FT	F: 325 3 cr. S: 270 3 cr.; 563X 3 cr.	40	40	20	
Starns, Gloria	FT	F: 515 3 cr. S: 415 3 cr.; 417 3 cr.	40	0	60	
Subramaniam, Shankar	FT	F: 270 3 cr.; 335C[1] 3 cr.	40	40	20	
Sundararajan, Sriram	FT	F: 370 3 cr. S: 370 3 cr.	40	40	20	
Vance, Judy	FT				100	
Winer, Eliot	FT	F: 270 3 cr. S: 415 3 cr.; 425 3 cr.	40	40	20	
Zou, Qingze	FT	F: 421L[1] 1 cr. S: 511 3 cr.	40	40	20	

Table 4 Faculty Analysis

Name	Rank	FT or PT	Highest Degree	Institution from which Highest	Years of Experience: Govt./Industry Practice	Total Faculty	This Institution (ISU)	Professional Registration (Indicate State)	Level of Activity (high, med, low, none) in: Professional Society	Research	Consulting/ Summer Work in Industry
Bahadur, Shyam	University Professor	FT	Ph.D.	University of Michigan-1970	1	44	35		High	Medium	Low
Battaglia, Francine	Associate Professor	FT	Ph.D.	Pennsylvania State University-1997	2	6	6		High	High	None
Bernard, James E.	Professor	FT	Ph.D.	University of Michigan-1971	5	29	23	MI	High	Medium	None
Brown, Robert C.	Professor	FT	Ph.D.	Michigan State University-1980	3	22	22		Low	High	Low
Bryden, Mark	Assistant Professor	FT	Ph.D.	University of Wisconsin-1998	14	9	9		High	High	Medium
Chandra, Abhijit	Professor	FT	Ph.D.	Cornell University-1983	2	20	6		Medium	High	Medium
DeVries, Warren R.	Professor and Chair	FT	Ph.D.	University of Wisconsin-1975	6	29	10		High	Low	None
Flugrad, Donald R., Jr.	Associate Prof.	FT	Ph.D.	University of Missouri-Rolla-1981	6	28	28		Low	Medium	Medium
Heindel, Theodore J.	Binger Associate Professor	FT	Ph.D.	Purdue University-1994	0	12	6		High	High	Low
Kelkar, Atul	Professor	FT	Ph.D.	Old Dominion University-1993	5	10	5		High	High	Medium
Kong, Song-Charng	Assistant Professor	FT	Ph.D.	University of Wisconsin, Madison-1994	8	4	1		High	High	Low
Luecke, Greg R.	Associate Professor	FT	Ph.D.	Pennsylvania State University-1992	9	14	14	Iowa	High	High	High
Mann, J. Adin	Associate Professor	FT	Ph.D.	Pennsylvania State University-1988	2	16	16		Medium	Medium	High
Maxwell, Gregory M.	Associate Professor	FT	Ph.D.	Purdue University-1984	5	20	20		Medium	Medium	Medium
Molian, Palaniappa A.	Professor	FT	Ph.D.	Oregon Graduate Institute of Science & Technology-1982	2	23	23		Low	High	Medium
Nelson, Ron M.	Professor	FT	Ph.D.	Stanford University-1981	3	25	25	Iowa	Medium	Medium	Medium

Name	Rank	FT or PT	Highest Degree	Institution from which Highest	Years of Experience: Govt/Industry Practice	Years of Experience: Total Faculty	Years of Experience: This Institution (ISU)	Professional Registration (Indicate State)	Level of Activity (high, med, low, none) in: Professional Society	Level of Activity: Research	Level of Activity: Consulting/ Summer Work in Industry
*Okiishi, Theodore H.	Assoc. Dean, Engineering	FT	Ph.D.	Iowa State University-1965	4	33	33		High	High	None
Oliver, James H.	Associate Professor	FT	Ph.D.	Michigan State University-1986	5	16	13		Medium	High	High
Olsen, Michael G.	Assistant Professor	FT	Ph.D.	University of Illinois at Urbana-Champaign-1999	0	5	5		Medium	High	None
Pate, Michael B.	Professor	FT	Ph.D.	Purdue University-1982	6	24	24		High	High	Low
Pletcher, Richard H.	Professor	FT	Ph.D.	Cornell University-1966	5	42	39	Iowa	Medium	High	None
Shrotriya, Pranav.	Assistant Professor	FT	Ph.D.	University of Illinois, 2001	0	3	3		Medium	High	None
Starns, Gloria	Lecturer/ME Advising Ctr. Coordinator	FT	Ph.D.	Iowa State University-1996	10	7	7		Medium	None	Low
Subramaniam, Shankar	Assistant Professor	FT	Ph.D.								
Sundararajan, Sriram	Assistant Professor	FT	Ph.D.	Ohio State University-2001	0	4	4		Medium	High	Low
Vance, Judy	Professor and Chair	FT	Ph.D.	Iowa State University-1992	5	21	21		High	High	None
Wilson, David	Professor	PT	Ph.D.	The Johns Hopkins University-1968		23	15		Medium	High	None
Winer, Eliot	Assistant Professor	FT	Ph.D.	University at Buffalo-1999	5	6	2.5		High	High	None
Zou, Qingze	Assistant Professor	FT	Ph.D.	University of Washington, 2003	0	2	2		Medium	High	None

**100% Administration*

Table 5 Support Expenditures Mechanical Engineering

Fiscal Year	1	2	3	4
	2004 (prior to previous year)	2005 (previous year)	2006* (current year)	2007 (year of visit)
Expenditure Category				
Operations[1] (not including staff)	312,931	545,408	302,062	302,062
Travel[2]	14,003	35,810	24,472	24,472
Equipment[3]	380,480	266,287	589,728	589,728
Institutional Funds	69,617	43,774	0	0
Grants and Gifts[4]	310,863	222,513	589,728	589,728
Graduate Teaching Assistants	386,011	346,372	407,949	407,949
Part-time Assistance[5] (other than teaching)	350,255	438,606	184,125	184,125

*The current fiscal year reflects actual expenditures through January 2006 and estimated expenditures through the remaining fiscal-year end.

Instructions:
Report data for the engineering program being evaluated. Updated tables are to be provided at the time of the visit.

Column 1: Provide the statistics from the audited account for the fiscal year completed 2 years prior to the current fiscal year.

Column 2: Provide the statistics from the audited account for the fiscal year completed prior to your current fiscal year.

Column 3: This is your **current fiscal year** (when you will be preparing these statistics). Provide your preliminary estimate of annual expenditures, since your current fiscal year presumably is not over at this point.

Column 4: Provide the budgeted amounts for your next fiscal year to cover the fall term when the ABET team will arrive on campus.

Notes:
1. General operating expenses to be included here.
2. Institutionally sponsored, excluding special program grants.
3. Major equipment, excluding equipment primarily used for research. Note that the expenditures under “Equipment” should total the expenditures for Equipment. If they don’t, please explain.
4. Including special (not part of institution’s annual appropriation) non-recurring equipment purchase programs.
5. Do not include graduate teaching and research assistant or permanent part-time personnel.

Appendix I-B

Course Descriptions

<u>MECHANICAL ENGINEERING</u>

Appendix I-B.1: Required Basic Level Courses

Chem 167. General Chemistry for Engineering Students.

Course Name: Chem 167. General Chemistry for Engineering Students. (Cr. 4)

2005-2007 Catalog Description: Principles of chemistry and properties of matter explained in terms of modern chemical theory with emphasis on topics of general interest to the engineer. This is an accelerated course designed for students with an excellent preparation in math and science and is a terminal course intended for engineering students who do not plan to take additional courses in chemistry. Credit may not be applied toward graduation for both 160 and another chemistry course. Only one of 163, 165, 167, and 177 may count toward graduation. Only one of 155, 163, 167, and 177 may count toward graduation. Credit by examination (test-out exams) for 167 is available only to students who are not currently enrolled in the course.

Prerequisites: Math 140 or the high school equivalent and one year of traditional college prep chemistry or Chem 50

Textbook(s) and/or Other Required Material
Chemistry, by Raymond Chang and Brandon Cruickshank (8th Edition), McGraw-Hill, 2005.

Course Learning Objectives

Topics Covered
Molecules, mass relationships, aqueous solutions, gases, thermochemistry, electrochemistry, quantum chemistry, chemical bonding, liquids and solids, kinetics, equilibrium, acids/bases, nuclear chemistry, atmospheric chemistry.

Class/Laboratory Schedule
Two 50-minute lectures, one 50-minute recitation. Lab not required. If elected, Chem 167L is one 3 hr (170 minute) laboratory.

Contribution of Course to Meeting Professional Component
This is a foundation course, providing the student with the background in chemistry necessary for further professional development.

Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is one component of the chemistry-sciences related outcomes.

Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

EM 274. Statics of Engineering.

Course Name: E M 274. Statics of Engineering. (Cr. 3)

2005-2007 Catalog Description: Vector and scalar treatment of coplanar and noncoplanar force systems. Resultants, equilibrium, friction, centroids, second moments of areas, principal second moments of area, radius of gyration, internal forces, shear and bending moment diagrams.

Prerequisites: Credit or enrollment in Math 166; credit or enrollment in Phys 111 or 221

Textbook(s) and/or Other Required Material
"Engineering Mechanics: Statics." 2nd Edition, by W.F. Riley and L.D. Sturges. John Wiley and Sons, Inc., New York. 1996

Course Learning Objectives
1. Determine the components of a force in rectangular or nonrectangular coordinates.

2. Determine the resultant of a system of forces

3. Draw complete and correct free-body diagrams and write the appropriate equilibrium equations from the free-body diagram.

4. Determine the support reactions on a structure

5. Determine the connection forces in trusses and in general frame structures

6. Determine the internal reactions in a beam, draw correct shear-force and bending moment diagrams, and write equations for the shear-force and bending moment as functions of position along the beam

7. Analyze systems that include frictional forces

8. Locate the centroid of an area

9. Calculate the second moment of an area, calculate the principal second moments of an area.

Topics Covered
Vector algebra, concurrent force systems, particle equilibrium, moments, couples, resultants (2-D) and (3-D), center of Mas, centroid. Composite bodies, distributed loads, free-body diagrams, Equilibrium (2-D) and (3-D), trusses, frames and machines, internal force analysis, beams, shear force and bending moment diagrams, concepts of friction, flexible belts, second moments of area, composite areas, mixed 2nd moments of areas. Principal moments of area, mass moments of inertia.

Class/Laboratory Schedule
Three 50-minute lectures. (One 50-minute 'help session' provided.)

Contribution of Course to Meeting Professional Component
This is a foundation course, providing the student with the background in engineering mechanics for professional engineering with a statics prerequisite.

Relationship of Course to Program Learning Outcomes and Program Educational Objectives
Learning outcome - 3.e "Identify, formulate, solve engineering problems."

Person(s) who Prepared this Description and Date of Preparation
Janet W. Putnam, March 2006

Engl 104. First-Year Composition I.

Course Name: Engl 104. First-Year Composition I. (Cr. 3)

2005-2007 Catalog Description: Introduction to college-level writing strategies with emphasis on critical reading and thinking skills. Six to eight major writing assignments with readings from a variety of sources.

Prerequisites:

Textbook(s) and/or Other Required Material
Odell, Lee, and Katz, Susan M. Writing in a Visual Age. Boston: Bedford/St. Martin’s, 2006. Muth, Marcia F., and Kitalong, Karla Saari. Getting the Picture: A Brief Guide to Understanding and Creating Visual Texts. Boston: Bedford/St. Martin’s, 2004. Faigley, Lester. The Brief Penguin Handbook. New York: Pearson, 2003. Student’s Guide to English 104-105

Course Learning Objectives
The purpose of English 104 is to prepare students for communicating well within their academic courses, as well as for their future career. While most of the course will be devoted to writing, students will also participate in small group discussions, interviewing others, analyzing and creating visual communication, and learning how to compose professional email correspondence.

Topics Covered
Written - Adapting writing to specific purposes and audiences, using organizational strategies, integrating informational sources into an essay, developing strategies to revise their own writing, avoiding errors that distract/confuse the reader, reflect on/evaluate personal communication processes, strengths, goals, and growth. Oral – Interviewing, being an effective member in a small group (listener/contributor), giving brief oral presentations. Visual – Learning appropriate layout formats, analyzing visual communication, and using “visuals” effectively in presentations. Electronic – Using appropriate languages in emails, developing word processing skills (attachments, tables, etc.)

Class/Laboratory Schedule
3 hours lecture/recitation per week.

Contribution of Course to Meeting Professional Component
This is a foundation course, providing the student with the background in communication skills necessary for further professional development. The course has expanded to include oral, visual and electronic skills development.

Relationship of Course to Program Learning Outcomes and Program Educational Objectives
Develops written, oral, visual and electronic communication skills. This course is one component of communication-related outcomes.

Person(s) who Prepared this Description and Date of Preparation
Janet Putnam 2/6/06 - 3/06

Engl 105. First-Year Composition II.

Course Name: Engl 105. First-Year Composition II. (Cr. 3)

2005-2007 Catalog Description: Development of college-level writing strategies with emphasis on arguing a position, analyzing texts, and using primary and secondary sources. Five to seven major writing assignments.

Prerequisites: 104 or exemption from 104; credit for or concurrent enrollment in Lib 160

Textbook(s) and/or Other Required Material
"Everything's an Argument", 3rd Edition. Andrea A. Lunsford, John J. Ruszkiewicz, and Keith Walters. Boston: Bedford/St. Martin's, 2004. "The Brief Penguin Handbook", Lester Faigley, New York: Pearson, 2003. "Student Guide: English 104-105, Iowa State University, Department of English, 2005-2006.

Course Learning Objectives
(See topics covered.)

Topics Covered
Written: Analyze professional writing to assess its purpose, audience, and rhetorical strategies; construct arguments that integrate logical, ethical, and emotional appeals; write source papers analyzing a rhetorical situation and identifying and accurately documenting appropriate source material; avoid distracting on confusing sentence-level errors; reflect systematically upon all of your communication processes, strengths, goals, and growth. Oral: give oral presentations (individually or as team) using effective invention, organization, language, and delivery strategies; be effective team member (contributor, listener, presenter). Visual: Rhetorically analyze visual communication (advertisement, film, etc.) and create visual arguments. Electronic: Rhetorically analyze electronic communication, such as emails or websites.

Class/Laboratory Schedule
Three 50-minute lecture/recitations

Contribution of Course to Meeting Professional Component
This is a foundation course, providing the student with the background in communication skills necessary for further professional development.

Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is one component of communication outcomes.

Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

Engl 314. Technical Communication.

Course Name: Engl 314. Technical Communication. (Cr. 3)

2005-2007 Catalog Description: Theories, principles, and processes of effective written communication in the technical disciplines. Attention to the major strategies for composing technical discourse; techniques of analyzing audiences and writing situations, and for organizing data and information. H. Honors.

Prerequisites: 105, junior classification

Textbook(s) and/or Other Required Material
"Technical Communication" by Rebecca E. Burnett, 5th Edition..

Course Learning Objectives
Understand and apply rhetorical principles to technical communication b. Understand the generic requirements of selected technical documents c. Demonstrate principles of effective document design d. Recognize the influences of organizational settings and communities of practice e. Distinguish one's own disciplinary communication conventions from those of other disciplines f. Participate in the collaborative planning and design of team projects

Topics Covered
Written communication in technical contexts (see above). Informational memo, technical articles, data display, creating a proposal. Working in a team to develop and present a project.

Class/Laboratory Schedule
Three 50-minute lectures/recitations per week.

Contribution of Course to Meeting Professional Component
This is a foundation course, providing the student with the background in teamwork, communication skills, and ethical considerations necessary for further professional development.

Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is one component of learning outcomes related to – a.teamwork b.communication skills c.consideration of engineering in a context of ethics.

Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

Engr 101. Engineering Orientation.

Course Name: Engr 101. Engineering Orientation. (Cr. R)

2005-2007 Catalog Description: Introduction to the College of Engineering and the engineering profession. Considerations in choosing an engineering curriculum. Information concerning university and college policies, procedures, and resources. Opportunities to interact with departments.

Prerequisites:

Textbook(s) and/or Other Required Material

Course Learning Objectives
To introduce students to other engineering students and encourage them to make friends and form study groups, familiarize students with Iowa State University and the College of Engineering, provide them with knowledge and resources to succeed at ISU and beyond, identify potential barriers to success and familiarize students with engineering and the different engineering disciplines.

Topics Covered
Time management, resume writing, learning styles assessment, career development competencies, functions of engineering, Academic Success Center, sessions presented by different engineering 'majors', study abroad opportunities. Students are encouraged to attend the Study Abroad Fair and Career Expo.

Class/Laboratory Schedule
One 50-minute lecture for 15 weeks.

Contribution of Course to Meeting Professional Component
This is a foundation course, providing students with an introduction to the profession of engineering on which to continue further professional development.

Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course contributes to learning outcomes related to life-long learning and engineering applications in a global context.

Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

Engr 160. Engineering Problems with Computer Applications Laboratory.

Course Name: Engr 160. Engineering Problems with Computer Applications Laboratory. (Cr. 3)

2005-2007 Catalog Description: Solving engineering problems and presenting solutions through technical reports. Significant figures. Use of SI units. Graphing and curve-fitting. Flowcharting. Introduction to material balance, mechanics, electrical circuits, statistics and engineering economics. Use of spreadsheet programs to solve and present engineering problems. Solution of engineering problems using computer programming languages. (The honors section includes application of programming to mobile robotics).

Prerequisites: Satisfactory scores on mathematics placement examinations; credit or enrollment in Math 142, 165

Textbook(s) and/or Other Required Material
"Engineering Fundamentals and Problem-Solving", 4th Edition, Eide et al. "Engr 160 & 160H Course Supplement", edited by Martha Selby, 200-2006 (pages in italics).

Course Learning Objectives
1. To develop in students a systematic approach to engineering problem solving. 2. To give students an understanding of an essential set of computer programming skills. 3. To develop in students an understanding of a variety of ways in which a spreadsheet program can be used as a problem solving tool. 4. To increase written communication skills, including the use of graphs and charts. 5. To increase group functioning skills and oral communication skills.

Topics Covered
Engineering presentation/Writing, Engineering solutions, dim., units and significant figures, graphing, Excel graphing, Flowcharting, VBA (Visual Basic) functions, procedures, files, one-dimensional arrays, two-dimensional arrays, Excel VBA applications, Statistics, statistics using Excel, Mechanics (statics), Engineering Economics.

Class/Laboratory Schedule
Two 2-hr lecture/labs

Contribution of Course to Meeting Professional Component
This is a foundation course, providing background in engineering concepts necessary for further professional development.

Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course helps engineering programs meet the following ABET outcomes – an ability apply knowledge of mathematics, science, and engineering, to identify, formulate, and solve engineering problems, to communicate effectively and function on multi-disciplinary teams.

Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

Engr 170. Engineering Graphics and Introductory Design.

Course Name: Engr 170. Engineering Graphics and Introductory Design. (Cr. 3)

2005-2007 Catalog Description: Integration of fundamental graphics, computer modeling, and engineering design. Applications of multiview drawings and dimensioning. Techniques for visualizing, analyzing, and communicating 3-D geometries. Application of the design process including written and oral reports. Freehand and computer methods.

Prerequisites: Satisfactory scores on mathematics placement examinations; credit or enrollment in Math 142

Textbook(s) and/or Other Required Material
This course contributes to learning outcomes related to life-long learning and engineering applications in a global context.

Course Learning Objectives
Represent and control mental images, graphically represent technical designs using accepted standard practices, use plan and solid geometric forms to create and communicate design solutions, solve technical design problems using CAD, communicate graphically using sketches and CAD, apply technical graphics principles to many engineering disciplines, learn the design process through reverse engineering, and apply the design process to an open-ended design problem.

Topics Covered
Introduction to graphics communication; Integrated design and 3-D modeling with CAD; Constraints and construction geometry; 3-D construction, 3-D sweeps, parametric equations, global parameters; assembly modeling; sketching, modeling, and visualization; coordinate space; multiview drawings; pictorial drawings; auxiliary views; section views; dimensioning and tolerancing practices; reading and constructing working drawings; oral/written communication; engineering design process

Class/Laboratory Schedule
Two 2-hour sessions, lecture integrated with laboratory.

Contribution of Course to Meeting Professional Component
Course includes 1 cr. of engineering design, 1 credit of traditional graphics, and 1 credit of computer-aided design.

Relationship of Course to Program Learning Outcomes and Program Educational Objectives
Addresses following ABET criteria. a. An ability to apply knowledge of mathematics, science, and engineering. b. An ability to design a system, component, or process to meet desired needs. c. An ability to function on multidisciplinary teams. d. An understanding of professional and ethical responsibility. e. An ability to communicate effectively. f. Recognition of the need for and an ability to engage in lifelong learning.

Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

Lib 160. Library Instruction.

Course Name: Lib 160. Library Instruction. (Cr. 0.5)

2005-2007 Catalog Description: Use of libraries and information sources, both print and electronic, including locations and services of the University Library with an emphasis on basic library research tools and information literacy concepts. To be taken as early as possible in the student's undergraduate career. See course descriptions of Engl 105 and 105H for prerequisite related to Lib 160.

Prerequisites: for students whose native language is not English: Completion of English 101 requirement

Textbook(s) and/or Other Required Material
"Library 160 Independent Study Manual" Fall 2005. ISU.

Course Learning Objectives
Introduce students to the use of academic and research libraries, available library services, and electronic information resources, with an emphasis on information literacy and research process. This course promotes student self-directed learning and provides a foundation for life-long learning.

Topics Covered
Library Facilities Orientation; Searching the Library Catalog by Author, Title or Subject Heading; Searching the Library Catalog by Keyword; Electronic Indexes to Periodical Literature; Print Indexes to Periodical Literature.

Class/Laboratory Schedule
8 weeks course, Classes begin with the Introductory Lecture (1 hr) : Monday-Friday, the first week. Completion of the course is on an independent basis with assignments due each week and a final exam the last week.

Contribution of Course to Meeting Professional Component
This is a foundation course, providing the student with the background in utilizing library resources necessary for further professional development.

Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is one component of learning outcomes related to life-long learning.

Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

Math 142. Trigonometry and Analytic Geometry.

Course Name: Math 142. Trigonometry and Analytic Geometry. (Cr. 3)

2005-2007 Catalog Description: May be taken concurrently with 140. Trigonometric functions and their inverses, solving triangles, trigonometric identities and equations, graphing, polar coordinates, complex numbers, standard equations of lines and conic sections, parametric equations. Students in the College of Liberal Arts and Sciences may not count Math 140, 141, 142, 149, or 195 toward Group III of the General Education Requirements. Only one of 141, 142 may count toward graduation.

Prerequisites: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of high school geometry, or enrollment in 140

Textbook(s) and/or Other Required Material
Precalculus", by Sullivan, 7th Edition.

Course Learning Objectives
This course is designed to meet the needs of students planning to take Calculus and other courses requiring analytical geometry and numerical aspects of trigonometry.

Topics Covered
Angles and their formulas, trig functions and identities, phase shift, inverse sine cosine and tangent functions, sum and different formulas, product-to-sum and sum-to-product formulas, law of sine and cosine, polar coordinates-equations and graphs, complex plane, DeMoivre's Theorem, conics, parabola, ellipse, hyperbola, rotation of axes, plane curves and parametric equations.

Class/Laboratory Schedule
Two 50-minute lectures, one 50-minute recitation. Also offered "on-line" with two 50-minute 'help sessions' per week.

Contribution of Course to Meeting Professional Component
Prepares students to succeed in upper-level foundation mathematics courses necessary for further professional development.

Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is an additional component of mathematics computation related learning outcomes.

Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

Math 165. Calculus I.

Course Name: Math 165. Calculus I. (Cr. 4)

2005-2007 Catalog Description: Differential calculus, applications of the derivative, introduction to integral calculus. Only one of 151 or 160 or the sequence 165-166, or the sequence 181-182 may be counted towards graduation.

Prerequisites: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of geometry, 1 semester of trigonometry or enrollment in 141 or 142

Textbook(s) and/or Other Required Material
"Calculus" Varberg, Purcell and Rigdon, 8th Edition.

Course Learning Objectives
a. Use graphical and numerical evidence to estimate limits and identify situations where limits fail to exist. b. Apply rules to calculate limits. c. Use the limit concept to determine where a function is continuous. d. Use the limit definition to calculate a derivative or to determine when a derivative fails to exist. e. Calculate derivatives (of first and higher orders) with pencil and paper, without calculator or computer algebra software f. Use the derivative to find tangent lines to curves g. Calculate derivatives of functions defined implicitly h. Interpret the derivative as a rate of change. Solve problems involving rates of change of variables subject to a functional relationship. i. Approximate functions by using linearization (differentials.) j. Find critical points, and use them to locate maxima and minima. k. Use critical points and signs of first and second derivatives to sketch graphs of functions. l. Use differential calculus to solve optimization problems. m. Apply the Mean Value Theorem. n. Use Newton's method to improve approximate roots of equations. o. Find antiderivatives of functions: apply antiderivatives to solve separable first-order differential equations. p. Use the definition to calculate a definite integral as a limit. q. Apply the Fundamental Theorem of Calculus to evaluate definite integrals and to differential functions defined as integrals. r. Calculate elementary integrals with pencil and paper, without calculator or computer algebra software. s. Use the relation between the derivative of a one to one function and the derivative of its inverse. t. Calculate with exponentials and logarithms to any base. u. Use Logarithmic differentiation. v. Use models describing exponential growth and decay.

Topics Covered
Limits, the derivative, applications of the derivative, the integral, and transcendental functions.

Class/Laboratory Schedule
Four 50-minute lectures or three 50-minute lectures, one 50-minute recitation.

Contribution of Course to Meeting Professional Component
This is a foundation course, providing the student with the background in mathematics necessary for further professional development.

Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is one component of the mathematics computation related learning outcomes.

Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

Math 166. Calculus II.

Course Name: Math 166. Calculus II. (Cr. 4)

2005-2007 Catalog Description: Integral calculus, applications of the integral, infinite series. Only one of 151, 160, the sequence 165-166, or the sequence 181-182 may be counted towards graduation.

Prerequisites: Grade of C- or better in 165, 165H, or high math placement scores

Textbook(s) and/or Other Required Material
"Calculus", by Varberg, Purcell and Rigdon. 8th Edition.

Course Learning Objectives
a. Develop problem solving ability and flexibility in using the tools of integral calculus and vectors in problem solving. This includes appropriate use of technology and the ability to use graphical, numerical, and symbolic techniques in investigating problems. b. Understand the definition of the definite integral and use the definition to obtain approximations of integrals c. Evaluate simple integrals by hand, more complicated integrals with the aid of tables and reduction formulas d. Be able to use a calculator or computer to implement a numerical integration procedure (trapezoid rule, midpoint rule, or Simpson's rule.) e. Use a partition-sum approach to model phenomena that can be studied with the integral (work, center of mass, volume, etc.) f. Be able to use vectors to analyze motion in two and three dimensions, including analysis of acceleration in terms of tangent and normal components g. Be able to use vectors to analyze motion in two and three dimensions, including analysis of acceleration in terms of tangent and normal components h. Know the definition of linear function and be able to show that a function is linear (or that it is not.) i. Be able to work with matrices, including representation of linear functions and applications involving determinants j. Understand and be able to work with lines and planes in three dimensions. k. Be able to analyze an equation for a function of two variables and use this analysis to draw a graph or interpret a graph produced by a graphics package. Understand parametric representation of surfaces and, for simple functions, select an appropriate parametric representation (for example, one that would produce a good picture when used in a plotting package.) l. Understand cylindrical and spherical coordinates, their relationship to parametric representations, and be able to sketch graphs of simple functions expressed in these coordinate systems. m. Understand the definition of partial derivative and be able to calculate partial derivatives. n. Be able to calculate and work with the gradient function.

Topics Covered
Applications of the integral, techniques of integration, indeterminate forms and improper integrals, infinite series, conics and polar coordinates.

Class/Laboratory Schedule
Four 50-minute lectures or Three 50-minute lectures and one 50-minuite recitation.

Contribution of Course to Meeting Professional Component
This is a foundation course, providing the student with the background in mathematics necessary for further professional development.

Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is one component of the mathematics computation related learning outcomes.

Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

Math 265. Calculus III.

Course Name: Math 265. Calculus III. (Cr. 4)

2005-2007 Catalog Description: Analytic geometry and vectors, differential calculus of functions of several variables, multiple integrals, vector calculus.

Prerequisites: Grade of C- or better in 166 or 166H

Textbook(s) and/or Other Required Material
"Calculus", Varberg, Purcell and Rigdon, 8th Edition

Course Learning Objectives
1. Develop problem solving ability and flexibility in using the tools of multivariable and vector calculus and series in problem solving. This includes appropriate use of technology and the ability to use graphical, numerical, and symbolic techniques in investigating problems. 2. Know and be able to discuss the definition of differentiability for functions with domain and range in R,, R2, R3. Be able to write the Jacobian matrix for such functions. 3. Understand the statement of the Chain rule for vector-valued functions of several variables and use the chain rule to calculate derivatives and Jacobian matrices for such functions. 4. Be able to model and solve optimization problems for functions of several variables. This includes optimization with constraints and the use of Lagrange multipliers. 5. Understand the definition of multiple integral for real-valued functions of two and three variables. Be able to set up an iterated integral for evaluation of a multiple integral and be able to evaluate iterated integrals. 6. Know the definition of linear function and be able to show that a function is linear (or that it is not.) 7. Be able to work with matrices, including representation of linear functions and applications involving determinants. 8. Understand and be able to work with lines and planes in three dimensions. 9. Be able to construct Taylor polynomials for simple elementary functions. 10. Understand the meaning and importance of error when dealing with approximations, and be able to work with and provide error estimates for approximation with Taylor polynomials. 11. Determine intervals for convergence for power series and construct power series representations for simple elementary functions. 12. Be able to use comparison, integral, ration, and / or alternating series test to analyze

Topics Covered
Geometry and vectors, the derivative in n-Space, the integral in n-Space, vector calculus

Class/Laboratory Schedule
Four 50-minute lectures or Three 50-minute lectures, one 50-minute recitations

Contribution of Course to Meeting Professional Component
This is a foundation course, providing the student with the background in mathematics necessary for further professional development.

Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is a component of mathematics computation related learning outcomes.

Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

Math 267. Elementary Differential Equations and Laplace Transforms.

Course Name: Math 267. Elementary Differential Equations and Laplace Transforms. (Cr. 4)

2005-2007 Catalog Description: Same as 266 but also including Laplace transforms and series solutions to ordinary differential equations.

Prerequisites: Grade of C- or better in 166 or 166H

Textbook(s) and/or Other Required Material
"Elementary Differential Equations and Boundary Value Problems" by W. Boyce and R. DiPrima. 6th edition

Course Learning Objectives
Identify and solve ordinary differential equations and corresponding initial value problems of the following types 1. First order linear 2. First order exact 3. Nth order constant coefficient linear (homogeneous or not) 4. Second order Cauchy-Euler equations b. Use differential equations to model some physical systems and problems, including mass-spring systems. c. Find equilibrium solutions of autonomous first order ordinary differential equations and classify them according to stability. d. Find solutions in the form of power series about an ordinary point for second order linear differential equations. e. Use Laplace transform tables to solve nth order linear constant coefficient equations with forcing functions that involve jump discontinuities and delta functions. f. Convert an ordinary differential equation or system by change of variables to a system of first order equations. g. Solve systems of first order linear differential equations with constant coefficients. h. Find a classify critical points of first order homogeneous constant coefficient systems. i. Identify critical points of nonlinear first order systems, and apply simple classification and stability theorems.

Topics Covered

Class/Laboratory Schedule
Four 50-minute lectures

Contribution of Course to Meeting Professional Component
This is a foundation course, providing the student with the background in mathematics necessary for further professional development.

Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is one component of mathematics computation related learning outcomes.

Person(s) who Prepared this Description and Date of Preparation
Janet Putman - March, 2006

Phys 221. Introduction to Classical Physics I.

Course Name: Phys 221. Introduction to Classical Physics I. (Cr. 5)

2005-2007 Catalog Description: For engineering and science majors. 3 hours of lecture each week plus 3 recitations and 1 laboratory every 2 weeks. Elementary mechanics including kinematics and dynamics of particles, work and energy, linear and angular momentum, conservation laws, rotational motion, oscillations, gravitation. Electric forces and fields. Electrical currents; DC circuits.

Prerequisites: Credit or enrollment in Math 166

Textbook(s) and/or Other Required Material
"Fundamentals of Physics" by Halliday, Resnick, and Walker. In addition, there is a lab manual for the course.

Course Learning Objectives
By the end of the course, students will have gained a. Knowledge and understanding of the basic laws of nature developed over the past 400 years, with particular emphasis on mechanics and electrical phenomena; b. The ability to analyze physics problems, to formulate a logical and systematic approach to their solution, and to solve the problems correctly; c. The ability to carry out physics experiments and to determine the significance of the experimental results.

Topics Covered
Vectors and scalars; Position, velocity, acceleration vectors; Newton's laws of motion; Force diagrams; One-dimensional motion: free fall; Two-dimensional motion; projectiles; Circular motion: kinematics and dynamics; Work and energy; Power. Potential energy; Mechanical energy. Conservation of energy; Energy diagrams. Energy quantization; Linear momentum and its conservation; Elastic collisions in 1 and 2 dimensions; Systems of particles; Postulates of special relativity; Fission and fusion ; Rotational kinematics; Rotational energy, Torque; Angular momentum; Rigid body rotation; Rigid body rotation; Kepler's laws of planetary motion; The Bohr theory of the hydrogen atom; Simple harmonic oscillation; Pendulums; Damped and forced oscillations; Electrostatics: Coulomb's law; Electric fields. Lines of force; Electric flux. Gauss' law; Electric potential; Electric field and electric potential energy.; Capacitance; Energy storage in capacitors. Dielectrics; Electric current and resistance; Electric energy and electric power; Simple DC circuits; RC circuits.

Class/Laboratory Schedule
3 one-hour lectures Monday, Wednesday, Friday mornings. One one-hour recitation (problem-solving) session every Tuesday. In alternate weeks either (1) a second one-hour recitation on Thursday or (2) a two-hour lab that could be on any day of the week.

Contribution of Course to Meeting Professional Component
This is a foundation course, providing the student with the background in physics necessary for further professional development.

Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is one component of the physical -science related learning outcomes.

Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

Phys 222. Introduction to Classical Physics II.

Course Name: Phys 222. Introduction to Classical Physics II. (Cr. 5)

2005-2007 Catalog Description: Magnetic forces and fields: LR, LC, LCR circuits; MaxwellÆs equations; waves and sound; ray optics and image formation; wave optics: heat, thermodynamics, kinetic theory of gases; topics in modern physics.

Prerequisites: 221, Math 166. 3 hours of lecture each week plus 1 recitation and 1 laboratory each week

Textbook(s) and/or Other Required Material
"University Physics, by H.D. Young and R.A. Freedman, 11th Edition. Pearson/Addison Wesley 2004.(Recommended: "University Physics, Student Solutions Manual", A. Lewis Ford, Pearson/Addison Wesley 2004. "Physics 222 Laboratory Manual" available at ISU bookstore.

Course Learning Objectives
By the end of the course, students will have gained a. Knowledge and understanding of the basic laws of nature, with particular emphasis on electromagnetic phenomena and thermodynamics. b. The ability to analyze physics problems, to formulate a logical and systematic approach to their solution, and to solve the problems correctly; c. The ability to carry out physics experiments and to determine the significance of the experimental results.

Topics Covered
Magnetic field, force, torque, moment; Ampere's law, Biot-Savart Law, Faraday's law, Lenz's law, ac generator, induced E field, displacement current, Maxwell's Equations, inductors, magnetic field energy, RL circuits, LC and series LRC circuits, phasors, AC circuits, reactance, driven LRC circuit, power in AC circuits, resonance, transformers, waves (mechanical, periodic, equation, speed, energy, standing, electromagnetic, matter) superposition, interference, wind instruments, resonance, Doppler effect, Poynting vector, radiation pressure, polarization, EM spectrum, light (dispersion, polarization, ray optics, reflection, refraction, total internal reflection, Huygens' Principle), geometric optics, images, magnifier, microscope, telescope, wave optics, thin films, diffraction (single- and multiple-slit, X-ray), photons, nuclear atom, Bohr model of H atom, lasers Schrodinger equation, quantum numbers, Pauli exclusion principle, periodic table, temperature, ideal gases, heat, internal energy, heat engines, refrigerators, second Law of Thermodynamics, Carnot cycle, entropy.

Class/Laboratory Schedule
Three 50-minute lectures, one 50-minute recitation and 1 2-hour laboratory weekly.

Contribution of Course to Meeting Professional Component
This is a foundation course, providing the student with the background in physics necessary for further professional development.

Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is one component of the physical sciences related learning outcomes.

Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

Stat 305. Engineering Statistics.

Course Name: Stat 305. Engineering Statistics. (Cr. 3)

2005-2007 Catalog Description: Statistics for engineering problem solving. Principles of engineering data collection; descriptive statistics; elementary probability distributions; principles of experimentation; confidence intervals and significance tests; one-, two-, and multi-sample studies; regression analysis; use of statistical software; team project involving engineering experimentation and data analysis. Credit for both 105 and 305 may not be applied for graduation.

Prerequisites: Math 165 (or 165H)

Textbook(s) and/or Other Required Material
"Basic Engineering Data Collection and Analysis" by Stephen B. Vardeman and J. Marcus Jobe. (Two handouts as supplements to text.) JMP software which is in many on-campus PC labs and can also be purchased. For ChE section: "Probability and Statistics for Engineering and the Sciences", by Devore, 6th Edition (2004).

Course Learning Objectives
For ChE majors section: To raise the students' statistical knowledge to the level of competent application of statistical methodologies critical to chemical engineering problem solving. (Other syllabus did not state objectives.

Topics Covered
Introduction to engineering statistics, laws of probability. Descriptive statistics, probability distributions: discrete and continuous and single and joint. Linear combinations, propagation of errors, and central limit theorem, data collection. One, two and multi-sample hypothesis testing and confidence intervals. Experimental design. Regression, statistical monitoring charts.

Class/Laboratory Schedule
Two 80 minute lectures per week.

Contribution of Course to Meeting Professional Component
This is a foundation course, providing students with the background in statistics necessary for further professional development.

Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is one component of learning outcomes related to the development of engineering analysis and judgement.

Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

Econ 101. Principles of Microeconomics.

Course Name: Econ 101. Principles of Microeconomics. (Cr. 3)

2005-2007 Catalog Description: Resource allocation, opportunity cost, comparative and absolute advantage. Supply and demand. Marginal analysis. Theories of production and consumption, pricing, and the market system. Perfect and imperfect competition and strategic behavior. Factor markets. Present discounted value.

Prerequisites:

Textbook(s) and/or Other Required Material
"Microeconomics" by Paul Krugman and Robin Wells, 2004. (Different section - "Microeconomics: Principles and Applications", by Robert E. Hall and Marc Lieberman. 2005. 3rd Edition.)

Course Learning Objectives

Topics Covered
a. Fundamental principles of microeconomics including decision making processes of consumers and firms. b. Gains from exchange. c. Role of prices in markets. d. Importance of variable costs versus sunk & fixed costs in decision making. e. Social gains from competition. f. Causes & effects of imperfect competition. g. Role of government regulation.

Class/Laboratory Schedule
Three 50 minute lectures.

Contribution of Course to Meeting Professional Component
This is a foundation course, providing the student with the background in economics necessary for further professional development.

Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is one component of learning outcomes related to development of a student's awareness of the impact of engineering in an economic context.

Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

Econ 102. Principles of Macroeconomics.

Course Name: Econ 102. Principles of Macroeconomics. (Cr. 3)

2005-2007 Catalog Description: Measurement of macro variables and general macro identities. Classical models of full employment. Production and growth. Savings and investment. Employment and unemployment. Money, inflation, and price levels. Operation of the U.S. banking system. Fiscal and monetary policy. Elements of international finance.

Prerequisites: 101 recommended

Textbook(s) and/or Other Required Material
"Principles of Macroeconomics" by Robert Frank and Ben Bernanke" (Different section) or "Macroeconomics" 9th edition by William Baumol and Alan Binder.

Course Learning Objectives

Topics Covered
Cost and benefits, supply and demand, measurement: production and unemployment, measurement: prices and interest rates, economic growth, long run labor market trends, saving and investment, money banking and financial markets, economics fluctuations, international trade, international capital flows.

Class/Laboratory Schedule
Three 50-minute lectures

Contribution of Course to Meeting Professional Component
This is a foundation course, providing the student with the background in economics necessary for further professional development.

Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is one component of learning outcomes related to development of a student's awareness of the impact of engineering in an economic context.

Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

EE 442. Introduction to Circuits and Instruments

Course (catalog) description

Basic circuit analysis using network theorems with time domain and Laplace transform techniques for resistive, resistive-inductive, resistive-capacitive, and resistive-inductive-capacitive circuits. Transient circuit behavior. Basic operational amplifiers and applications. Familiarization with common E E instrumentation and demonstration of basic principles.

Prerequisite(s)

Phys 222, Introduction to Classical Physics II; Math 267, Elementary Differential Equations and Laplace Transforms.

Textbook(s) and/or other required material

1. Hambley, Allan R., *ELECTRICAL ENGINEERING Principles & Applications*, 1st Ed., Prentice Hall, 1997.
2. Nilsson, J., *Electric Circuits*, (Ch 15 & 16), 4th Ed, Addison Wesley, 1993. (ISU CourseWorks reprint)
3. Patterson, R., *Lab Manual, EE 442, Introduction to Circuits and Instruments*, ISU CourseWorks, 1999.

Course objectives

After taking this course students will be able to:

- Define current, voltage, and power, including applicable units; calculate power and energy and determine whether energy is supplied or absorbed by a circuit element; state and apply basic circuit laws, Kirchhoff's Voltage Law (KVL) and Kirchhoff's Current Law (KCL); and, solve for currents, voltages, and powers in simple circuits using KVL and KCL.
- Solve for any designated circuit voltage or current (solve the circuit) by the following resistive circuit analysis techniques: series and parallel resistance reductions; voltage division and current division; node voltage (including super nodes); mesh current (including super meshes); source transformations (Thevenin and Norton) including maximum power determination; and, superposition.
- Find the current or voltage for a capacitor or inductor given the corresponding voltage or current, respectively, as a function of time; compute the power supplied to and energy stored in a capacitor or inductor.
- Write and solve (by the method of undetermined coefficients) differential equations for first order circuits; find and sketch the transient response of switched-DC, first order circuits by the initial-value/final-value/time-constant method.
- Apply Laplace functional and operational transforms to solve differential and integro-differential equations; transform circuits into the Laplace domain using appropriate capacitor and inductor models (with or without initial conditions); solve circuits using Laplace transforms (including overdamped, critically damped and underdamped, second order circuits).
- List the characteristics of ideal op amps; identify op amp circuits with negative feedback; analyze ideal op amp circuits (with negative feedback) using the ideal op amp approximations, including integrating and differentiating op amp circuits; design simple op amp circuits.
- Operate and take accurate measurements with typical EE instruments such as an oscilloscope (analog), current and voltmeters (powered and nonpowered), signal sources, and power supplies; recognize instrument loading effects and calculate corrected (unloaded) values; build and troubleshoot simple circuits; demonstrate selected EE principles such as superposition, maximum power transfer, etc.

Topics covered

Class Topics:

- Basic definitions (current, voltage, power, units) - 1 week
- Basic circuit analysis laws (KVL, KCL) - 1 week
- Resistive circuit analysis (circuit reduction, voltage and current division, node voltage analysis, mesh current analysis, source transformations and maximum power transfer, superposition) - 1 week
- Capacitor and inductor properties - 1 week
- General circuit analysis by differential equations methods - 1 week
- General circuit analysis by Laplace Transform methods - 1 week

- Operational amplifier circuit analysis and simple design - 1 week
- Operation of basic EE instrumentation - 1 week

Laboratory Topics:
- Introduction to the Function Generator Cathode Ray Oscilloscope Video Tape
- Introduction to the Cathode Ray Oscilloscope
- Introduction to the Measurement of Voltage, Current, Resistance, and Frequency; and Voltmeter Loading
- Introduction to Thevenin's Theorem and Maximum Power Transfer
- Step Response of RL Circuit
- Step Response of RLC Circuit
- Introduction to Operational Amplifiers

Class/laboratory schedule, i.e., number of sessions each week and duration of each session

Three one-hour class sessions per week for eight weeks.
One three-hour laboratory session per week for eight weeks.

Contribution of course to meeting the professional component

Engineering Topics: 2 credits

Relationship of course to program objectives

This course addresses the following program objectives:
- Students will attain the basic knowledge required to understand and analyze mechanical engineering systems.
- Students will be able to apply engineering principles to create, analyze or improve processes, devices or systems to accomplish desired objectives.
- Students will learn to effectively work in teams to solve engineering problems involving a disciplined process of critical thinking that crosses content boundaries.

Person(s) who prepared this description and date of preparation

Bartlett; March 9, 2006.

EE 448. Introduction to AC Circuits and Motors

Course (catalog) description

Magnetic circuits. Power transformers. AC steady state and three-phase circuit analysis. Basic principles of operation and control of induction and single-phase motors.

Prerequisite(s)

EE 442, Introduction to Circuits and Instruments.

Textbook(s) and/or other required material

Hambly, A., *Electrical Engineering Principles and Applications*, Prentice Hall.

Course objectives

After taking this course students will be able to:

- Identify the frequency, angular frequency, peak value, rms value and phase of a sinusoidal signal.
- Compute power for steady state ac circuits. Find Thevenin and Norton equivalent circuits. Determine load impedance for maximum power transfer.
- Solve balanced three phase circuits.
- Apply magnetic circuit concepts to determine the magnetic fields in practical devices.
- Find hysteresis, and eddy currents loss in cores composed of magnetic materials.
- Understand ideal transformers. Use the equivalent circuits of real transformers to determine their voltage regulation and power efficiencies.
- Understand the concept of the rotating magnetic field.
- Understand the basic operation of a three-phase induction motor. For this motor, find the input power, air gap power, mechanical power developed, rotor copper loss, stator copper loss and torque developed. Find also the maximum torque and starting torque.
- Understand the concept of torque production in single-phase AC motors through auxiliary windings. Understand the operation of capacitor start and capacitor run single-phase motors, shaded pole motors, and stepper motors.

After taking this laboratory students will be able to:

- Follow safe procedures for working with high voltages and currents. Demonstration of electrical safety through a video.
- Complete pre-lab exercises and find their relation to lab experiments.
- Conduct practical experiments related to sinusoidal analysis, three-phase circuits, core loss, three-phase induction motor, and single-phase motors.
- Plan for, document, and report experimental work.

Class/laboratory schedule, i.e., number of sessions each week and duration of each session

Three one-hour class sessions per week for eight weeks.
One two-hour laboratory session per week for eight weeks.

Contribution of course to meeting the professional component

Engineering Topics: 2 credits

Relationship of course to program objectives

This course addresses the following program objectives:

- Students will attain the basic knowledge required to understand and analyze mechanical engineering systems.
- Students will be able to apply engineering principles to create, analyze or improve processes, devices or systems to accomplish desired objectives.
- Students will learn to effectively work in teams to solve engineering problems involving a disciplined process of critical thinking that crosses content boundaries.

Person(s) who prepared this description and date of preparation

Bartlett; March 9, 2006.

ME 231. Engineering Thermodynamics I.

Course (catalog) description

Fundamental concepts based on zeroth, first and second laws of thermodynamics. Properties and processes for ideal gases and solid-liquid-vapor phases of pure substances. Applications to vapor power cycles.

Prerequisite(s)

Math 265, Calculus III; Chem 167, General Chemistry for Engineering Students; Phys 222, Introduction to Classical Physics II

Textbook(s) and/or other required material

1. Moran, M. and Shapiro, H., *Fundamentals of Engineering Thermodynamics*, Fifth Edition, John Wiley and Sons, 2004.
2. Shapiro, H., Van Gerpen, J., and Bathie, W., *Property Tables and Figures for Engineering Thermodynamics*, John Wiley Custom Services, 2000.

Course objectives

1. Use thermodynamic terminology and concepts appropriately.
2. Define appropriate system boundaries for analyzing a variety of thermodynamic components and systems.
3. Determine and calculate the appropriate energy transfers and system properties to solve closed system processes and cycles.
4. Determine and calculate the appropriate mass and energy transfers and properties to solve steady flow open system applications with any number of heat, work, or mass flows crossing the system boundary.
5. Determine and calculate appropriate mass and energy transfers and properties to solve transient open system applications.
6. Use tables, charts, equations, and software to fix states of a pure substance and determine relationships among pressure, temperature, specific volume, internal energy, enthalpy, and entropy.
7. Determine when a process is reversible, irreversible, or impossible.
8. Calculate states and performance parameters for vapor power cycles based on the Rankine cycle with superheat, reheat, and regeneration.
9. Appreciate thermodynamics in the context of contemporary issues and the interplay of technological, social, and political factors in resolving or exacerbating problems facing society.

Topics covered

- Definition of units and thermodynamic quantities (3 days)
- First law concepts applied to closed systems (6 days)
- Property evaluations for generalized thermodynamic substances and ideal gases (8 days)
- Energy and mass analysis for control volumes (9 days)
- Second law of thermodynamics (4 days)
- Entropy evaluations (9 days)
- Vapor power systems (6 days)

Class/laboratory schedule, i.e., number of sessions each week and duration of each session

Three one-hour class sessions per week

Contribution of course to meeting the professional component

Engineering Topics with Design: 3 credits

Relationship of course to the program objectives

<u>This course addresses the following program objectives:</u>

- Students will attain the basic knowledge required to understand and analyze mechanical engineering systems.
- Students will be able to apply engineering principles to create, analyze or improve processes, devices or systems to accomplish desired objectives.
- Students will be aware of social and environmental aspects of engineering, as well as the ethical standards of the engineering profession.

Person who prepared this description and date of preparation

Nelson, February 10, 2006

ME 270. Introduction to Mechanical Engineering Design.

Course (catalog) description

Introduction to fundamentals of mechanical engineering design with applications to thermal and mechanical systems. Examination of existing machines and systems. Team-based projects, open- ended problems and prototyping. Application of engineering tools. Oral and written reports required.

Prerequisite(s)

Engr 170, Graphics and Introductory Design; Phys 221, Introduction to Classical Physics I

Textbook(s) and/or other required material

All class materials are available via WebCT. There is no required textbook.

Course objectives

1. Introduce the student to all aspects of the design process, e.g., conceptualization, synthesis, analysis, fabrication.
2. Train the students in the tools required to facilitate the design process, e.g., group dynamics, teamwork, creativity.
3. Provide opportunities for students to develop oral and written communication skills.
4. Introduce the student to professional practice, e.g., ethics, legal issues, intellectual property.

Topics covered

1. Identify a relevant design concept
2. Perform analysis to target a specific business market
3. Work in a industry simulated engineering team with different management levels
4. Create, rank, and eventually satisfy a list of design goals for the developed product
5. Use a wide variety of creative thinking methods and tools to develop unique, meaningful, and viable design options
6. Incorporate appropriate analysis and optimization tools into the design process
7. Schedule and plan multi-faceted tasks, coordinating disparate groups to complete the project
8. Demonstrate an understanding of ethics, patents, and legal issues in the design process
9. Assess the functional fitness of the final prototype to meet design criteria
10. Present technical material using appropriate written, oral, and graphical techniques
11. Plan for continuous improvement through future design iterations

Class/laboratory schedule, i.e., number of sessions each week and duration of each session

Sec.	Time	Professor	Office	Phone	Email
A	8-10	Dr. Greg Maxwell	Black 3029	4-8645	gmaxwell@iastate.edu
B	10-12	Dr. Angran Xiao	Black 2030	4-1640	axiao@iastate.edu
E	1-3	Dr. Pranav Shrotriya	Black 3023	4-9719	schrotriy@iastate.edu
F	3-5	Dr. Angran Xiao	Black 2030	4-1640	axiao@iastate.edu

Contribution of course to meeting the professional component

Engineering Topics with Design: 3 credits

Person(s) who prepared this description and date of preparation

Oliver, February 13, 2006

ME 324. Manufacturing Engineering

Course (catalog) description

Plastic deformation and work hardening. Manufacturing processes including forming, machining, casting and welding with emphasis on manufacturing considerations in design. Modern manufacturing practices. Laboratory exercises will be an integral component of the course.

Prerequisite(s)

ME 270, Introduction to Mechanical Engineering Design; Mat E 272, Principles of Materials Science and Engineering; EM 324, Mechanics of Materials

Textbook(s) and/or other required material

3. Kalpakjian, S. and Schmid, S., *Manufacturing Processes for Engineering Materials*, Fourth Edition, Prentice Hall, 2004
4. Laboratory Manual on *Teksoft Milling*

Course objectives

After taking this course students will be able to:

1. Identify the capabilities and limitations of different manufacturing processes in terms of their feasibility, capital needs, economic considerations, etc.
2. Plan sequentially the steps in processing a part taking into account the geometrical complexity, process capabilities, surface finish, and tolerances for assembly
3. Analyze the feasibility of manufacturing processes in terms of the material properties, capital equipment needs, worker skill, and ecological considerations
4. Analyze the effect of a manufacturing process on the properties of the end product including surface integrity and residual stresses
5. Apply the design and manufacturing integration approach to produce quality product at minimum cost
6. Use teamwork to produce a part by reverse engineering and for communication of results

Topics covered

- Tensile Test**:** Mechanical properties of materials including tensile, hardness, impact and fatigue
- Casting**:** Solidification phenomena, cast structures, castability of materials, casting defects, casting processes, design the casting process for fabrication of a part, AFS solidification software for casting design
- Welding**:** Arc, resistance and special welding processes, weldability of different materials, effect of welding on microstructure and mechanical properties, weld distortion and residual stresses, weldment design, robotic arc welding
- Forming**:** Work-hardening behavior of materials, effect of cold-working on mechanical properties, analysis of processes such as forging, extrusion, wire drawing, etc. by ideal work and slab methods, design forming sequence involving cold working and annealing concepts, sheet metal forming sequence of operations in compound and progressive dies, and forming limit diagrams
- Machining: Cutting parameters and their effect on chip formation, heat build-up, and surface integrity, selection of proper cutting conditions, calculation of cutting power requirements, cutting tool materials, tool geometry on cutting conditions and surface finish. Machinability, economics of machining, CNC program for making a part, and the capabilities of numerical, adaptive, and robotic controls as applied to manufacturing.

Class/laboratory schedule, i.e., number of sessions each week and duration of each session

Three one-hour class sessions per week
One two-hour laboratory session per week

<u>Laboratory schedule</u>

- Casting processes such as sand casting, lost foam and investment casting
- Welding processes such as oxyacetylene welding, arc welding – different kinds, robotic welding, spot welding
- Coldworking and annealing treatments, forging, extrusion and bending
- Machining operations and cutting tools, surface roughness measurement

- Group project involving CNC machining with project written report

Contribution of course to meeting the professional component

Engineering Topics with Design: 4 credits

Relationship of course to program objectives

This course addresses the following program objectives:

- Students will attain the basic knowledge required to understand and analyze mechanical engineering systems
- Students will be able to apply engineering principles to create, analyze or improve processes, devices or systems to accomplish desired objectives
- Students will develop engineering judgment through open-ended problems that require establishment of reasonable engineering assumptions and realistic constraints
- Students will not only be able to apply their engineering knowledge to real-life design problems but also to critically evaluate the solutions

Person(s) who prepared this description and date of preparation

Molian, February 7, 2006

ME 325. Machine Design

Course (catalog) description

Philosophy of design and design methodology. Consideration of stresses and failure modes useful for static and fatigue loading. Analysis, selection and synthesis of machine elements.

Prerequisite(s)

Engr 170, Engineering Graphics and Introductory Design; EM 324, Mechanics of Materials; Stat 305, Engineering Statistics.

Textbook(s) and/or other required material

Shigley, Mischke and Budynas, *Mechanical Engineering Design*, 7^{th} edition, McGraw-Hill, 2004

Course objectives

Upon completion of ME 325, students should be able to:

1. Apply design theory and methodology to the task of generating design alternatives.
2. Identify the functional characteristics of various machine elements.
3. Evaluate design alternatives using a utility function.
4. Design or select bearings, gears and shafts for a specific application.
5. Apply static and fatigue failure theories to the design of machine components.
6. Work effectively with team members in achieving final design results.
7. Communicate design results in written and oral reports.
8. Appreciate mechanism and machine design in the context of contemporary issues and the interplay of technological, social, and political factors in resolving or exacerbating problems facing society.

Topics covered

- Machine element failure theories (static and fatigue)
- Design/select specific machine elements
- Shafts
- Bearings
- Gears
- Team-based design project

Class/laboratory schedule, i.e., number of sessions each week and duration of each session

Three one-hour class sessions per week

Contribution of course to meeting the professional component

Engineering Topics with Design: 3 credits

Relationship of course to program objectives

This course addresses the following program objectives:

- Students will attain the basic knowledge required to understand and analyze mechanical engineering systems.
- Students will be able to apply engineering principles to create, analyze or improve processes, devices or systems to accomplish desired objectives.
- Students will develop engineering judgment through open-ended problems that require establishment of reasonable engineering assumptions and realistic constraints.
- Students will not only be able to apply their engineering knowledge to real-life design problems but also to critically evaluate the solutions.
- Students will learn to effectively work in teams to solve engineering problems involving a disciplined process of critical thinking that crosses content boundaries.

Person(s) who prepared this description and date of preparation

Flugrad; February 20, 2006

ME 332. Engineering Thermodynamics II

Course (catalog) description

Gas power cycles. Fundamentals of gas mixtures, psychrometry, and thermochemistry. Applications to one dimensional compressible flow, refrigeration, air conditioning and combustion processes.

Prerequisite(s)

ME 231, Engineering Thermodynamics I

Textbook(s) and/or other required material

1. Moran, M. and Shapiro, H., *Fundamentals of Engineering Thermodynamics*, Fifth Edition, John Wiley and Sons, 2004.
2. Shapiro, H., Van Gerpen, J., and Bathie, W., *Property Tables and Figures for Engineering Thermodynamics*, John Wiley Custom Services, 2000.

Course objectives

<u>After taking this course students will be able to:</u>

1. Calculate states and performance parameters for gas power cycles based on the Otto, Diesel, and Brayton cycles.
2. Explain important phenomena and do calculations for the steady flow of compressible fluids. The flows studied will include variable area isentropic flows, constant area flows with friction and heat transfer, and normal shocks.
3. Compute COPs and power requirements for simple vapor compression cycle refrigeration systems. These systems will include split evaporators and multiple compressors with intercooling.
4. Determine properties for ideal gas mixtures including the equation of state, u, h, and s and perform energy and mass balances for processes using nonreactive gas mixtures. Students will use commercially available computer software to analyze properties and compare design scenarios.
5. Calculate the common psychrometric properties associated with air-water vapor mixtures and use these properties in mass and energy balances to analyze and design heating, ventilating, and air conditioning processes.
6. Apply mass and energy balances on chemically reacting systems to analyze and design combustion processes. Students will be able to relate the heat transfer and exit (or final) temperature so that given one, they will be able to calculate the other.
7. Determine equilibrium states and system composition for chemically reacting gas-phase systems, including air pollution formation.
8. Design and analyze thermodynamic systems.
9. Communicate the results of a system analysis.
10. Appreciate thermodynamics in the context of contemporary issues and the interplay of technological, social, and political factors in resolving or exacerbating problems facing society.

Topics covered

- Gas power cycles (5 days)
- 1-D compressible flow (7 days)
- Jet engines (2 days)
- Shocks (4 days)
- Refrigeration (5 days)
- Gas mixtures (3 days)
- Psychrometrics (8 days)
- Combustion (11 days)

Class/laboratory schedule, i.e., number of sessions each week and duration of each session

Three one-hour class sessions per week

Contribution of course to meeting the professional component

Engineering Topics with Design: 3 credits

Relationship of course to program objectives

This course addresses the following program objectives:

- Students will attain the basic knowledge required to understand and analyze mechanical engineering systems.
- Students will be able to apply engineering principles to create, analyze or improve processes, devices or systems to accomplish desired objectives.
- Students will develop engineering judgment through open-ended problems that require establishment of reasonable engineering assumptions and realistic constraints.
- Students will not only be able to apply their engineering knowledge to real-life design problems, but also to critically evaluate the solutions.
- Students will learn to effectively work in teams to solve engineering problems involving a disciplined process of critical thinking that crosses content boundaries.
- Students will be aware of social and environmental aspects of engineering, as well as the ethical standards of the engineering profession.

Person who prepared this description and date of preparation

Nelson, February 10, 2006

ME 335. Fluid Flow

Course (catalog) description

Incompressible and compressible fluid flow fundamentals. Dimensional analysis and similitude. Internal and external flow applications. Lab experiments emphasizing concepts in thermodynamics and fluid flow.

Prerequisite(s)

Engineering Mechanics 345, Math 267

Corequisite(s)

Mechanical Engineering 332, Mechanical Engineering 370

Textbook(s) and/or other required material

Munson, Young, & Okiishi, *Fundamentals of Fluid Mechanics*, 2005 (5th Ed.)

Course Objectives

General Objectives - the purpose of ME 335 is:

1. Enable students to recognize different categories of fluid flow.
2. Enable students to simplify and formulate solutions to fluid flow problems.
3. Provide the student with tools to solve fluid flow problems.
4. Enable student to appreciate distinction between ideal and real world problems.
5. Provide student with a working knowledge of fluid instrumentation.

Specific Objectives - upon completion of ME 335, students should be able to:

1. Identify the following types of fluid flow problems: internal vs. external, steady vs. unsteady, viscid vs. inviscid, and compressible vs. incompressible.
2. Analyze demonstrations and/or perform experiments to understand different flow regimes (e.g., laminar vs. turbulent pipe flow, rotational vs. irrotational flow). Students will be able to apply data analysis techniques, including curve fits, root finding, extremization, statistics, and propagation of error, to experimental data obtained from fluid flows.
3. Understand in depth the fundamental physical concepts of fluid forces (body, surface, inertial), momentum transfer, viscosity, stress, deformation, vorticity, streamlines, streaklines and pathlines.
4. Understand advanced mathematical concepts of material derivative, Eulerian and Lagrangian reference systems, fluid acceleration, and velocity and pressure fields.
5. Apply the physical principles of mass, momentum, and energy balance using integral and differential methods as appropriate to model specific fluid flow problems including: hydrostatics, potential flows, pipe flows, boundary layer flows, drag-lift and thrust problems.
6. Determine relevant dimensionless parameters in a fluid flow problem using the Buckingham Pi Theorem and/or model equations; to carry out order of magnitude estimates to determine relevance of variables; and to use dimensional analysis to correlate data and to perform model studies (scaling).
7. Solve elementary fluid flow models either by (i) analytically solving model differential equations, (ii) numerically solving model differential equations, or (iii) using pre-existing known solutions (includes experimental results presented in generalized tables and figures).
8. Work in a team environment and communicate technical topics.
9. Appreciate fluid dynamics in the context of contemporary issues and the interplay of technological, social, and political factors in resolving or exacerbating problems facing society.

Topics covered

- Definition of units and fluid and thermodynamic properties (2 days)
- Hydrostatic (fluid statics) (3 days)
- Bernoulli Equation (3 days)
- Reynolds Transport Theorem (1 day)
- Integral analysis of fluid flow (5 days)
- Dimensional Analysis and Similitude (4 days)
- Differential analysis of fluid flow (5 days)
- Pipe flow (6 days)
- External flows, boundary layers (5 days)
- Ideal fluid flow (3 days)
- Lift and Drag (3 days)

Class/laboratory schedule, i.e., number of sessions each week and duration of each session

Three one-hour class sessions per week

Contribution of course to meeting the professional component

Engineering Topics with Design: 3 credits

Relationship of course to the program objectives

This course addresses the following program objectives:

- Students will attain the basic knowledge required to understand and analyze mechanical engineering systems.
- Students will be able to apply engineering principles to create, analyze or improve processes, devices or systems to accomplish desired objectives.
- Students will develop engineering judgment through open-ended problems that require establishment of reasonable engineering assumptions and realistic constraints.
- Students will learn to effectively work in teams to solve engineering problems involving a disciplined process of critical thinking that crosses content boundaries.
- Students will be aware of social and environmental aspects of engineering, as well as the ethical standards of the engineering profession.

Person(s) who prepared this description and date of preparation

Olsen, February 21, 2006

ME 370. Engineering Measurements and Instrumentation

Course (catalog) description

Fundamentals of design, selection, and operation of components of measuring systems. Measurement processes, data acquisition systems, analysis of data, and propagation of measurement uncertainty.

Prerequisite(s)

EE 442, Introduction to Circuits and Instruments; Stat 305, Engineering Statistics

Textbook(s) and/or other required material

1. Figliola, R.S. and Beasley, D.E., *Theory and Design for Mechanical Measurements*, Third Edition, John Wiley & Sons, Inc., New York, 2000 (and the accompanying MATLAB software files)
2. ME 370 Laboratory Manual (available through WebCT and in the ME 370 Lab)
3. Additional notes, tutorials, and examples will be made available through WebCT

Course objectives

Upon completion of ME 370, the student will be able to:

1. Recognize basic measurement systems and identify basic terms related to measuring instruments and the measurement process.
2. Obtain theoretical knowledge and practical experience of various sensors such as: variable resistance and capacitance devices, strain gauges, thermocouples, and accelerometers.
3. Recognize a sensor and/or transducer system's dynamic limitations by learning how to identify first-order and second-order behavior, and to characterize damping and frequency response.
4. Understand the role of signal conditioning in enhancing measurements by experimenting with active and passive noise filters and operational amplifiers.
5. Use computers and software to control instruments, perform/automate data acquisition, manipulate data, and graphically present results.
6. Establish rigorous data treatment procedures by applying statistical and error propagation methods to experimental results.
7. Synthesize theoretical knowledge with the experience gained in the laboratory to perform measurements.
8. Develop effective communications skills by engaging in verbal interaction with team members and by submitting succinct and descriptive written reports.
9. Appreciate measurement and instrumentation in the context of contemporary issues and the interplay of technological, social, and political factors in resolving or exacerbating problems facing society.

Topics covered:

Lectures:

- Instrumentation for measurements (2 days)
- Probability and statistics of measurement data (2 days)
- Uncertainty analysis and error propagation (2 days)
- System dynamics and behavior (4 days)
- Signal analysis, sampling and digital devices (4 days)
- Analog components of measurement systems (4 days)
- Sensors and transducers (temperature, strain, acceleration, pressure) (7 days)

Labs:

- Lab 1 - Equipment overview
- Lab 2 - Equipment overview and LabVIEW introduction
- Lab 3 - Probability and statistics
- Lab 4 - Calibration and uncertainty analysis
- Lab 5 - System dynamics: 1st and 2nd order response
- Lab 6 - Signal analysis and sampling

- Lab 7 - Op amps
- Lab 8 - Noise
- Lab 9 - Accelerometers
- Lab 10 - Strain gauges

Class/laboratory schedule, (number of sessions each week and duration)

Two one-hour class sessions per week
One three-hour laboratory session per week

Contribution of course to meeting the professional component

Engineering Topics: 3 credits

Relationship of course to the program objectives

This course addresses the following program objectives:

- Students will attain the basic knowledge required to understand and analyze mechanical engineering systems.
- Students will be able to apply engineering principles to create, analyze or improve processes, devices or systems to accomplish desired objectives.
- Students will develop engineering judgment through open-ended problems that require establishment of reasonable engineering assumptions and realistic constraints.
- Students will learn to effectively work in teams to solve engineering problems involving a disciplined process of critical thinking that crosses content boundaries.
- Students will be aware of social and environmental aspects of engineering, as well as the ethical standards of the engineering profession.

Person who prepared this description and date of preparation

Sundararajan, January 20, 2006

ME 415. Mechanical Systems Design

Course (catalog) description

Solution of a total design problem involving a mechanical system, documenting decisions concerning form and function, material specification, manufacturing methods, safety, cost and conformance with codes and standards. Solution description includes oral and written reports.

Prerequisite(s)

ME 324, Manufacturing Engineering; ME 325, Machine Design

Textbook(s) and/or other required material

Product Design, Otto, Kevin and Wood, Kristen, Prentice Hall, 2001

Course objectives

After taking this course students will be able to:

1. Design one or more machines or assemblies that emphasize mechanical systems. Plan the sequential steps required in the overall design process.
2. Present results of the design process in written and oral form. Provide documentation of form and function, materials, manufacturing methods, safety, costs, assembly methods, serviceability, and conformance with codes and standards.
3. Use computer aided engineering techniques throughout the design process.
4. Apply concurrent engineering methods in the overall aspects of the design process.
5. Apply knowledge from fields other than mechanical, as needed, to design a complete and satisfactory machine or assembly.
6. Consult and work with industry and business personnel to achieve a final satisfactory design.
7. Work as part of a team to produce the desired results.
8. Evaluate and incorporate safety, economic, social, environmental, and legal considerations in the design process. Understand the impact of ethics, ergonomics, manufacturing, maintenance, and standards in developing credible products.

Topics covered

- Use of CAD to develop solid models
- Finite element analysis
- Project scheduling
- Economic and cost considerations
- Design for manufacturing
- Development of professional oral and written reports

Class/laboratory schedule, i.e., number of sessions each week and duration of each session

Three two-hour laboratory sessions per week or two three-hour laboratory sessions per week

Contribution of course to meeting the professional component

Engineering Topics with Design: 3 credits

Relationship of course to program objectives

This course addresses the following program objectives:

- Students will attain the basic knowledge required to understand and analyze mechanical engineering systems.
- Students will be able to apply engineering principles to create, analyze or improve processes, devices or systems to accomplish desired objectives.
- Students will develop engineering judgment through open-ended problems that require establishment of reasonable engineering assumptions and realistic constraints.
- Students will not only be able to apply their engineering knowledge to real-life design problems but also to critically evaluate the solutions.

- Students will learn to effectively work in teams to solve engineering problems involving a disciplined process of critical thinking that crosses content boundaries.
- Students will be aware of social and environmental aspects of engineering, as well as the ethical standards of the engineering profession.
- Students will develop an understanding of the societal context in which they will practice engineering, including environmental, legal, aesthetic, and human aspects.

Person(s) who prepared this description and date of preparation

Flugrad, February 20, 2006

ME 421. Mechanical Systems and Control

Course (catalog) description

Modeling and simulation of mechanical systems. Development of equations of motion and dynamic response characteristics. Fundamentals of classical control applications including mathematical analysis and design for closed-loop control systems. Introduction to computer interfacing for data acquisition and control. Laboratory exercises for hands-on motion and control implementation. Non-major graduate credit.

Prerequisite(s)

Engineering Mechanics (EM) 345, Math 267, Electrical Engineering (EE) 442, EE448

Textbook(s) and/or other required material

Ogata, K., *System Dynamics*, Prentice Hall, Fourth Edition

Course objectives

After completion of this course student should be able to:

1. Define a suitable set of variables that describe the dynamics of a system and construct a simplified mathematical description using idealized elements.
2. Use the basic element and interconnection laws to develop a mathematical model based on the ordinary differential equations governing the motion of the system.
3. Determine the equilibrium conditions for non-linear systems and obtain a linearized model.
4. Arrange the governing differential equations of the model in a form that is suitable for computer simulation. Program the simulation for both linear and nonlinear models. Analyze the results of the simulation to assure appropriate behavior of the system.
5. Solve directly for the time-domain response of a first- or second-order system.
6. Identify and analyze modes and natural frequencies of 2 degrees-of-freedom systems.
7. Use Laplace transforms as a tool to find the complete time response for a model, determine the transfer function, identify system poles and zeros, and analyze stability and evaluate time constants, damping ratios, and system natural frequencies.
8. Use the system transfer function to find steady-state response to constant or sinusoidal input.
9. Use block diagrams to represent the system schematically.
10. Work together to document the activity and results of laboratory exercises.
11. Appreciate mechanical systems and control in the context of contemporary issues and the interplay of technological, social, and political factors in resolving or exacerbating problems facing society.
12. Acquire an understanding of the ethical and professional responsibilities of engineers
13. Be able to obtain mathematical models of simple systems involving mechanical, electrical, electromechanical, pneumatic, and fluid components using classical modeling techniques and modern simulation tools.
14. Be able to write numerical simulation codes for response calculations and analyze open-loop behavior of first- and second-order dynamic systems.
15. Be able to obtain linearized models of nonlinear systems.
16. Have proficiency in using commercial simulation software (MATLAB) for modeling and simulation of linear as well as nonlinear systems.

Topics covered

This course is intended to provide theoretical foundation and hands on laboratory experience in the modeling of dynamic systems. The main focus is on the modeling and open-loop analysis of dynamic systems using classical techniques. The course includes an extensive use of the control system analysis and design software, namely, MATLAB, for lab and homework assignments. This experience is expected to help prepare students for 'real-life' modeling and control design as practiced in industry. Laboratory assignments are intended to bridge the gap between the theory and practice.

- complex analysis
- Laplace transform

- matrix analysis
- modeling techniques
- modeling of mechanical systems
- modeling of electrical systems
- modeling of fluid systems
- modeling of hybrid systems
- open-loop response analysis
- linearization
- block diagrams
- introduction to control systems

Class/laboratory schedule, i.e., number of sessions each week and duration of each session

Two, one-hour and 15 minute class sessions per week, with a two-hour laboratory each week

Contribution of course to meeting the professional component

This is a four-credit course that develops analytical and computational skills in mathematical modeling and open loop analysis of dynamic systems. The skills acquired are expected to prepare students for real-life engineering problems encountered in industry environment. The course consists primarily of engineering topics and requires good preparation in college level mathematics. The course has no design and general education content.

Relationship of course to the program objectives

This course addresses the following program objectives:

- Students will learn basic techniques for first-principles modeling of the dynamic aspects of a wide variety of mechanical systems, providing a strong foundation for technical contributions upon graduation.
- Students will work in laboratory teams to solve measurement and analysis problems that are common in systems applications, developing communications and interaction skills within a technical framework.
- Students will learn to analyze and simulate dynamic linear and non-linear dynamic systems using fundamental engineering principles and modern simulation tools.

Person(s) who prepared this description and date of preparation

Luecke, 2006

ME 436. Heat Transfer

Course (catalog) description

Heat Transfer by conduction, convection, and radiation. Similarity concepts in heat, mass, and momentum transfer. Methods for determination of heat transfer coefficients. Combined modes of heat transfer. Heat exchangers. Lab experiments and experiments emphasizing concepts in thermodynamics and heat transfer. Written reports are required. Nonmajor graduate credit.

Prerequisite(s)

ME 335, Fluid Flow

Textbook(s) and/or other required material

Incropera, F. P. and Dewitt, D. P., *Fundamentals of Heat and Mass Transfer*, Fifth Edition, John Wiley and Sons, 2002

Course objectives

After taking this course students will be able to:

1. Identify the primary mode(s) of heat transfer applicable to a specific situation and perform energy balances across control volumes and surfaces.
2. Recognize symmetry and the simplifications it provides in heat transfer problem solution.
3. Translate a physical situation into the appropriate form of the conduction equation and the corresponding boundary and initial conditions to compute temperature distributions and heat flows in objects that may or may not be generating heat.
4. Compute the enhancement of heat transfer resulting from the use of extended surfaces.
5. Develop the ability to recognize the conditions necessary for the application of approximate and detailed techniques for the computation of temperature variations with time and space in solids.
6. Identify the flow regimes and boundary conditions in external and internal flows and use pertinent non-dimensional variables to compute heat transfer coefficients while distinguishing between local and average coefficients.
7. Obtain an awareness of the various empirical correlations for forced and natural convection and recognize their applicability to different physical situations.
8. Predict heat transfer due to radiation from ideal and actual surfaces and enclosures, while accounting for directional and spectral variations in surface properties.
9. Gain an appreciation of the different types of heat exchangers and their applicability to particular situations.
10. Predict heat exchanger performance given size and inlet conditions, and also design the geometry of a heat exchanger required to deliver a desired heat transfer rate.
11. Compute spatial and temporal temperature variations and heat flows in 1- or 2-dimensional objects using the appropriate numerical techniques.
12. Measure thermal conductivities of solids, and compute heat transfer coefficients and heat duties from measured temperatures and flow rates and report and discuss experimental results.
13. Appreciate heat transfer in the context of contemporary issues and the interplay of technological, social, and political factors in resolving or exacerbating problems facing society.

Topics covered

<u>Class Topics:</u>

- Heat transfer and its relation to thermodynamics, conservation of energy, modes of heat transfer (4 days)
- Steady-state conduction in plane, cylindrical and spherical systems, resistance networks (5 days)
- Extended surface heat transfer, fin efficiency, finned-surface efficiency (2 days)
- Unsteady conduction (lumped capacitance, plane walls and cylinders, semi-infinite solids) (3 days)
- Numerical analysis of steady and unsteady conduction (1 day)
- Convection boundary layers, laminar and turbulent flow, non-dimensionalization of variables (4 days)
- External flow, empirical heat transfer correlations, variable fluid properties (4 days)
- Internal flow empirical heat transfer correlations, variable fluid properties (4 days)
- Natural convection on surfaces and enclosures, mixed convection (2 days)

- Heat exchangers: types, LMTD method, ε-NTU method, fouling, finned and cross-flow (4 days)
- Radiation physics, black body radiation exchange, shape factors, gray, diffuse surfaces, solar radiation (6 days)
- Multimode heat transfer (2 days)

Laboratory Topics:

- Linear heat conduction
- Extended surfaces
- Unsteady heat transfer
- External convection
- Internal convection
- Free convection
- Heat exchangers
- Radiation heat transfer

Class/laboratory schedule, i.e., number of sessions each week and duration of each session

Three one-hour class sessions per week
Eight two-hour laboratory sessions during the semester

Contribution of course to meeting the professional component

Engineering Topics with Design: 4 credits

Relationship of course to program objectives

This course addresses the following program objectives:

- Students will attain the basic knowledge required to understand and analyze mechanical engineering systems.
- Students will be able to apply engineering principles to create, analyze or improve processes, devices or systems to accomplish desired objectives.
- Students will develop engineering judgment through open-ended problems that require establishment of reasonable engineering assumptions and realistic constraints.
- Students will not only be able to apply their engineering knowledge to real-life design problems, but also to critically evaluate the solutions.

Person(s) who prepared this description and date of preparation

Battaglia and Heindel, February 2006

ME 442. Heating, Ventilating and Air-Conditioning Design

Course (catalog) description

Design criteria and assessment of building environment and energy requirements. Design of heating, ventilating, and air conditioning systems. Systems control and economic analysis. Oral and written reports required.

Prerequisite(s)

ME 441, Fundamentals of Heating, Ventilating, and Air Conditioning

Textbook(s) and/or other required material

1. McQuiston, M., Parker, J and Spitler, J., *Heating, Ventilating, and Air Conditioning Analysis and Design*, 6th Edition, John Wiley and Sons, 2005
2. Various chapters from the ASHRAE Handbook series
3. Various ASHRAE standards
4. Various manufacturers' product documents

Course objectives - upon completion of ME 442, students will be able to:

1. Select heating and cooling coils for an HVAC system.
2. Design a piping system including selection of system components (including pumps, valves, chillers, cooling towers, and expansion tanks).
3. Design a room-air distribution system including selection and placement of supply, return and exhaust diffusers and grills.
4. Design an air distribution system using both high and low-velocity duct design methods.
5. Select components for an air distribution system including terminal boxes and fans.
6. Determine the proper indoor air conditions (temperature, humidity and ventilation rate) for building occupants based on level of activity and ASHRAE standards.
7. Utilize a commercial software program to perform thermal analyses on buildings and determine design heating and cooling loads.
8. Design an HVAC system for a building given design constraints that impact system selection.
9. Appreciate ME 442 in the context of contemporary issues and the interplay of technological, social, and political factors in resolving or exacerbating problems facing society.
10. Acquire an understanding of the ethical and professional responsibilities of engineers.
11. Practice working in design teams.

Topics covered

- HVAC system types, applications and selection criteria
- Constraints in HVAC system design
- Control sequences for variable-air-volume systems
- Ventilation requirements and exhaust airflow requirements
- Building and HVAC energy simulation modeling
- Selection of components used in HVAC systems
- Gas and electric utility rate structures
- Duct design methods and software
- Piping design methods and software
- Architectural and mechanical drawings

Class/laboratory schedule, i.e., number of sessions each week and duration of each session

Three two-hour class sessions per week

Contribution of course to meeting the professional component

Engineering Topics with Design: 3 credits

Relationship of course to the program objectives

This course addresses the following program objectives:

- Students will attain the basic knowledge required to understand and analyze mechanical engineering systems.
- Students will be able to apply engineering principles to create, analyze or improve processes, devices or systems to accomplish desired objectives.
- Students will develop engineering judgment through open-ended problems that require establishment of reasonable engineering assumptions and realistic constraints.
- Students will learn to effectively work in teams to solve engineering problems involving a disciplined process of critical thinking that crosses content boundaries.
- Students will be aware of social and environmental aspects of engineering, as well as the ethical standards of the engineering profession.

Person(s) who prepared this description and date of preparation

Gregory Maxwell, February 8, 2006

ME 446. Power Plant Design

Course (catalog) description

Design of a power plant to meet regulatory, cost, fuel, and output needs. Selection and synthesis of principal components. Oral and written reports required.

Prerequisite(s)

ME 332, Engineering Thermodynamics II; Credit or enrollment in ME 335, Fluid Flow

Textbook(s) and/or other required material

Bryden, K. M., *Power Plant Design Class Notes*, 2005

Course objectives

After taking this course students will be able to:

1. Understand the engineering design and fundamental basis for new concept power plants being considered for implementation in the near future.
2. Given a statement of need, develop a proposed solution that meets the need. The proposed solution will include engineering specifications and a plan to develop the solution to a final product.
3. Apply their existing knowledge of thermal and mechanical systems to an engineering design problem and show that they are capable of acquiring new knowledge as needed to solve the problem.
4. Work in teams that delegate responsibility evenly and appropriately, share information, and coordinate tasks so that the project flows smoothly.
5. Produce well-organized and well-documented written material. Students will be able to present this material orally in a clear, interesting, and well-organized manner.
6. Demonstrate that they have acquired new knowledge in the field of power plant operation and design beyond the level of their previous engineering training.
7. Demonstrate the ability to use energy systems design and analysis tools.
8. Appreciate ME 446 in the context of contemporary issues and the interplay of technological, social, and political factors in resolving or exacerbating problems facing society. Understand the societal and environmental impact of power generation and power plant design.
9. Acquire an understanding of the ethical and professional responsibilities of engineers.

Topics covered

- Power plant engineering (7 sesssions)
- Project management (3 sessions)
- Cost estimating (2 sessions)
- Engineering ethics and social awareness (4 sessions)
- Communication skills (3 sessions)
- Engineering design (10 sessions)

Class/laboratory schedule, i.e., number of sessions each week and duration of each session

Two two-hour sessions per week, the sessions are split between lecture, group exercises, tours, and group meetings.

Contribution of course to meeting the professional component

Engineering Topics with Design: 3 credits

Relationship of course to the program objectives

This course addresses the following program objectives:

- Students will demonstrate the ability to apply knowledge of physics and mathematics, including calculus, linear algebra, and statistics to understand and analyze mechanical engineering systems.
- Students will be able to apply engineering principles to identify, formulate, and solve problems in thermal systems using techniques, skills, and tools of the engineering profession.
- Students will be able to design a system, component, or process associated with power plants using techniques, skills, and tools of the engineering profession.

- Students will learn to effectively work in teams to solve engineering problems involving a disciplined process of critical thinking that crosses content boundaries.
- Students will demonstrate communication skills that reflect professionalism through the use of appropriate grammar, mannerisms, writing style, and the use of visual aids.
- Students will learn to show initiative in the use of information resources, the exploration and implementation of new engineering practices, and skillful use of visual aids.
- Students will be aware of social and environmental aspects of engineering, as well as the ethical standards of the engineering profession.

Person(s) who prepared this description and date of preparation

Bryden, February 26, 2006

ME 449. Internal Combustion Engine Design

Course (catalog) description

Thermodynamic and mechanical design of a spark-ignition or compression ignition internal-combustion engine to meet specified performance, fuel, economy and air pollution requirements. Oral and written reports required.

Prerequisite(s)

ME 324, Manufacturing Engineering; ME 325, Mechanism and Machine; ME 445, Internal Combustion Engines

Textbook(s) and/or other required material

Stone, Richard., *Introduction to Internal Combustion Engines*, 3rd Edition, Society of Automotive Engineers, 1999

Course objectives

1. Given a statement of need, develop a proposed solution that meets the need. The proposed solution will include engineering specifications and a plan to develop the solution to a final product.
2. Apply their existing knowledge of thermal and mechanical systems to an engineering design problem and show that they are capable of acquiring new knowledge as needed to solve the problem.
3. Work in teams that delegate responsibility evenly and appropriately, share information and coordinate tasks so that the project flows smoothly.
4. Produce well-organized and well-documented written material. Students will be able to present this material orally in a clear, interesting and well-organized manner.
5. Demonstrate that they have acquired new knowledge in the field of internal combustion engines beyond the level attained in the prerequisite course, Internal Combustion Engine (ME 445).
6. Demonstrate competence in the use and interpretation of internal combustion engines simulation software.
7. Appreciate ME 449 in the context of contemporary issues and the interplay of technological, social, and political factors in resolving or exacerbating problems facing society.
8. Acquire an understanding of the ethical and professional responsibilities of engineers.

Topics covered

- Introduction and contemporary issues (1 period)
- Engine operating characteristics (1 period)
- Engine inspection and mechanical components (3 periods)
- Computer simulations (2 periods)
- Mechanical design considerations, balance, dynamic analysis (2 periods)
- Professional ethics (1 period)
- Reporting on progress (3 periods)
- Group discussions, design specifications, overall design documentation and drawings (24 periods)
- Reporting on final designs (3 periods)
- Poster presentation (2 periods)

Class/laboratory schedule, i.e., number of sessions each week and duration of each session

Three one-hour class sessions per week

Contribution of course to meeting the professional component

Engineering Topics with Design: 3 credits

Relationship of course to program objectives

This course addresses the following program objectives:

- Students will attain the basic knowledge required to understand and analyze mechanical engineering systems.
- Students will be able to apply engineering principles to create, analyze or improve processes, devices or systems to accomplish desired objectives.
- Students will develop engineering judgment through open-ended problems that require establishment of reasonable engineering assumptions and realistic constraints.

- Students will not only be able to apply their engineering knowledge to real-life design problems but also to critically evaluate the solutions.
- Students will learn to effectively work in teams to solve engineering problems involving a disciplined process of critical thinking that crosses content boundaries.
- Students will be aware of social and environmental aspects of engineering, as well as the ethical standards of the engineering profession.
- Students will develop an understanding of the societal context in which they will practice engineering, including environmental, legal, aesthetic, and human aspects.

Person(s) who prepared this description and date of preparation

Kong, February 15, 2006

Appendix I-B.2: Technical Electives

ME 410. Mechanical Engineering Applications of Mechatronics

Course (catalog) description

Fundamentals of sensor characterization, signal conditioning, and motion control are coupled with the concept of embedded computer control. Digital and analog components used for interfacing with computer controlled systems. Mechanical system analysis, combined with various control approaches. Focus on automation of hydraulic actuation processes. Laboratory exercises provide hands-on development of mechanical systems

Prerequisite(s)

EE 442, Introduction to Circuits and Instruments; EE 448, Introduction to AC Circuits and Motors; Credit or enrollment in ME 421, Mechanical Systems and Control.

Textbook(s) and/or other required material

M. B. Histand and D. G. Alciatore, *Introduction to Mechatronics and Measurement Systems*, McGraw-Hill, 1999.

Course Objectives

The student will learn the fundamentals of design using electronic sensors, microprocessor control, and mechanical actuation. The student will learn how to identify design needs and use sensors, actuation, and control to meet these needs.

Topics covered

This course provides the basic knowledge required to understand and analyze mechanical systems. It provides the students with practice in designing systems to accomplish desired objectives. This course provides open ended design problems that require establishment of reasonable engineering assumptions and realistic constraints. The laboratory component teaches the students to work effectively in teams on problems that cross content boundaries.

Class Topics:

1) Introductory material, course motivation, P.C. fundamentals, laboratory use and objectives. (1 class)
2) Digital logic fundamentals, digital I/O, binary number representations and applications. . (1 class)
3) Combinational logic circuits, hardware logic families. (3 classes)
4) Sequential Logic, sequential devices. (3 classes)
5) Asynchronous sequential logic. (2 classes)
6) Hardware implementation of digital circuits, transistors. (3 classes)
7) Sensors, transducers, measurement. (3 class)
8) Analog and digital signal conditioning. (3 classes)
9) Power amplifiers and power supplies. (1 class)
11) Computer structures, programming languages. (2 classes)
12) Stepping motors, DC motors. (2 classes)
13) Project development and presentations(5 periods)

Laboratory Topics:

LAB 1 Optical isolation
LAB 2 Logic implementation with I/O
LAB 3 Measurement and display
LAB 4 Stepper Motor Control
LAB5 Hydraulics and Control
LAB6 Asynchronous interfacing-data buss

Class/laboratory schedule, i.e., number of sessions each week and duration of each session

Two one-hour class sessions per week. Each laboratory meets for two hours each week.

Person(s) who prepared this description and date of preparation

Luecke, June 2006.

ME 411. Automatic Controls

Course (catalog) description

Methods and principles of automatic control. Pneumatic, hydraulic, and electrical systems. Representative applications of automatic control systems. Mathematical analysis of control systems.

Prerequisite(s)

ME 421, Mechanical Systems and Control.

Textbook(s) and/or other required material

Norman S. Nise, *Control Systems Engineering*, Third Edition, John Wiley and Sons, New York, 2000.

Course objectives

After taking this course students will be able to:

- Make approximate models for various types of systems (mechanical, electrical, hydraulic, etc.) in the time domain as well as the frequency domain,
- Analyze open and closed loop systems to determine stability, steady state error, etc.
- Design control systems using root locus and frequency domain techniques,
- Implement basic control systems.

Topics covered

<u>Class Topics:</u>

- System modeling, transfer function analysis, block diagram representation (4 periods)
- Linearization, numerical simulation, system response (4 periods)
- Stability, steady state errors, characteristic root behavior, root locus (6 periods)
- Root-locus compensation design (6 periods)
- State-space and matrix formulation, state feedback, controllability , observability (4 periods)
- Examinations and review (6 periods)

<u>Laboratory Topics:</u>

- Digital system simulation.
- Feedback control of electro-mechanical system.
- Dynamic system implementation using analog electronics.
- Analong lead control compensator design and implementation.
- Digital lead control implementation.
- PID design and simulation.
- Ball and beam analysis, control design, and implementation.

Class/laboratory schedule, i.e., number of sessions each week and duration of each session

Two one-hour class sessions per week.
One two-hour laboratory session alternate weeks.

Person(s) who prepared this description and date of preparation

Luecke; June 1, 2006.

ME 414. Hydraulic Systems and Control

Course (catalog) description

Characteristics of hydraulic motors and pumps, system components, system analysis, feedback control and stability, control circuits, computer simulation.

Prerequisite(s)

ME 421, Mechanical Systems and Control; ME 335 Fluid Flow.

Textbook(s) and/or other required material

Akers, Gassman, & Smith, *Hydraulic Power System Analysis*, Taylor & Francis CRC Press, 2006.

Course objectives

After taking this course students will be able to:

- Analyze components of hydraulic systems, their dynamics and design procedures in terms of stability analysis.
- Size hydraulic system components.
- Apply feedback to improve system performance.

Topics covered

- Communication of design with ISO, ANSI (NFPA/JIC) graphic symbols and circuit diagrams (3 classes)
- Advantages and disadvantages of hydraulic machinery (2 class)
- Hydraulic fluids, types of flow, losses, and machine efficiency (3 classes)
- Pumps and motors: types, characteristics and representation (4 classes)
- Sizing of hydraulic components (4 classes)
- Transfer functions, block diagrams, and system specifications (3 classes)
- Valves: types, analysis, flow equations, forces (3 classes)
- Heat transfer, noise, and vibration characteristics (4 classes)
- Graphical and mathematical system and component models (3 classes)
- Systems operational characteristics and response (3 classes)
- Pressure transients (2 classes)
- Simulation by digital computer methods (3 classes)

Class/laboratory schedule, i.e., number of sessions each week and duration of each session

Three one-hour class sessions per week.
One three-hour optional laboratory session per week.

Contribution of course to meeting the professional component

Engineering Topics: 3 credits

Relationship of course to program objectives

This course addresses the following program objectives:

- Students will attain the basic knowledge required to understand and analyze mechanical engineering systems.
- Students will be able to apply engineering principles to create, analyze or improve processes, devices or systems to accomplish desired objectives.
- Students will develop engineering judgment through open-ended problems that require establishment of reasonable engineering assumptions and realistic constraints.
- Students will not only be able to apply their engineering knowledge to real-life design problems but also to critically evaluate the solutions.
- Students will learn to effectively work in teams to solve engineering problems involving a disciplined process of critical thinking that crosses content boundaries.
- Students will be aware of social and environmental aspects of engineering, as well as the ethical standards of the engineering profession.

- Students will develop an understanding of the societal context in which they will practice engineering, including environmental, legal, aesthetic, and human aspects.

Person(s) who prepared this description and date of preparation

M. Gassman; June 1, 2006.

ME 417. Advanced Machine Design I

Course (catalog) description

Continuation of ME 325 involving some additional elements, alternative viewpoints, and computational considerations. Analysis, selection, synthesis, and redesign of machine elements using computer and CAD/CAM assistance.

Prerequisite(s)

ME 325, Mechanism and Machine Design.

Textbook(s) and/or other required material

Metal Fatigue in Engineering, 2nd Edition, Stephens, et. al., Wiley Inter-Science, 2001

Course objectives

After taking this course students will be able to:

- Analyze and design a machine component using stress life analysis
- Analyze and design a machine component using strain life analysis
- Analyze and design a machine component using linear elastic fracture mechanics
- Determine fatigue of machine components subjected to variable amplitude, multi-axial loadings
- Understand and apply appropriate failure theories for design and analysis of machine components
- Identify and determine material properties needed to perform LEFM, strain life and stress life analysis
- Communicate design, analysis, and justification of failure theories using both written and oral communications.

Topics covered

- Multi-axial variable amplitude stress life analysis (3)
- Multi-axial variable amplitude strain life analysis (4)
- Multi-axial variable amplitude linear elastic fracture mechanics (4)
- Dealing with stress risers in stress life, strain life, and LEFM (3)
- Determination of notch stresses and strains using hysteresis loops (2)
- Rain flow cycle counting (2)
- Palmgren-Miner cumulative damage rule (2)
- Determination of principal strains and stresses for isotropic and orthotropic materials (1)
- Pane stress verses plan strain (2)
- Determining stress concentration factors using finite element analysis (1)
- Mechanism of fatigue (2)

Class/laboratory schedule, i.e., number of sessions each week and duration of each session

Two, 75 minute class sessions per week.

Person(s) who prepared this description and date of preparation

Starns; June 1, 2006.

ME 418. Mechanical Considerations in Robotics

Course (catalog) description

2-2) Cr. 3. S. *Prereq: 421*. Three dimensional kinematics, dynamics, and control of robot manipulators, hardware elements and sensors. Laboratory experiments using industrial robots. Nonmajor graduate credit.

Prerequisite(s)

ME 421 Mechanical Systems and Control

Textbook(s) and/or other required material

Craig, J. J., *Introduction to Robotics, Mechanics and Control*, Third Edition, Pearson Prentice Hall 2005

Course objectives

- Analyze three-dimensional kinematic systems.
- Analyze the dynamics of manipulators.
- Demonstrate an understanding of control of robotic systems.

Topics covered

- Description of position and orientation in 3-space, kinematics of manipulators and static positioning.
- Inverse kinematics of manipulators.
- Velocity and static force analysis.
- Dynamic analysis.
- Trajectory planning and generation.
- Manipulator design requirements.
- Manipulator position control.

Class/laboratory schedule, i.e., number of sessions each week and duration of each session

Three one-hour class sessions per week

Person(s) who prepared this description and date of preparation

Atul Kelkar 2006

ME 425. Mechanical Systems Optimization

Course (catalog) description

Mechanical system optimization techniques including unconstrained and constrained minimization and linear programming. Both the theory of the methods and the application to mechanical system design will be presented. Nonmajor graduate credit.

Prerequisite(s)

Engr 160, Engineering Problems with Computer Applications Laboratory; ME 415, Mechanical Systems Design

Textbook(s) and/or other required material

Vanderplaats, *Numerical Optimization Techniques for Engineering Design*, 3rd Edition, Vanderplaats Res & Dev Inc,

Course objectives

Upon completion of ME 425 students will:

1) Be able to create a standard optimization problem from an engineering problem.
2) Be able to identify pertinent features of optimization problems necessary to solve them.
3) Have gained a basic knowledge of numerical optimization algorithms.
4) Have sufficient understanding of the strengths and weaknesses of these algorithms.
5) Use off-the-shelf routines to solve optimization problems.
6) Understand how optimization methods can be used to solve a wide variety of problems across engineering and science disciplines.
7) Have been exposed to numerous case-studies of real-world situations where optimization was used.

Topics covered

Formulation of Optimization Problems
Terminology
Iterative Optimization Approach
Existence and Uniqueness of an Optimum Solution
Functions of a Single Variable
Unconstrained Functions of Several Variables
Introduction and Review of Iterative Solution Technique
Sequentially Unconstrained Minimization Techniques (SUMT)
Constrained Function Minimization

Class/laboratory schedule, i.e., number of sessions each week and duration of each session

3 classes per week, 50 minutes per class

Person(s) who prepared this description and date of preparation

Eliot Winer, 12/22/05

ME 433. Alternative Energy Conversion

Course (catalog) description

3-0) Cr. 3. F. *Prereq: 332.* Basic principles, thermodynamics, and performance of alternative energy conversion technologies such as direct energy conversion (fuel cells, photovoltaics, magnetohydrodynamics), wind energy, biomass energy, non-combustion thermal sources (ocean gradients, geothermal and nuclear fusion), non-conventional environmental energy sources (ocean tides and currents), and finally other alternative approaches (molecular motors, cryo-engines, and solar sailing). Performance analysis and operating principles of systems and components, economic analysis for system design and operation. Nonmajor graduate credit.

Prerequisite(s)

ME 332 Engineering Thermodynamics II

Textbook(s) and/or other required material

Course objectives

The objectives of the course are to

1. Provide students with an understanding of contemporary issues related to alternative energy.
2. Provide students with a technical understanding of the major types of alternative energy techniques,
3. Enable students to perform an energy and economic analysis on each alternative energy technology.
4. Enable students to evaluate the advantages and disadvantages of each technology.

Topics covered

Topics to be covered in the course span the full range of alternative energy technologies applicable to contemporary society including hydrogen economy, fuel cells, wind power generation, hydroelectric power generation, ocean thermal energy conversion, tidal power, wave power, photovoltaic, solar, biomass, geothermal, fusion and fission.

Class/laboratory schedule, i.e., number of sessions each week and duration of each session

Three one-hour class sessions per week

Person(s) who prepared this description and date of preparation

Mike Pate 2006

ME 441. Fundamentals of Heating, Ventilating, and Air Conditioning

Course (catalog) description

Space conditioning and moist air processes. Applications of thermodynamics, heat transfer, and fluid flow principles to the analysis of heating, ventilating, and air conditioning components and systems. Performance and specifications of components and systems.

Prerequisite(s)

Credit or enrollment in ME 436, Heat Transfer.

Textbook(s) and/or other required material

Mcquiston, F.C. and Parker, J. D., *Heating, Ventilating, and Air Conditioning, Analysis and Design*, 6th Ed., John Wiley and Sons, 2005.

Course objectives

After taking this course students will be able to:

- Apply a psychrometric analysis to a variety of HVAC systems.
- Compute the transmission heating loads on a structure (including walls, roofs, slabs, below grade construction and fenestration).
- Compute the design cooling load for a structure (including solar loads, transmission loads and internal loads).
- Compute the infiltration loads on a structure for both summer and winter design conditions.
- Calculate the appropriate pipe size for both open and closed piping systems.
- Determine the operation characteristics (head loss and flow rate) of pump/piping systems.
- Calculate the appropriate duct size for both high and low velocity duct systems.
- Determine the operating characteristics (pressure and flow rate) of duct/fan systems.
- Determine the type, number and placement of diffusers for proper room air distribution.
- Analyze a vapor compression refrigeration cycle and describe the components that make up the cycle.
- Calculate properties and perform elementary process analysis of binary mixtures used in absorption refrigeration cycles.
- Analyze an absorption refrigeration cycle.

Topics covered

- Overview of building types and HVAC considerations (1 day)
- Psychrometrics review (1 day)
- Moist air processes (2 days)
- Space conditioning (design and off-design conditions) (3 days)
- Basic heat transfer modes for building structures (2 days)
- Solar time and solar angles (1 day)
- Solar irradiation (1 day)
- Heat gain through fenestration (1 day)
- Infiltration (1 day)
- Space heat load (1 day)
- Cooling load calculations overview (1 day)
- Cooling load calculations using the CLTD/SCL/CLF methods (4 days)
- Fluids review (1 day)
- Pumps piping systems (3 days)
- Larger systems and control (1 day)
- Behavior of air jets (1 day)
- Air distribution system design (1 day)
- Fan performance, selection, installation (2 days)
- Duct systems design (4 days)
- Refrigeration cycle review (1 day)

- Refrigerants (1 day)
- Compressor types and operation (1 day)
- Evaporators, condensers and throttling devices (1 day)
- Absorption cycle overview (1 day)
- Binary mixtures and elementary binary processes (2 days)
- Absorption refrigeration cycle analysis (2 days)
- Heating equipment (1 day)

Class/laboratory schedule, i.e., number of sessions each week and duration of each session

Three one-hour class sessions per week.

Person(s) who prepared this description and date of preparation

Maxwell; June 2, 2006.

ME 443. Compressed Air Systems

Course (catalog) description

(3-0) Cr. 3.S. *Prereq: 332.* Basic principles, thermodynamics, and performance of compressed air systems including various components such as compressors, (reciprocating, rotary, centrifugal, and axial), prime movers, coolers, intercoolers, aftercoolers, dryers, heat recovery receivers, separators, filters, regulators, fault detectors, controllers, etc., performance analysis and operating principles for both systems and components, energy consumption and economic analysis for system design and operation. Nonmajor graduate credit.

Prerequisite(s)

ME 332, Engineering Thermodynamics II

Textbook(s) and/or other required material

Course objectives

1. Provide students with an understanding of the basic principles, thermodynamics, and performance of compressed air systems including various components, such as compressors ,coolers, dryers, heat recovery, receivers, separators, filters, regulators, controllers etc.
2. Provide students with engineering principles required to analyze, design and operate compressed air systems while taking into account energy and economic considerations.
3. Enable students to select components and operations for the purpose of reducing energy consumption and/or to improve system performance.

Topics covered

The topics to be conveyed in this course include an overview of compressed air systems including definitions, industrial applications, system problems, and the impact of the operation on energy consumption; components analysis using basic principles and thermodynamics; system performance including how components interact when integrated into a complete system; optimization of system design and operation including both economic and energy considerations.

Class/laboratory schedule, i.e., number of sessions each week and duration of each session

Three one-hour class sessions per week

Person(s) who prepared this description and date of preparation

Mike Pate 2006

ME 444. Elements and Performance of Power Plants

Course (catalog) description

Basic principles, thermodynamics, and engineering analysis of power supply systems. Topics include existing power plant technologies, the advanced energyplex systems of the future, societal impacts of power production, and environmental and regulatory concerns.

Prerequisite(s)

ME 332, Engineering Thermodynamics II. Credit or enrollment in ME 335, Heat Transfer.

Textbook(s) and/or other required material

Stultz, S.C. and J. B. Kitto, *Steam: Its Generation and Use* 41st Edition, Babcock & Wilcox Company
El-Wakil, M.M., *Powerplant Technology*, McGraw-Hill (suggested).

Course objectives

After taking this course students will be able to:

- Identify, based on a fundamental understanding, the basic building blocks of the power plant of the future.
- Select technologies for power plant development based on fuel sources, economic considerations, emissions, and regulatory concerns.
- Perform detailed thermodynamic analysis of various power plant designs and determine their performance characteristics.
- Analyze and describe the strengths and weaknesses of various power plant strategies within the overall power needs of society.
- Describe and model the primary components of a power plant including furnaces, fuel cells, fluidized beds, heat exchangers, pumps, turbines, valves, condensers.

Topics covered

- Introduction and overview
- Power cycles (Rankine, Brayton, Otto, Diesel)
- Thermodynamic analysis of power plant performance
- Power Sources – combustion
- Power Sources – fuel cells
- Power Sources – nuclear
- Power Sources – other (wind, solar, etc.)
- Power plant components
- Coal and biomass fired power plants
- Gas-turbine and combined-cycle powerplants
- Advanced concept power plants and energyplexes
- Economic considerations and current and future regulatory environment
- Environmental impacts
- Societal concerns related to power production

Class/laboratory schedule, i.e., number of sessions each week and duration of each session

Three one-hour class sessions per week.

Person(s) who prepared this description and date of preparation

Bryden; June 10, 2006.

ME 445. Internal Combustion Engines

Course (catalog) description

Basic principles, thermodynamics, and performance of spark ignition and compression ignition engines. Engine-drive train vehicle considerations. Properties of engine fuels, combustion generated air pollutants. Laboratory determination of engine performance.

Prerequisite(s)

ME 332, Engineering Thermodynamics II. Credit or enrollment in ME 436, Heat Transfer.

Textbook(s) and/or other required material

Ferguson, C.R., Kirkpatrick, A.T., *Internal Combustion Engines – Applied Thermosciences*, 2nd Edition, Wiley, New York, 2001.

Course objectives

After taking this course students will be able to:

- Predict and explain engine performance.
- Select and specify engines to satisfy a given power, fuel economy, and emission limit requirement.

Topics covered

- Basic engine types, nomenclature, operation and construction
- Review of thermodynamics and combustion
- Air standard cycles
- Real working medium and fuel-air cycles
- Engine heat transfer
- Intake and exhaust gas flow
- Manifold and cylinder fuel injection
- Cylinder combustion, including normal progressive burning and abnormal effects such as knock
- Combustion generated pollution emissions
- Fuels for internal combustion engines
- Engine performance including engine - vehicle matching considerations

Class/laboratory schedule, i.e., number of sessions each week and duration of each session

Two 1.5 hours sessions per week.

Person(s) who prepared this description and date of preparation

Song-Charng Kong, June 1, 2006.

ME 451. Engineering Acoustics

Course (catalog) description

(Same as E M 451.) (2-2) Cr. 3. S. *Prereq: Phys 221 and Math 266 or 267.* Sound sources and propagation. Noise standards and effects of noise on people. Principles of noise and vibration control used in architectureal and engineering design. Characteristics of basic noise measurement equipment. Experience in use of noise measuring equipment, sound power measurements, techniques for performing noise surveys, evaluation of various noise abatement techniques applied to common noise sources. Selected laboratory experiments. Nonmajor graduate credit.

Prerequisite(s)

Phys 221, Introduction to Classical Physics; Math 266, Elementary Differential Equations; or Math 267, Elementary Differential Equations and Laplace Transforms

Textbook(s) and/or other required material

Bies, *Engineering Noise Control*, Third Edition, Spon Press, 2003

Course objectives

- Develop a physical insight into acoustics and noise control
- Obtain basic skills and knowledge of noise control methods
- Learn the equipment and procedures for several standard measurement techniques
- Assess the accuracy of several measurement techniques

Topics covered

- Acoustic Variables, Wave Equation, Wave Types, Mean Square Quantities, Sound Intensity, Sound Power,
- Decibel Scale, Frequency Analysis, Octave Bands and Weightings, Digital Implementation of Frequency Analysis,
- Instrumentation – Sound Level Meters and Sound Intensity Method
- Hearing - Basics, Damage, and Perception, ,
- Noise Criteria – Hearing Damage, Environmental, and Sound Quality
- Simple Sound Sources – Monopole, Dipole, Quadrupole, Line Source, Radiation from Pistons
- Directivity, Source Strength, Radiation Efficiency, Effects of Reflection Surfaces
- Modeling with Basic Sound Sources
- Room Acoustics: Low Frequency Models and High Frequency Models, Reverberant Field and Direct Field in Rooms, and Room Noise Control Strategies
- Sound Power Measurement Techniques
- Radiation from Vibrating Plates
- Sound Isolation – Sound Transmission Through Partitions, Enclosures, Barriers, Transmission Loss, Noise Reduction, Insertion Loss
- Ducts and Mufflers - Finite Length Ducts, Finite Length Ducts and Helmholtz Resonators, Expansions Chambers and Side Branch Resonators, Lined Ducts, Plenums, Exhaust Radiation, Break-Out Noise
- Airflow Noise - Fan Noise, Valve Noise
- Piping Noise

Class/laboratory schedule, i.e., number of sessions each week and duration of each session

Three lectures per week. Two lectures on week with lab. 8 Labs

Person(s) who prepared this description and date of preparation

Adin Mann – 14 June 2006

Appendix I-C

Faculty Resumes

MECHANICAL ENGINEERING

IOWA STATE UNIVERSITY
Mechanical Engineering Department
Ames, IA 50011
Vita

1. PERSONAL DATA

Name: Shyam Bahadur, University Professor

Address: 3026 Black Engineering, Ames, IA 50011 **Phone:** 515-294-7658

2. EDUCATION

Ph.D. - Mechanical Engineering, University of Michigan, Ann Arbor, 1970
M.E. - Mechanical Engineering, University of Roorkee, Roorkee (India), 1962
B.E. - Mechanical Engineering, University of Roorkee, Roorkee (India), 1957

3. ACADEMIC RECORD WITH ISU

University Professor, 2001
Interim Chair, Mechanical Engineering Dept., July 1995-September 1996
Professor, March 1977-present
Associate Professor, 1973-1977
Assistant Professor, 1970-1973

4. OTHER RELATED EXPERIENCE: TEACHING, INDUSTRIAL, ETC.

Visiting Professor, University of Cambridge, U.K., September 1978-February 1979
Head, Mechanical Engineering Department, M.M.M. Engineering College, University of Gorakhpur, Gorakhpur (India), 1962-1967
Lecturer, M.N. Regional Engineering College, University of Allahadad, Allahadad (India), 1961-1962
Lecturer, University of Roorkee, Roorkee (India), 1958-1961
Junior Engineer, Bhilai Steel Plant, M.P., India, November 1958-January 1959
Engineer Trainee, Agriculture Workshop and Irrigation Department, U.P., India, September 1957-August 1958

5. CONSULTING, PATENTS, ETC.

Consulting

Vickers, Inc., Omaha, Nebraska, 1997
Maytag Corp., Newton, Iowa, 1995
Ethicon, Johnson & Johnson, Cincinnati, Ohio, 1995
Frigidaire, Webster City, Iowa, 1995
General Dynamics Corp., San Diego, California, 1993, 1994

Patent

Nano-fraction mineral powders obtaining device, Patent No. 1501 A2, Republic of Armenia, 2004

6. STATE(S) IN WHICH REGISTERED

7. PRINCIPAL PUBLICATIONS WITHIN LAST 5 YEARS

M.H. Cho and S. Bahadur, A study of the thermal, dynamic mechanical and tribological properties of polyphenylene sulfide composites reinforced with carbon nanofibers, Trigology Letters (accepted for publication)

M.H. Cho, S. Bahadur, J.W. Anderegg, Design of experiments approach to the study of tribological performance of Cu-concentrate-filled polyphenylene sulfide composites, Tribology International (accepted for publication)

A. Ahmed, S. Bahadur, B. A . Cook, and J. Peters, Mechanical properties and scratch test studies of new ultra-hard AlMgB14 modified by TiB2, Tribology International, Vol. 39, pp. 129-137, 2006.

A. K. Pogosian, S. Bahadur, K. V. Hovhannisyan, and A. N. Karapetyan, Investigation of the tribological and physico-mechanical processes in sliding of mineral-filled formaldehyde copolymer composites against steel, Wear, Available online June 2005.

M.H. Cho, S. Bahadur, A.K. Pogosian, Observations on the effectiveness of some surface treatments of mineral particles and inorganic compounds from Armenia as the fillers in polyphenylene sulfide for tribological performance, Tribology International, Vol. 39, Issue 3, pp. 249-260, 2005.

M.H. Cho, S. B S. Bahadur, A.K. Pogosian, Friction and wear studies using Taguchi method on polyphenylene sulfide filled with a complex mixture of MoS_2, Al_2O_3, and other compounds, *Wear* , Volume 258, pp. 1825-1835, 2005.

S. Bahadur and C. Sunkara, Effect of transfer film structure, composition and bonding on the tribological behavior of polyphenylene sulfide filled with nano particles of TiO_2, ZnO, CuO and SiC, *Wear*, Volume 258, No. 9, pp. 1411-1421, 2005.

M.H. Cho and S. Bahadur, Study of the tribological synergistic effects in nano CuO-filled and fiber-reinforced polyphenylene sulfide composites, *Wear*, Volume 258, Issues 5-6, 2004, Pages 835-845.

M. Palabiyik and S. Bahadur, Tribological studies of polyamide 6 and high density polyethylene blends filled with PTFE and copper oxide and reinforced with short glass fibers, Wear, Vol. 253, Nos. 3-4, pp. 369-376, 2002.

Q. Zhao and S. Bahadur, "Investigation of transition State in the Wear of Polyphenylene Sulfide Sliding against Steel", Tribology Letters, Vol. 12, No. 1, pp. 23-33, 2002.

C. Schwartz and S. Bahadur, "The Role of Filler Deformability, Filler-Polymer Bonding, and Counterface Materials on the Tribological Behavior of PPS, Wear, 251, PP. 1532-1540, 2001.

O. Desa, and S. Bahadur, "The Effect of Lubricants in Single Point Scratching and Abrasive Machining of Alumina and Silicon Nitride", Wear, 251, PP. 1085-1093, 2001.

M. Palabiyik and S. Bahadur, "Mechanical and Tribological Properties of Polyamide 6 and High Density Polyethylene Polyblends with and without Compatibilizers, Wear, Vol 8621, pp. 1-10, 2000.

Bahadur, S., "The Development of Transfer Layers and their Role in Polymer Tribology," Wear, Vol. 245, pp. 92-99, 2000.

Schwartz, C. and S. Bahadur, "Studies on the Tribological Behavior and Transfer Film -Counterface Bond Strength for Polyphenylene Sulfide Filled with Nanoscale Alumina Particles," Wear, Vol. 237, PP. 261-273, 2000.

8. SCIENTIFIC & PROFESSIONAL SOCIETIES OF WHICH A MEMBER

ASME, ASTM, ASM

9. HONORS & AWARDS

ASTM Fellow, 1999
Award of Merit, ASTM, 1999
ASME Fellow, 1998
Certificate of Merit, ASTM, 1991, 1995
Certificate of Appreciation, STLE, 1987, 1990, 1991

10. INSTITUTIONAL & PROFESSIONAL SERVICE IN THE LAST 5 YEARS

Professional Society Activities:
Member, Nominating Committee, ASTM, Committee G-2, 2002
Member, Nominating Committee, ASTM, Committee G-2, 2000
Chair, Editorial Subcommittee, Committee G-2 Wear and Erosion, American Society for Testing and Materials, 1997- 2002.
External Examiner for MS, PhD and DSc theses

Institutional Service Activities:
Chair, Academic Standards Committee, 2005
Ad Hoc Committee for Engel Professor Evaluation, 2004
Department Curriculum Development Committee on ME 324, 1999, 2000, 2001
Chair, Graduate Committee, 2000
Faculty Recruitment, 1999, 2000
Graduate Committee, 1999, 2001, 2002
Department Governance Document, 1999, 2004

11. PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST 5 YEARS

IOWA STATE UNIVERSITY
Mechanical Engineering Department
Ames, IA 50011
Vita

1. PERSONAL DATA

Name: Francine Battaglia, Associate Professor

Address: 3027 Black Engineering, Ames, IA 50011 **Phone:** 515-294-2085

2. EDUCATION

Ph.D. - Mechanical Engineering, Pennsylvania State University, May 1997
M.S. - Aerospace Engineering, State University of New York at Buffalo, September 1992
B.S. - Mechanical Engineering, State University of New York at Buffalo, June 1991

3. ACADEMIC RECORD WITH ISU

Associate Professor, August 2005-present
Director, Center for Building Energy Research, January 2005-present
Associate Director, Center for Building Energy Research, May -December 2004
Assistant Professor, August 1999-July 2005

4. OTHER RELATED EXPERIENCE: TEACHING, INDUSTRIAL, ETC.

National Institute of Standards and Technology, Gaithersburg, MD
Mechanical Engineer, Recipient of NRC Postdoctoral Fellowship, September 1997-July 1999

Pennsylvania State University, University Park, PA
Lecturer, January-August 1997
Graduate Research Assistant, Recipient of DOE-GAANN Fellowship, January 1995-December 1996
Graduate Teaching Fellow, January-December 1994
Graduate Teaching Assistant, August 1992-December 1993

University of Adelaide, Adelaide, Australia
Visiting Scholar, October-November 1995

State University of New York at Buffalo, Buffalo, NY
Graduate Research Assistant, June 1991-July 1992

5. CONSULTING, PATENTS, ETC.

6. STATE(S) IN WHICH REGISTERED

7. PRINCIPAL PUBLICATIONS WITHIN LAST 5 YEARS

Refereed Journal Articles

Xie, N., Battaglia, F., and Fox, R. O., 2004. "Simulations of multiphase reactive flows in fluidized beds using in situ adaptive tabulation". *Combustion, Theory, and Modeling*, **8** (2), pp. 195-209.
Mammoser, J. H. and Battaglia, F., 2004. "A computational study on the use of balconies to reduce flame spread in high-rise apartment fires". *Fire Safety Journal*, **39** (4), pp. 277-296.
Battaglia, F., Rehm, R. G., and Baum, H. R., 2000. "The fluid mechanics of fire whirls: An inviscid model". *Physics of Fluids*, **12** (11), pp. 2859-2867.
Battaglia, F., McGrattan, K. B., Rehm, R. G., and Baum, H. R., 2000. "Simulating fire whirls". *Combustion, Theory, and Modeling*, **4** (3), pp. 123-138.

Refereed Proceedings Articles

Miller, R.H., Battaglia, F., and Olsen, M.G., 2005. "A Computational and Experimental Investigation of Flow in an Intracranial Side-wall Aneurysm". 2005 ASME Fluids Engineering Division Summer Meeting and Exhibition, FEDSM2005-77097, Houston, TX, pp. 1-10.
Battaglia, F. and Papadopoulos, G., 2005. "Bifurcation Characteristics of Flows in Rectangular Sudden

Expansion Channels". 2005 ASME Fluids Engineering Division Summer Meeting and Exhibition, FEDSM2005-77098, Houston, TX, pp. 1-11.

Sun, J. and Battaglia, F., 2004. "Effects of Particle Rotation on the Hydrodynamics Modeling of Segregation in Gas-Fluidized Beds". ASME Fluids Engineering Division (Publication) FED, Proceedings of the ASME Fluids Engineering Division 2004, IMECE2004-62316, Vol. 260, pp. 745-753, Anaheim, CA.

Bondar, F. and Battaglia, F., 2003. "A Computational Study on Mixing of Two-Phase Flow in Microchannels". ASME Fluids Engineering Division (Publication) FED, Proceedings of the ASME Fluids Engineering Division 2003, IMECE2003-43957, Vol. 259, pp. 101-109, Washington, DC.

Gokarn, A., Battaglia, F., Fox, R. O., and Hill, J. C., 2003. "Direct Numerical Simulations of Turbulent Mixing in a Channel with Two Splitter Plates". Forty-first Aerospace Sciences Meeting and Exhibit, AIAA Paper 2003-1291, Reno, NV, pp. 1-10.

Bondar, F. and Battaglia, F., 2002. "Bifurcation Analysis of Mixing Actuated by Time-Periodic Vortices". 2002 ASME International Mechanical Engineering Congress and Exposition, New Orleans, LA, pp. 1-8.

Battaglia, F., Brown, R. C., and Flugrad, D. R., 2001. "ABET EC 2000: Developing Assessment Tools for Continuous Improvement". 2001 ASEE Annual Conference and Exposition, Albuquerque, NM, pp. 1-12.

8. SCIENTIFIC & PROFESSIONAL SOCIETIES OF WHICH A MEMBER

American Institute of Aeronautics and Astronautics, American Society of Engineering Education, American Society of Mechanical Engineers, The Combustion Institute, Sigma Xi

9. HONORS & AWARDS

Marquis Who's Who in America, 2002-2006
Marquis Who's Who of American Women, 2002-2006
Marquis Who's Who in Science and Engineering, 2003-2006
ASME Outstanding Student Section Advisor, Region VII, 2004

10. INSTITUTIONAL & PROFESSIONAL SERVICE IN THE LAST 5 YEARS

Professional Society Activities:

Referee: *AIAA Journal, Journal of Energy Resources Technology, Journal of Fluids Engineering, Computer & Fluids, Journal of Heat Transfer, Journal of Micromechanics and Microengineering, Journal of Physics A*

Topical Organizer: "Forum on Bifurcation, Instability and Hysteresis in Fluid Flow", ASME International Mechanical Engineering Conference and Exposition, December 2000-present.

Institutional Service Activities:

Department Committees:
Mechanical Engineering Curriculum Committee, August 1999-August 2002

Advisory Roles:
Student Advisor for ISU Student Chapter of the American Society of Mechanical Engineering, January 2000-present
Faculty Advisor for the Interactive Mechanical Engineering Educational Network (IMEEN), January 2000-December 2001

11. PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST 5 YEARS

Invited Lectures:

"Simulating Multiphase Reactive Flows in Fluidized Beds," Mechanical Engineering Seminar Series, University of Iowa, September 2005.

"The Effects of Circulation on Combustion-Driven Flows," Combustion Seminar Series, Pennsylvania State University (University Park, PA), October 2002.

"Simulating Fire Whirls," Industrial Applications and Engineering Science Seminar, Mechanical Engineering, University of Kentucky (Lexington, KY), May 2002.

"Modeling Fire Whirls," Fire, Science and Technology, Sandia National Laboratories (Albuquerque, NM), February 2002.

IOWA STATE UNIVERSITY
Mechanical Engineering Department
Ames, IA 50011
Vita

1. PERSONAL DATA

Name: Jim Bernard, Professor
Address: 1620 Howe; VRAC, Ames, IA 50011 **Phone:** 515-294-0360

2. EDUCATION

Ph.D. - Engineering Mechanics, University of Michigan, 1971
M.S. - University of Michigan, 1968
B.S. - University of Michigan, 1966

3. ACADEMIC RECORD WITH ISU

Anson Marston Distinguished Professor of Engineering, 1999-present.
Professor of Mechanical Engineering, 1983-1999

4. OTHER RELATED EXPERIENCE: TEACHING, INDUSTRIAL, ETC.

Director, Iowa State University Virtual Reality Applications Center, 1990-present
Interim Director, Iowa State University Computation Center, 1995-1997
Mechanical Engineering faculty at Michigan State, 1976-1983
Research Scientist at the University of Michigan's Highway Safety Research Institute, 1971-1976

5. CONSULTING, PATENTS, ETC.

6. STATE(S) IN WHICH REGISTERED

Michigan

7. PRINCIPAL PUBLICATIONS WITHIN LAST 5 YEARS

Lund, Y., and Bernard, J., "Analysis of Simple Rollover Metrics", SAE-950306, (SP-1074).

Bernard, J., and Clover, C., "Tire Modeling for Low-Speed and High-Speed Calculations", SAE 950311, (SP-1074).

Lund, Y., and J. Bernard, "Highway Vehicle Simulation", chapter in *Shock and Vibration Computer Programs, SAVIAC*. Edited by Walter and Barbara Pilkey, 1995, pp. 525-550.

Vance, J. M., and Bernard, J. E., "Using Pade Approximants and Curve-fitting to Approximate Eigenvalues and Eigenvectors for Large Design Changes", *Journal of Mechanical Design*, Vol. 113, No. 1, March 1996, p. 151-153.

Gruening, J., Williams, K., Hoffmeister, K., Bernard, J.E., "Tire Force and Moment Processor", SAE 960182.

Gruening, J., and Bernard, J.E., "Verification of Vehicle Parameters by Computer Simulation", SAE 960176.

Fancher, P., Bernard, J., Clover, C., and Winkler, C., "Representing Truck Tire Characteristics in Simulations of Braking and Braking-in-a-Turn Maneuvers", 2nd International Colloquium on Tire Models for Vehicle Dynamic Analysis, February 1997, Berlin, Germany

Bernard, J., "Introducing IPTs in Engineering and Science", Proceedings, International Immersive Projection Technology Workshop, Stuttgart, Germany, July 1997. Springer Verlag.

Clover, C.L., and Bernard, J., "Longitudinal Tire Dynamics", *Vehicle System Dynamics*, Vol. 29, No. 4, April 1998.

Bernard, Gruening, and Hoffmeister, "Evaluation of Vehicle/Driver Performance Using Genetic Algorithms", SAE 980226.

Gruening, Bernard, Clover, and Hoffmeister, "Driving Simulation", SAE 980223.

Hoffmeister, K., and Bernard, J. "Tread Pitch Arrangement Optimization through the Use of a Genetic Algorithm", *Tire Science and Technology*, 26 (1), 1998.

Bernard, J., Vance, J., and Cruz-Neira, C., "The Making of the C6", 3. International Immersive Projection Technology Workshop, Center of the Fraunhofer Society Stugttgart IZS, Springer-Verlag, 10,11; May, 1999.

8. SCIENTIFIC & PROFESSIONAL SOCIETIES OF WHICH A MEMBER

ABET, ASME, SAE

9. HONORS & AWARDS

1998: Co-author "Tread Pitch Arrangement Optimization through the Use of a Genetic Algorithm", *Tire Science and Technology*, Superior Paper Award

1994: Selected Outstanding Mechanical Engineering Graduate Faculty Member by the Mechanical Engineering Graduate Student Association

1994: Selected Outstanding Mechanical Engineering Professor by the College of Engineering Student Council

1992: Co-author, "Approximating Eigenvalues and Eigenvectors Across a Wide Range of Design", Best Technical Paper, 1992 MSC NASTRAN World Users Conference

1979: Selected Eminent Engineer, Michigan State Chapter of Tau Beta Pi

1978: Society of Automotive Engineers Ralph R. Teetor Award, "Significant Contributions to Teaching, Research and Student Development"

1978: Michigan State University Teacher Scholar Award: Given to members of faculty who have "earned the respect of students and colleagues for their devotion to and skill in undergraduate teaching"

1973: Society of Automotive Engineers Arch T. Colwell Award for the SAE paper, "A Digital Computer Method for the Prediction of Braking Performance of Trucks and Tractor Trailers"

10. INSTITUTIONAL & PROFESSIONAL SERVICE IN THE LAST 5 YEARS

Professional Society Activities:

Engineering Accreditation Commission, 1998-present
American Society of Mechanical Engineers, ASME Committee on Engineering Accreditation, 1993-present
Chairman-Program Criteria Subcommittee, 1993-1996

Institutional Service Activities:

Mechanical Engineering Curriculum Committee, 1996
University Intellectual Property Task Force, 1996
Chair, Search Committee for new Director for the Center for Nondestructive Evaluation, 1996
University Task Force on Research, 1996
Faculty Senate Committee on Promotion and Tenure, 1996
University Intellectual Property Task Force, 1996-1997
Provost Search Committee, 1998-1999

11. PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST 5 YEARS

Mechanical Engineering Department
Ames, IA 50011
Vita

1. PERSONAL DATA

Name: Robert C. Brown, Professor
Address: 3022 Black Engineering, Ames, IA 50011 **Phone:** 515-294-8733

2. EDUCATION

Ph.D. - Mechanical Engineering, Michigan State University, 1980
M.S. - Mechanical Engineering, Michigan State University, 1977
B.A. - Mathematics, University of Missouri-Columbia, 1976
B.S. - Physics, University of Missouri-Columbia, 1976

3. ACADEMIC RECORD WITH ISU

Bergles Professor of Thermal Sciences, Department of Mechanical Engineering, 2002-present
Professor of Agricultural and Biosystems Engineering, 2004-present
Professor of Mechanical Engineering, 1993-present
Professor of Chemical and Biological Engineering, 1993-present
Director, Graduate Studies in Mechanical Engineering, 1991-1997
Associate Professor, Mechanical Engineering, 1987-1993
Assistant Professor, Mechanical Engineering,1983-1987

4. OTHER RELATED EXPERIENCE: TEACHING, INDUSTRIAL, ETC.

Research Assistant, Michigan State University, 1978-1980
Teaching Assistant, Michigan State University, 1976-1978
Director, Office of Biorenewables Programs, Iowa State University, 2002-present
Director, Biotechnology Byproducts Consortium, Iowa State University, 1998-present
Director, Center for Sustainable Environmental Technologies, Iowa State University, 1996-present
Senior Engineer, Thermodynamics Group, General Dynamics Corporation, Fort Worth, Texas. Lead man in the Advanced Design Department, 1980-1983

5. CONSULTING, PATENTS, ETC.

Co-inventor on seven patents

6. STATE(S) IN WHICH REGISTERED

7. PRINCIPAL PUBLICATIONS WITHIN LAST 5 YEARS

Zhang, R., Cummer, K., Suby, A., and Brown, R. C., Biomass-derived hydrogen from an air-blown gasifier," Fuel Processing Technology 86, 861-874, 2005.
Norton, G. A. and Brown, R. C., “Wet chemical method for determining levels of ammonia in syngas from a biomass gasifier,” Energy & Fuels, 19, 618-624, 2005.
Cummer, K. and Brown, R. C., “Indirectly heated biomass gasification using a latent heat ballast. Part 3: Refinement of the heat transfer model,” Biomass and Bioenergy 28, 321–330, 2005.
E. Sandvig, G. Walling, D. Daugaard, R. Pletka, D. Radlien, W. Johnson, and R.C. Brown, "The prospects for integrating fast pyrolysis into biomass power systems," International Journal of Power and Energy Systems, 24(3), 228-38, 2004.
Zhang, R., Brown, R., Suby, A., and Cummer, K., “Catalytic destruction of tar in biomass-derived producer gas,” Energy Conversion and Management (2004) 45 (7-8), 995-1014.
Zhang, R., Brown, R. C., and Suby, A., “Thermochemical generation of hydrogen from switchgrass,” Energy and Fuels 18, 251-256, 2004.
Mérida, W., Maness, P., Brown, R. C., and Levin, D. B., “Enhanced hydrogen production and removal of carbon dioxide from indirectly heated biomass gasification,” International Journal of Hydrogen Energy 29, 283-290, 2004.
Daugaard, D. E. and Brown, R. C., “Enthalpy for pyrolysis for several types of biomass,” Energy and Fuels 17,

934-939, 2003.
Cummer, K. and Brown, R. C., "Ancillary equipment for biomass gasification," Biomass and Bioenergy 23, 113 – 128, 2002.
Brown, R. C. and Brue, E., "Resolving dynamical features of fluidized beds from pressure fluctuations," Powder Technology, 119, 68-80, 2001.

8. SCIENTIFIC & PROFESSIONAL SOCIETIES OF WHICH A MEMBER

American Society for Mechanical Engineers
American Institute of Chemical Engineers
Combustion Institute

9. HONORS & AWARDS

John Deere Visiting Scholar, 2004
Vice Provost's Special Citation, for service on the BIOWA Board of Directors, Iowa State University Extension, 2003
Fellow, American Society of Mechanical Engineering International, 2002
David R. Boylan Eminent Faculty Award for Research, College of Engineering, Iowa State University, 2002
Achievement by an Educational Team, Outstanding Service Award, Iowa State University Extension, 2002
Leadership through Engineering Academic Diversity Program, Special Recognition Award, Iowa State University, 2000

10. INSTITUTIONAL & PROFESSIONAL SERVICE IN THE LAST 5 YEARS

Professional Society Activities:
Member, Editorial Board, *Biomass & Bioenergy Journal*, March, 1999-present
Member, Scientific Committee, International Conference on Progress in Thermochemical Biomass Conversion, May 2000
Conference Co-Chair, Getting Value from Ag Biotechnology, Biotechnology Byproducts Symposium, Des Moines, IA, March 1999
Member, Conference Steering Committee, Climate Change and the Implications for Agriculture, National Forum for Agriculture, Ames, IA, March 1999
Review Board Member, National Science Foundation Graduate Fellowship Program, 1999
Panelist, Department of Defense Experimental Program for Stimulation of Competitive Research (DEPSCoR), August 1999
Panelist, 1998 National Science Foundation Graduate Research Fellowship Program
Proposal reviewer, National Science Foundation, U.S. Environmental Protection Agency, United States Department of Agriculture

Institutional Service Activities:
Member, Farm and Agriculture Issue Group (Ad hoc, 1998-present)
Mentor for K. M. Bryden (1997-present)
Member, Landscape Management Project Committee (Ad hoc 1996-1997)
Mentor for G. I. Maldonado (1994-1999)
Member, Search Committee for Sustainable Development and Environmental Policy faculty position (Ad hoc, 1998-1999)
Chair, Engineering College Academic Advisory Committee (Standing, 1998-1999)
Member, Engineering College Academic Advisory Committee (Standing, 1993-1998)
Member, Engineering College Research and Graduate Studies Committee (Standing 1998-1999)
Chair, Engineering College Research and Graduate Studies Committee (Standing 1992-1997)
Chair, Curriculum Committee (Standing, 1998-1999)

11. PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST 5 YEARS

Mechanical Engineering Department
Ames, IA 50011
Vita

1. PERSONAL DATA

Name: Kenneth "Mark" Bryden, Associate Professor and Associate Chair
Address: 3030 Black Engineering, Ames, IA 50011 **Phone:** 515-294-3891

2. EDUCATION

Ph.D. - Mechanical Engineering, University of Wisconsin - Madison, 1998
M.S. - Mechanical Engineering, University of Wisconsin - Madison, 1993
B.S. – General Engineering, Idaho State University, 1977

3. ACADEMIC RECORD WITH ISU

Associate Chair, Department of Mechanical Engineering, 2005-present
Program Chair, Complex and Adaptive Systems 2004-present
Associate Professor of Mechanical Engineering (tenured), 2004-present
Assistant Professor, Mechanical Engineering,1998-2004

4. OTHER RELATED EXPERIENCE: TEACHING, INDUSTRIAL, ETC.

Graduate Fellow, University of Wisconsin - Madison, 1991-1998
Teaching Assistant, University of Wisconsin - Madison, 1995-1997
Manager, Radiological Controls Engineering, Westinghouse Electric Corp.,1989–1991
Shift Test Manager, A1W Plant, Westinghouse Electric Corp., 1987–1989
Assistant Manager, Operations, A1W Plant, Westinghouse Electric Corp., 1986–1987
Manager, Long Range Planning and Engineering, Westinghouse Electric Corp., 1984–1986
Manager, Prototype Programs, Westinghouse Electric Corp., 1982–1984
Shift Supervisor, A1W Plant, Westinghouse Electric Corp., 1981–1982
Nuclear Plant Engineer, A1W Plant, Westinghouse Electric Corp., 1977–1981

5. CONSULTING, PATENTS, ETC.

Co-inventor on three pending patents

6. STATE(S) IN WHICH REGISTERED

7. PRINCIPAL PUBLICATIONS WITHIN LAST 5 YEARS

K. M. Bryden, D. A. Ashlock, S. M. Corns, and S. J. Willson, "Graph Based Evolutionary Algorithms," *IEEE Transactions on Evolutionary Computation*, accepted for publication.

D. A. Ashlock, K. M. Bryden, P. E. Johnson, and D. S. McCorkle, "A Data Segregation Strategy Using Graph Based Evolutionary Algorithms," *International Journal of General Systems Design*, provisionally accepted for publication.

A. C. Velivelli and K. M. Bryden, "Parallel Performance and Accuracy of Lattice Boltzmann and Traditional Finite Difference Methods for Solving the Unsteady Two-Dimensional Burger's Equation," *Physica A*, 362:139-145 (2006).

S. J. Kirstukas, K. M. Bryden, and D. A. Ashlock, "A Hybrid Evolutionary Strategy for the Analytical Solution of Differential Equations," *International Journal of General Systems Design*, 34(3):279-299 (2005).

C. G. Carmichael, W. A. Gallus, B. R. Temeyer, and K. M. Bryden, "A Winter Weather Index for Estimating Winter Roadway Maintenance Costs in the Midwest," *Journal of Applied Meteorology*, 43:1783-1790 (2004).

A. C. Velivelli and K. M. Bryden, "A Cache-Efficient Implementation of the Lattice-Boltzmann Method," *Concurrency and Computation: Practice and Experience*, 16:1415-1432 (2004).

K. M. Bryden, and D. S. McCorkle, "Evolutionary Optimization of Energy Systems Using Population Graphing and Neural Networks," *Advances in Engineering Software*, 35(5):289-299 (2004).

S. McCorkle, K. M. Bryden, and C. G. Carmichael, "A New Methodology for Evolutionary Optimization of

Energy Systems," *Computer Methods in Applied Mechanics and Engineering*, 192(44-46):5021-5036 (2003).

K. M. Bryden and M. J. Hagge, "Modeling the Combined Impact of Moisture and Char Shrinkage on the Pyrolysis of a Biomass Particle," *Fuel*, 82(13):1633-1644 (2003).

K. M. Bryden, D. A. Ashlock, D. S. McCorkle, and G. L. Urban, "Optimization of Heat Transfer Utilizing Graph Based Evolutionary Algorithms," *International Journal of Heat and Fluid Flow*, 24(2):267-277 (2003).

M. J. Hagge and K. M. Bryden, "Modeling the Impact of Shrinkage on the Pyrolysis of Dry Biomass," *Chemical Engineering Science*, 57(14):2811-2823 (2002).

K. M. Bryden, K. W. Ragland, and C. J. Rutland, "Modeling Thermally Thick Pyrolysis of Wood," *Biomass and Bioenergy*, 22(1):41-53 (2002).

8. SCIENTIFIC & PROFESSIONAL SOCIETIES OF WHICH A MEMBER

Association for Computing Machinery
American Nuclear Society
American Society of Engineering Education
American Society for Mechanical Engineers
Combustion Institute
Engineers in Technical and Humanitarian Opportunities for Service
Institute of Electronic and Electronic Engineers

9. HONORS & AWARDS

Margaret Ellen White Graduate Faculty Award, ISU, 2006
Miller Faculty Fellow, Center for Teaching Excellence, ISU, 2004-2006
2004 Information and Electrical Technologies Select Paper Award, 2004 American Society of Agricultural Engineers International Meeting, 2004.
Superior Engineering Teacher, College of Engineering, ISU, 2004
E-Week Outstanding Mechanical Engineering Professor, 2003
Most Effective Instructor Award, ISU Academic Success Center, 2003
Leadership through Engineering Academic Diversity, Special Recognition Award, ISU LEAD program, 2001
Outstanding Mechanical Engineering Faculty Member Award, ISU ASME Student Chapter, 2000
Pi Tau Sigma Mechanical Engineering Department Outstanding Teaching Assistant Award, UW–Madison, 1997
Power Engineering Education Foundation Fellowship, Edison Electric Institute, 1993–1997

10. INSTITUTIONAL & PROFESSIONAL SERVICE IN THE LAST 5 YEARS

Professional Society Activities:

President, Engineers in Technical and Humanitarian Opportunities for Service, 2002-present
Associate Editor, *Journal of Gas Turbines and Power*, 2004 - Present
Guest Editor, *Energy for Sustainable Development*, Cookstoves in Developing Nations, March 2005
Chair, The Seventh Inverse Problems Symposium, July 2006
Review Board Member, National Science Foundation Graduate Fellowship Program, 2001 - present

Institutional Service Activities:

Member, Mentoring Program Review Taskforce (Ad hoc, 2005-2006)
Member, Reactor Safety Committee (Standing 1999-2004)
Member, Administrative Group (2005 – present)
Chair, Computing Committee (2004 – present)
Member, Design Course Development Committee (2002 – present)
Member, Fluid Dynamics Course Development Committee (2005 – present)

11. PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST 5 YEARS

IOWA STATE UNIVERSITY
Mechanical Engineering Department
Ames, IA 50011
Vita

1. PERSONAL DATA

Name: Abhijit Chandra, Professor
Address: 3038 Black Engineering, Ames, IA 50011 **Phone:** 515-294-4834

2. EDUCATION

Ph.D. - Theoretical and Applied Mechanics, Cornell University, May 1983
M.S. - Mechanical Engineering, University of New Brunswick, July 1980
B.Tech (Honors) - Mechanical Engineering, Indian Institute of Technology, Kharagpur, January 1979

3. ACADEMIC RECORD WITH ISU

Professor, Department of Mechanical Engineering, December 1999-present (Engel Professor & Director Engel Lab, December 1999 – June 2004)

4. OTHER RELATED EXPERIENCE: TEACHING, INDUSTRIAL, ETC.

Member, Board of Directors, Actus Potentia Inc.. July 2004-present
Professor, Department of ME-EM, Michigan Technological University, August 1995-November 1999
Associate Professor, Department of Aerospace and Mechanical Engineering, University of Arizona**,** August 1985-July 1995, (Assistant Professor August 1985-July 1989)
Visiting Professor, Institut fur Maschinenelemente und Maschinenakustik, Technische Hochschule, Darmstadt, Germany, January 1992-July 1992
Visiting Professor, Department of Solid Mechanics, The Technical University of Denmark, Lyngby, Denmark, August 1991-December 1991
Senior Research Engineer, General Motors Research Laboratories, Warren, Michigan (also served on GM Committee on Forming Model Development and Metal Characterization), June 1983-July 1985

5. CONSULTING, PATENTS, ETC.

Subhash, G., Chandra, A. and Koeppel, B. J., "Apparatus and Method for Determining the Dynamic Indentation Hardness of Materials," 2002 (U.S. Patent No. 6,343,502, issued February 5, 2002; Canadian Patent No. 2,207,354, issued September 28, 2004)
Mitra, A. K. and Chandra A., "System and Method for Learning Intervention through Dynamic/Interactive Concept Mapping," (patent application pending), 2004
Holds one U.S. patent that has been licensed by the U.S. Army. Three other patent applications are in process.
Reviewer for various international journals and panel reviewer for various programs of National Science Foundation.

6. STATE(S) IN WHICH REGISTERED

7. PRINCIPAL PUBLICATIONS WITHIN LAST 5 YEARS

Fu, G. and Chandra, A., "An Analytical Dishing and Step Height Reduction Model for Chemical Mechanical Planarization," *IEEE Trans. Semiconductor Manufacturing*, Vol. 16, No. 3, p. 477-485, 2003.
Che, W., Guo, Y., Bastawros, A. F. and Chandra, A., "Mechanistic Understanding of Material Detachment During Micro-scale Polishing," *J. Mfg. Sc. Eng.*, *ASME*, Vol. 125, No. 4, p. 731-735, 2003.
Che, W., Guo, Y., Chandra, A. and Bastawros, A. F., "A Scratch Intersection Model of Material Removal During Chemical Mechanical Planarization," *J. Mfg. Sc. Eng.* (accepted 2004).
Chandra, A., Wang, K., Huang, Y. and Subhash, G., Miller, M. H. and Qu, W., "Role of Unloading in Machining of Brittle Materials," *ASME, J. Mfg. Sc. Eng*., Vol. 122, No. 3, p. 452-462, 2000.
Chandra, A., Huang, Y., Jiang, Z. Q., Hu, K. X. and Fu, G., "A Model of Crack Nucleation in Layered Electronic Assemblies Under Thermal Cycling," *ASME, J. Electronic Packaging*, Vol. 122, p. 220-226, 2000.

Fu, G. and Chandra, A., “Wafer Scale Variation of Removal Rate in Chemical Mechanical Polishing Based on Elastic Pad Deformation,” *J. Electronic Mat.*, Vol. 30, No. 4, p. 400-408, 2001.

Fu, G., Chandra, A., Guha, S. and Subhash, G., A, “Plasticity Based Model of Material Removal in Chemical Mechanical Polishing (CMP),” *IEEE Trans. Semiconductor Manufacturing*, Vol. 14, No. 4, p. 406-417, 2001.

Bastawros, A. F., Chandra, A., Guo, Y. and Yan, B., “Pad Effects on Material Removal Rate in Chemical Mechanical Planarization,” *J. Electronic Materials*, Vol. 31, No. 10, p. 1022-1031, 2002.

Ye, Y., Biswas, R., Morris, J., Bastawros, A. and Chandra, A., “Molecular Dynamics Simulation of Nanoscale Machining of Copper,” *J. Nanotechnology*, Vol. 14, p. 390-396, 2003.

8. SCIENTIFIC & PROFESSIONAL SOCIETIES OF WHICH A MEMBER

Fellow: American Society of Mechanical Engineers
Member: Institute of Electrical & Electronics Engineers, Society of Manufacturing Engineers (SME), Sigma Xi

9. HONORS & AWARDS

National Science Foundation, Presidential Young Investigator Award, 1987
J. F. Lincoln Arc Welding Foundation Award for Achievement in Arc Welded Design, Engineering and Fabrication, 1989
Alexander von Humboldt-Stiftung, Humboldt Research Fellowship, 1991
American Society of Mechanical Engineers, Fellow, 1996
Society of Manufacturing Engineers, Outstanding Paper Award, 1999

Biographee:
American Men and Women of Science, 18th Edition, 1992
Who's Who in the World, 12th Edition, 1994
Who’s Who in Science and Engineering, 3rd Edition, 1996
Who's Who in American Education, 4th Edition, 1994

10. INSTITUTIONAL & PROFESSIONAL SERVICE IN THE LAST 5 YEARS

Professor Chandra’s research interests include investigations of fundamental mechanics of manufacturing processes and in utilizating those insights for designing effective and efficient manufacturing processes with unique capabilities. Current interests focus on: understanding fundamental mechanisms in nano-scale machining, investigation of the Chemical Mechanical Planarization (CMP) process at different length scales, high speed precision finishing of ceramics and metals, thermomechanical effects on micro-scale defect evolutions during manufacturing, and net shape sinter forming of functionally graded materials.

Educational interests include development of dynamic and interactive concept mapping principles.

He is the author of a book (Boundary Element Methods in Manufacturing , Oxford U. Press, 1997), and has published over ninty technical articles in international archival journals.

11. PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST 5 YEARS

IOWA STATE UNIVERSITY
Mechanical Engineering Department
Ames, IA. 50011

Vita

1. PERSONAL DATA

Name: Warren R. DeVries, Professor
Address: 2025 Black Engineering, Ames, IA 50010 **Phone:** 515-294-5560

2. EDUCATION

Ph.D. - Mechanical Engineering (with minors in Statistics and Electrical and Computer Engineering), University of Wisconsin, 1975
M.S. - Mechanical Engineering, University of Wisconsin, 1973
B.S. - Mechanical Engineering (with honors), University of Wisconsin, 1971
B.S. - Letter and Engineering, Calvin College, 1971

3. ACADEMIC RECORD WITH ISU

Professor of Mechanical Engineering, Mechanical Engineering, Iowa State University, 1996-present.
Division Director, Division of Design and Manufacturing Innovation, National Science Foundation, 2003-pressent Chair and Professor of Mechanical Engineering, Department of Mechanical Engineering, Iowa State University, 1996-2002.

4. OTHER RELATED EXPERIENCE: TEACHING, INDUSTRIAL, ETC.

Professor of Mechanical Engineering (1994- 1996), Associate Professor of Mechanical Engineering (1982-1994), Department of Mechanical Engineering, Aeronautical Engineering and Mechanics, Rensselaer Polytechnic Institute, Program Director for Manufacturing Machines and Equipment, Division of Design, Manufacture and Industrial Innovation, National Science Foundation, 1994-1996.
Visiting Scientist, Department of Mechanical Engineering and the Forest Products Laboratory, University of California at Berkeley, 1990-1991;
Assistant Professor of Mechanical Engineering (1977-1982), Department of Mechanical Engineering and Applied Mechanics, University of Michigan Research Associate & Lecturer (1975-1977), Research Assistant (1971-1975) Department of Mechanical Engineering, University of Wisconsin-Madison.
Engineering Trainee, Research and Development Division, Consolidated Papers, Inc., Wisconsin Rapids, WI, summer, 1973.
Engineering Trainee, Plant Engineering, S.C. Johnson Wax, Racine, WI, summers 1970, 1971.

5. CONSULTING, PATENTS, ETC.

University of South Florida, Tampa, FL (5 days/year, 2002).

6. STATE(S) IN WHICH REGISTERED

7. PRINCIPAL PUBLICATIONS WITHIN LAST 5 YEARS

8. SCIENTIFIC & PROFESSIONAL SOCIETIES OF WHICH A MEMBER

American Society of Mechanical Engineers, North American Manufacturing Research Institution of SME (NAMRI/SME)

Society of Manufacturing Engineers, International Institution for Production Engineering Research (CIRP)
American Society for Engineering Education, Society of Women Engineers.

9. HONORS & AWARDS

Charles Russ Richards Memorial Award of Pi Tau Sigma and ASME, (2005), for “outstanding achievement in mechanical engineering for 20 years or more following graduation.”
Distinguished Service Citation, College of Engineering, University of Wisconsin-Madison, (2004),”Recognized for his engineering educational excellence, pioneering research in material removal processes and systems, and outstanding leadership of the NSF Division that is the primary advocate for the manufacturing sector.”

Fellow of both SME (1999) and ASME (1997).
Outstanding Service Award, ASME Manufacturing Engineering Division, (1997), "in recognition of his dedicated and long standing service and innovations that have significantly enhanced the image of the Division." University LEAD Award, Member of the Rensselaer Polytechnic Institute team, SME, (1987), for "Leadership Excellence in the Application and Development (LEAD) of Computer Integrated Manufacturing Curricula."
Outstanding Young Manufacturing Engineer, SME, (1983), "Conferred in recognition of significant achievement and leadership in manufacturing engineering." College of Engineering Fellow, University of Wisconsin-Madison, (1975) Marie Christine Kohler Fellow, University of Wisconsin-Madison, (1973-1975).
Pi Tau Sigma (1971), Tau Beta Pi (1980), Society of the Sigma Xi (1974)

10. INSTITUTIONAL & PROFESSIONAL SERVICE ON THE LAST 5 YEARS

American Society of Mechanical Engin**eers**: Governor, Board of Governors (1999-2002); Chair the Board of Governors' Congress Strategic Planning Committee, (2005-present), Member, The Board of Governors' Committee on Finance and Investment, (2004-present).
National Science Foundation: Member, Committee of Visitors for the National Science Foundations Division of Engineering Education and Centers, (2001). Member, Site visit teams for Engineering Research Centers.
Panelist for CAREER, SBIR and research proposals
Reviewer for professional journals such as ASME *Journal of Manufacturing Science and Engineering, Journal of Dynamic Systems, Measurement and Control, Journal of Mechanical Design;* American Society for Precision Engineering; *Wear; Institute of Industrial Engineers Transactions*; *Transactions of the North American Manufacturing Research Institution of SME,* SME *Journal of Manufacturing Systems*, National Research Council, NIST ATP Program.

11. PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST 5 YEARS

Professional and Public Lectures

"Thinking Further About 21st Century Manufacturing," 2004 SME Automation & Assembly Summit in Fort Worth, TX.
"NSF's Plans and Priorities for Enabling the Nation's Future", 11th Annual Kentucky EPSCoR Meeting, Louisville, KY, May 13, 2005.
"Nanomanufacturing", National Science and Technology Council Committee on Technology Interagency Working Group on Manufacturing Research and Development Public Forum, March 3, 2005
"Design, Manufacture & Industrial Innovation: Status, Plans and Future Look", 2004 at Rensselaer Polytechnic Institute, Dartmouth College and Worcester Polytechnic Institute, 2003 at Clemson University..
The US National Science Foundation's Investments in Manufacturing Enterprises for the Future, Keynote Speaker, 34th Annual Monterrey Tech Research and Innovation Conference, Monterrey MX, February, 2004; Keynote
Presentation, 7th International Conference on Manufacturing Technology, Hong Kong, China, December, 2003.
Opportunities to Participate In Research, Education and Innovation at NSF, Clark-Atlanta University, Atlanta, GA October, 2003.
Research Program Development, ASEE Annual Meeting, Nashville, TN, June 2003.
NSF Engineering: An Update for Department Chairs, INFORMS annual meetings November, 2002 in San Jose, CA October, 2003 in Atlanta, GA, ME Department Heads Committee, ASME Congress, November 2003. in Washington, DC and November 2004 in Anaheim, CA, and the Institute of Industrial Engineers annual meeting, May, 2005 in Atlanta, GA.
Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) at the National Science Foundation, University of Wisconsin-Milwaukee; April 2002, Elgin, IL; November 2003, and Wisconsin Entrepreneur's Conference in Milwaukee, WI, June 2004.

Foreign Professional Travel

January, 2006, University of Cyprus..
June 2004, National Science Foundation of China/Wu Symposium, Ji'an, China.
March, 2003, NSF representative on site visit team for DFG (German NSF) research center, University of Bremen, Germany.
January, 2003, Represented the National Science Foundation's Engineering Directorate at the inaugural meeting of the Latin American and Caribbean Consortium on Engineering Institutions, Santiago, Dominican Republic. CIRP General Assemblies in 2005 in Antalya, Turkey, 2004 in Crakow, Poland, 2003 in Montreal, Canada; January Meetings in 2006, 2003 and 2001in Paris, France.

IOWA STATE UNIVERSITY
Mechanical Engineering Department
Ames, IA 50011
Vita

1. PERSONAL DATA

Name: Donald R. Flugrad, Jr., Associate Professor

Address: 2038 Black Engineering, Ames, IA 50011 **Phone:** 515-294-9415

2. EDUCATION

Ph.D. - Mechanical Engineering, University of Missouri-Rolla, 1981
M.S. - Mechanical Engineering, University of Missouri-Rolla, 1973
B.S. - Mechanical Engineering, University of Missouri-Rolla, 1967

3. ACADEMIC RECORD WITH ISU

Associate Professor, 1991-present
Assistant Professor, 1978-1991

4. OTHER RELATED EXPERIENCE: TEACHING, INDUSTRIAL, ETC.

Co-Founder of CMnet, Incorporated, a software development company in the ISU Research Park
Graduate Instructor, University of Missouri-Rolla, 1974-1978
Teaching Assistant, University of Missouri-Rolla, 1972-1974
Associate Engineer, International Business Machines, Inc., 1967-1972
Summer Employment in Product Engineering, John Deere Des Moines Works, 1991, 1992, 1993, 1997

5. CONSULTING, PATENTS, ETC.

Consulting:

HON Industries, 1996, 1997
Mechanical Design Solutions, Inc., 1997
CIMTechnologies Corporation, 1995
Henderson and Sturm Patent Attorneys, 1990

***Patents*:**

Position Feedback Mechanism for an Implement; Inventors: Robert E. Fox, William L. Smith, Jr., Donald R. Flugrad, Jr.; Assignee: Deere & Company, Patent Number-5,339,906; Date of Patent: August 23, 1994.

Hand-Held Pointing Device; Inventors: Abir Z. Qamhiyah, Donald R. Flugrad, Jr.; Assignee: ISU Research Foundation, Patent Number 6,937,227, Date of Patent: August 30, 2005.

6. STATE(S) IN WHICH REGISTERED

7. PRINCIPAL PUBLICATIONS WITHIN LAST 5 YEARS

Flugrad, D., and Qamhiyah, A., "A Self-Actuating Traction-Drive Speed Reducer," ASME Journal of Mechanical Design, Vol. 127, No. 4, July 2005, pp. 631-636.

8. SCIENTIFIC & PROFESSIONAL SOCIETIES OF WHICH A MEMBER

American Society of Mechanical Engineers

9. HONORS & AWARDS

Iowa State University Faculty Citation, presented by the Iowa State University Alumni Association, October 2000.

Anna Pate Mentoring Award, 1998
Miller Faculty Fellow, 1996-1997
Outstanding Professor in Mechanical Engineering, 1984, 1995, 1996
Mechanical Engineering Professor of the Year, 1985, 1992
James H. Anderson Award for Design Education Excellence, 1992
Iowa Legislature Excellence in Teaching Award, 1991
Engineering College Superior Engineering Teaching Award, 1990
Engineering College Rockwell Excellence Award, 1989
Member, Tau Beta Pi, Engineering Honor Society
Member, Pi Tau Sigma, Mechanical Engineering Honor Society

10. INSTITUTIONAL & PROFESSIONAL SERVICE IN THE LAST 5 YEARS

Professional Society Activities:

Paper reviewer for ASME *Journal of Mechanical Design*

ABET Mechanical Engineering program evaluator for ASME.

Institutional Service Activities:

College Committees
Systems Engineering Degree Supervisory Committee, 1995-present
Curriculum, standing, Ad hoc member, 1998-2005
ABET Task Force, 1998-2005
Co-op/Internship Task Force, 1999-2005

Department Committees
Chair, Design Curriculum Development Committee
Chair, ME 325 Curriculum Development Committee
PICC Committee for M.E. Curriculum Improvement

Other Activities:
Associate Chair of Mechanical Engineering Department, 1998-2005
Served as mentor for Dr. Abir Qamhiyah, who was hired as an assistant professor in fall 1996
Faculty Adviser, Tau Beta Pi, 1991-2005

11. PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST 5 YEARS

Attended ABET evaluator training workshop, 2001.

Mechanical Engineering Department
Ames, IA 50011
Vita

1. PERSONAL DATA

Name: Theodore (Ted) J. Heindel, William and Virginia Binger Associate Professor

Address: 2026 Black Engineering, Ames, IA 50011 **Phone:** 515-294-0057

2. EDUCATION

Ph.D. - Mechanical Engineering, Purdue University, December 1994
M.S. - Mechanical Engineering, Purdue University, December 1990
B.S. - Mechanical Engineering, University of Wisconsin - Madison, May 1988

3. ACADEMIC RECORD WITH ISU

William and Virginia Binger Associate Professor of Mechanical Engineering, November 2001 - present
Associate Professor, August 2000 - present

4. OTHER RELATED EXPERIENCE: TEACHING, INDUSTRIAL, ETC.

Assistant Professor and Research Engineer, Institute of Paper Science and Technology, Atlanta, Georgia, September 1994 - July 2000

5. CONSULTING, PATENTS, ETC.

None

6. STATE(S) IN WHICH REGISTERED

None

7. PRINCIPAL PUBLICATIONS WITHIN LAST 5 YEARS

(over 40 total peer-reviewed journal publications)

Tang, C., and Heindel, T.J., “Estimating Gas Holdup via Pressure Difference Measurements in a Cocurrent Bubble Column,” *International Journal of Multiphase Flow*, To appear (2006).

Tang, C., and Heindel, T.J., “A Gas Holdup Model for Cocurrent Air-Water-Fiber Bubble Columns,” *Chemical Engineering Science*, In press (2006).

Tang, C., and Heindel, T.J., “Quantifying the Fiber Effect on Gas Holdup in a Cocurrent Air-Water-Fiber Bubble Column,” *The Canadian Journal of Chemical Engineering*, To appear (2006).

Su, X., Hol, P.D., Talcott, S.M., Staudt, A.K. and Heindel, T.J., “The Effect of Bubble Column Diameter on Gas Holdup in Fiber Suspensions,” *Chemical Engineering Science*, In press (2006).

Su, X., and Heindel, T.J., “Gas Holdup Models for Gas-Liquid-Fiber Semi-Batch Bubble Columns,” *Industrial and Engineering Chemistry Research*, 44(24) 9355-9363 (2005).

Tang, C., and Heindel, T.J., “Gas-Liquid-Fiber Flow in a Cocurrent Bubble Column,” *AIChE Journal*, 51(10): 2665-2674 (2005).

Tang, C., and Heindel, T.J., “Effect of Fiber Type on Gas Holdup in a Cocurrent Air-Water-Fiber Bubble Column,” *Chemical Engineering Journal*, 111(1): 21-30 (2005).

Su, X., and Heindel, T.J., “Effect of Perforated Plate Open Area on Gas Holdup in Rayon Fiber Suspensions,” *ASME Journal of Fluids Engineering*, 127(4), 816-823 (2005).

Hubers, J.L., Striegel, A.C., Heindel, T.J., Gray, J.N., and Jensen, T.C., “X-ray Computed Tomography in Large Bubble Columns,” *Chemical Engineering Science*, 60(22), 6124-6133 (2005).

Hol, P.D., and Heindel, T.J., “Local Gas Holdup Variation in a Fiber Slurry,” *Industrial and Engineering Chemistry Research*, 44, 4778-4784 (2005).

Su, X., and Heindel, T.J., “Gas Holdup Behavior in Nylon Fiber Suspensions,” *Industrial and Engineering Chemistry Research*, 43, 2256-2263 (2004).

Giorges, A.T.G., White, D.E., and Heindel, T.J., “Concentric Mixing of Hardwood Pulp and Water,” *TAPPI Journal*, 3(5): Online Exclusive (2004). (http://www.tappi.org/content/pdf/journal/04MAYTJ.pdf).

Tang, C., and Heindel, T.J., “Time-Dependent Gas Holdup Variation in an Air-Water Bubble Column,” *Chemical Engineering Science*, 59(3): 623-632 (2004).

Heindel, T.J., “A Review of Gas Flows in Fiber Suspensions,” *TAPPI Journal*, 2(11): Online Exclusive (2003). (http://www.tappi.org/journals/99516603NOV22.pdf).

Su, X., and Heindel, T.J., “Gas Holdup in a Fiber Suspension,” *The Canadian Journal of Chemical Engineering*, 81(3-4): 412-418 (2003).

Bloom, F., and Heindel, T.J., "Modeling Flotation Separation in a Semi-Batch Process," *Chemical Engineering Science*, 58(2): 353-365 (2003).
Heindel, T.J., and Bloom, F., "Theory of Dispersed Air Flotation," In *Encyclopedia of Surface and Colloid Science*, A. Hubbard, Ed., Marcel Dekker, New York, 5298-5311 (2002).
Bloom, F., and Heindel, T.J., "On the Structure of Collision and Detachment Frequencies in Flotation Models," *Chemical Engineering Science*, 57(13): 2467-2473 (2002).
Heindel, T.J., "Bubble Size in a Cocurrent Fiber Slurry," *Industrial and Engineering Chemistry Research*, 41(3): 632-641 (2002).

8. SCIENTIFIC & PROFESSIONAL SOCIETIES OF WHICH A MEMBER

American Institute of Chemical Engineers (AIChE)
American Physical Society (APS)
American Society for Engineering Education (ASEE)
American Society of Mechanical Engineers (ASME)
Technical Association of the Pulp and Paper Industry (TAPPI)
Pi Tau Sigma Mechanical Engineering Honor Society
Tau Beta Pi Engineering Honor Society

9. HONORS & AWARDS

Iowa State University Miller Faculty Fellow, AY 2003/2004
Recipient of Binger Professorship Medallion, ISU President's Convocation, September 23, 2002.
Recognized by ISU Engineering Student Council with Leadership Award - Spring 2002, Spring 2005.
Nominated for 2001 VEISHEA Outstanding Faculty Member Award at ISU - 2001
Nominated for Institute of Paper Science and Technology Teacher of the Year Award - 1996-1999
Institute of Paper Science and Technology President's Award for Excellence in Teaching - 1997
Institute of Paper Science and Technology Teacher of the Year Award - 1997
Georgia Tech Teaching Fellow, Winter 1996 Class

10. INSTITUTIONAL & PROFESSIONAL SERVICE IN THE LAST 5 YEARS

Professional Society Activities:

Associate Editor, ASME Journal of Fluids Engineering, November 2004 - present
Reviewer, NSF SBIR/STTR and CTS Division
Reviewer for over 12 peer-reviewed journals
Chairman: 2006 ASME Fluids Engineering Division Summer Meeting Topical Forum entitled, "Flow Applications in the Process Industries," July 17-19, 2006, Miami, FL
Co-Chairman: 2005 ASME Fluids Engineering Division Summer Meeting Topical Session entitled, "2nd Symposium on Measurements in Opaque Fluids," June 19-23, 2005, Houston, TX
Co-Chairman: 2004 ASME Heat Transfer/Fluids Engineering Summer Conference Topical Session entitled "Transport Phenomena in Gas-Solid-Liquid Three-Phase Flow Systems," July 11-15, 2004, Charlotte, NC

Institutional Service Activities:

University Level:
2004 Carver Trust Grant Review Committee, March-April 2004
College Level:
Honors Program Committee, August 2003-present
Department Level:
Chair, ME 370 - Measurement and Instrumentation CDC, April 2003 - present
ME Honors and Awards Committee, August 2004-present
ME Governance Document Committee, January 2004-May 2005
ME Curriculum Committee, August 2000-May 2004

11. PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST 5 YEARS

None

IOWA STATE UNIVERSITY
Mechanical Engineering Department
Ames, IA 50011
Vita

1. PERSONAL DATA

Name: Atul G. Kelkar, Professor

Address: 2018 Black, Mechanical Engineering
Iowa State University, Ames, IA 50011 **Phone:** 515-294-0788

2. EDUCATION

Ph.D. - Mechanical. Engineering, Old Dominion University, Norfolk, VA,, August 1993
M.S. - Mechanical. Engineering, Old Dominion University, Norfolk, VA,, April 1990
B.S. - Mechanical. Engineering, University of Poona, Pune, India, June 1984

3. ACADEMIC RECORD WITH ISU

Professor, Mechanical Engineering, August 2005- present
Associate Professor, Mechanical Engineering, January 2001 - July 2005

4. OTHER RELATED EXPERIENCE: TEACHING, INDUSTRIAL, ETC.

Kansas State University, Manhattan, Kansas
  Mechanical and Nuclear Engineering
  Associate Professor (Aug. 1999-Dec. 0200); Assistant Professor (Jan. 1996-Aug. 1999)
NASA Langley Research Center, Hampton, Virginia
  Associate Fellow, National Research Council (NRC), June 1994 - January 1996
Old Dominion University, Norfolk, Virginia
  Adjunct Assistant Professor, Mechanical Engineering Department, August 1993 - January 1996
  Visiting Assistant Professor, Aerospace Engineering Department, September 1993 - August 1994
NASA Langley Research Center, Hampton, Virginia
  Research Associate, June 1990 - September 1993
Larsen and Toubro Limited, Bombay, India - Design and Planning Engineer, July 1984 - July 1987
Tata Engineering and Locomotive Co. Ltd., Pune, India - Trainee Engineer, 06-12/1982 and 01-06/1984

5. CONSULTING, PATENTS, ETC.

U.S. Patent Application # 10/731,742 - A. G. Kelkar and S. M. Joshi: *Method and System to Perform Energy Extraction-based Active Noise Control*, ISURF file #03045.
U.S. Patent Application # 11/187, 366 - Jerry Vogel and A. G. Kelkar: *A Continuously Variable Natural Frequency Vibration Isolation System*, filed July 2005.
U.S. Patent Application # 60/647,489 - Christopher Whitmer, Craig Shores, Atul Kelkar: *Active-Passive Composite Material for Vibration and Noise Control*, filed January 2005.

6. STATE(S) IN WHICH REGISTERED

None

7. PRINCIPAL PUBLICATIONS WITHIN LAST 5 YEARS

[1] A. G. Kelkar, Y. Mao, and S. M.Joshi. Synthesis of lq-optimal constant-gain positivereal controllers. *Control and Intelligent Systems*, 29(3):65–73, 2001.
[2] H. R. Pota and A. G. Kelkar. On perfect acoustic noise cancelling control. *IASTED Journal of Intelligent Systems and Control*, 28, No.2, pp. 48-54(2):48–54, 2001.
[3] H. R. Pota and A. G. Kelkar. Modeling and control of acoustic ducts. *ASME Journal of Vibration and Acoustic*, 123(1):2–10, January 2001.
[4] S. M. Joshi and A. G. Kelkar. Passivity-based robust control of systems with redundant sensors and actuators. *International Journal of Control*, 74(5):474–481, March 2001.
[5] S. Woodard, A. G. Kelkar, and G. Koganti. Multidisciplinary concurrent design optimization via the internet. *NASA Technical Memorandum*, (TM-2001-210644), March 2001.
[6] F. Andreev, D. Auckley, S. V. Gosavi, L. Kapitanski, A. G. Kelkar, and W. N. White. Matching, linear systems, and the ball and beam. *Automatica*, 38(12):2147–2152, 2002.
[7] S. M. Joshi and A. G. Kelkar. Design of norm bounded and sector-bounded lqg controllers for uncertain systems. *International Journal of Optimization Theory and Applications*, 113(2):269–282, May 2002.

[8] S. M. Joshi, D. E. Cox, and A. G. Kelkar. Robust control of uncertain systems via norm- and sector-bounded lqg-type controllers. *International Journal of Optimization Theory and Applications*, 113(2):269–282, May 2002.
[9] H. R. Pota, I. R. Petersen, and A. G. Kelkar. Robust control of a 2-d acoustic enclosure. *ASME Journal of Vibration and Acoustics*, 125:1–10, 2003.
[10] P. Krishnaswami and A. G. Kelkar. Optimal design of controlled multibody dynamic systems for performance, robustness, and tolerancing. *Engineering with Computers*, 19:26–34, 2003.
[11] A. G. Kelkar and H. R. Pota. Robust broadband control of acoustic noise in ducts: A passivity-based approach. *International Journal of Noise Control Engineering*, 51(2):97–105, March-April 2003.
[12] A. G. Kelkar and H. R. Pota. Robust broadband control of acoustic noise in ducts: A passivity-based approach. *International Journal of Noise Control Engineering*, 51(2):97–105, Mar-Apr 2003.
[13] S.V.Gosavi and A. G. Kelkar. Modeling, identification, and passivity-based robust control of piezo-actuated flexible beam. *ASME Journal of Vibration and Acoustics*, 126(2):260–271, April 2004.
[14] B. Fang, A. G. Kelkar, S. M. Joshi, and H. R. Pota. Modeling and control of acoustic noise in 3-d enclosures with acoustic-structure interaction. *Control Engineering Practice, Elsevier Publication*, 12 (Special Issue On Emerging Technologies for Active Noise and Vibration Control Systems):989–1004, 2004.

8. SCIENTIFIC & PROFESSIONAL SOCIETIES OF WHICH A MEMBER

ASME, Sigma Xi

9. HONORS & AWARDS

ASME Fellow
Recipient of NSF CAREER award
Honored Member of America's Registry of Outstanding Professionals
Recipient of National Research Council (NRC) Fellowship, 1994-1996
Nominee for ASME Dynamic Systems & Control Division's *Outstanding Young Investigator Award*, 1999

10. INSTITUTIONAL & PROFESSIONAL SERVICE IN THE LAST 5 YEARS

Professional Society Activities

National and International Service:

<u>Review Activities</u>
Reviewer for numerous ASME, IEEE, and AIAA journals; NSF technical review panels; and various international conferences. Invited reviewer for text books.

<u>Editorial Activities</u>
Associate editor for leading controls journals for ASME and IEEE
Served on IEEE Conference Editorial Board over 4 years
Associate editor for ASME Dynamic Systems and Control Division conference reviews

<u>Committee Activities</u>
Operating Committee member for key conferences
Served on Program Committees for several international conferences

<u>Organization and Panel Activities</u>
Panel member for NSERC Evaluation Committee, January - February 2006, Organizer for several technical sessions and invited sessions for IEEE and ASME conferences, Panel chair over 4 years for Aerospace Systems panel for ASME DSCD Division, Chaired and co-chaired numerous technical sessions in various conferences, Student Best Paper Award Judging Panel

Institutional Service Activities

<u>University Service</u>
Member of Special Task Force on salary compression

<u>College Service</u>
Serving on College of Engineering Research Awards Committee, Promotion and Tenure Committee

<u>Department Service</u>
Served on departmental committees: Faculty Search, Enrollment Management, Curriculum, Course Development, Teaching Load Assessment, Graduate, Computer, Library Liaison

11. PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST 5 YEARS

IOWA STATE UNIVERSITY
Mechanical Engineering Department
Ames, IA 50011
Vita

1. PERSONAL DATA

Name: Song-Charng Kong, Assistant Professor
Address: 3028 Black Engineering, Ames, IA 50011 **Phone:** 515-294-3244

2. EDUCATION

Ph.D. – Department of Mechanical Engineering, University of Wisconsin-Madison, 1994
M.S. - Department of Mechanical Engineering, University of Wisconsin-Madison, 1992
B.S. – Department of Power Mechanical Engineering, National Tsing-Hua University-Taiwan, 1987

3. ACADEMIC RECORD WITH ISU

Assistant Professor, August 2005-present

4. OTHER RELATED EXPERIENCE: TEACHING, INDUSTRIAL, ETC.

Associate Scientist, University of Wisconsin-Madison, 1998-2005
Associate Professor, Department of Mechanical Engineering, Chung-Hua University, Taiwan, 1994-1998

5. CONSULTING, PATENTS, ETC.

Consulting for automotive industry, 2000-present

6. STATE(S) IN WHICH REGISTERED

7. PRINCIPAL PUBLICATIONS WITHIN LAST 5 YEARS

Kong, S.-C., Ra, Y. and Reitz, R.D., "Performance of Multi-Dimensional Models for Simulating Diesel PCCI Engine Combustion Using Low and High Pressure Injectors," *Int. J. Engine Research*, Vol. 6, pp. 475-486, 2005.

Kong, S.-C., Sun, Y. and Reitz, R.D., "Modeling Diesel Spray Flame Lift-Off, Sooting Tendency and NOx Emissions Using Detailed Chemistry with Phenomenological Soot Models," *ASME J. Eng Gas Turbines Power*, 2005.

Kong, S.-C., Kim, H., Reitz, R.D. and Kim, Y., "Comparisons of Combustion Simulations Using A Representative Flamelet Model and Direct Integration of CFD with Detailed Chemistry," *ASME J. Eng Gas Turbines Power*, 2005.

Liang, L., Jung, C., Kong, S.-C. and Reitz, R.D., "Development of a Semi-Empirical Solver for Detailed Chemistry in I.C. Engine Simulations," *ASME J. Eng Gas Turbines Power*, 2006.

Dougan, C.L., Kong, S.-C. and Reitz, R.D., "Modeling the Effects of Variable Intake Valve Timing on Diesel HCCI Combustion at Varying Load, Speed and Boost Pressures," *ASME J. Eng Gas Turbines Power*, 2006.

Kong, S.C., Patel, A., Yin, Q. and Reitz, R.D., "Numerical Modeling of Diesel Engine Combustion and Emissions Under HCCI-Like Conditions with High EGR Levels," SAE Paper 2003-01-1087, *Journal of Engines*, Vol. 112, pp. 1500-1510, 2003.

Eckert, P., Kong, S.C. and Reitz, R.D., "Modeling Autoignition and Engine Knock Under Spark Ignition Conditions," SAE Paper 2003-01-0011, *Journal of Engines*, Vol. 112, pp. 100-111, 2003.

Zhang, Y., Kong, S.C. and Reitz, R.D., "Modeling and Simulation of a Dual Fuel (Diesel/Natural Gas) Engine with Multidimensional CFD", SAE Paper 2003-01-0755, *Journal of Fuels and Lubricants*, Vol. 112, pp. 336-347, 2003.

Kong, S.C., Reitz, R.D., Christensen, M. and Johansson, B., "Modeling the Effects of Geometry Generated Turbulence on HCCI Engine Combustion," SAE Paper 2003-01-1088, *Journal of Engines*, Vol. 112, pp. 1511-1521, 2003.

Kong, S.C. and Reitz, R.D., "Numerical Study of Premixed HCCI Engine Combustion and Its Sensitivity to Computational Mesh and Model Uncertainties," *Combust Theory Modeling*, Vol. 7, pp.417-433, 2003.

Kong, S.C. and Reitz, R.D., "Application of Detailed Chemistry and CFD for Predicting Direct Injection HCCI

Engine Combustion and Emissions," *Proc. Combust. Inst.* Vol. 29, pp.663-669, 2002.

Kong, S.C. and Reitz, R.D., "Use of Detailed Chemical Kinetics to Study HCCI Engine Combustion with Consideration of Turbulent Mixing Effects," *ASME J. Eng Gas Turbines Power,* Vol. 124, pp.702-707, 2002.

Marriott, C.D., Kong, S.C. and Reitz, R.D., "Investigation of Hydrocarbon Emissions from a Direct Injection Gasoline Premixed Charge Compression Ignited Engine," SAE Paper 2002-01-0419, *Journal of Engines*, Vol. 111, pp. 875-888, 2002.

8. SCIENTIFIC & PROFESSIONAL SOCIETIES OF WHICH A MEMBER

American Society of Mechanical Engineers
Society of Automotive Engineers
The Combustion Institute
Institute of Liquid Atomization and Spray Systems

9. HONORS & AWARDS

Myers-Uyehara Meritorious Paper Award, University of Wisconsin-Madison, 1993

10. INSTITUTIONAL & PROFESSIONAL SERVICE IN THE LAST 5 YEARS

Professional Society Activities

Conference organizer and chair
ASME IC-Engine Division Conference, 2003-present
Society of Automotive Engineers Conference, Diesel Modeling Session, 2002-present
International Multidimensional Engine Modeling User's Group Meeting, 2002-present
Institute of Liquid Atomization and Spray Systems Conference, Diesel Session, 2005

Education Outreach
Instructor in *Multidimensional Engine Modeling Workshop*, annually, 2000-present

Institutional Service Activities

Course Development Committee (Design Courses), August 2005-present

11. PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST 5 YEARS

CHEMKIN Training Course, San Diego, CA, January 10-11, 2002

IOWA STATE UNIVERSITY
Mechanical Engineering Department
Ames, IA 50011
Vita

1. PERSONAL DATA

Name: Greg R. Luecke

Address: 3033 Black Engineering Bldg, Ames, IA 50011 **Phone:** 515-294-5916

2. EDUCATION

Ph.D. - Pennsylvania State University, 1992
M.S. - Yale University, 1987
B.S.M.E. - University of Missouri-Columbia, 1979

3. ACADEMIC RECORD WITH ISU

Associate Professor, 1998-present
Assistant Professor, 1992-1998

4. OTHER RELATED EXPERIENCE: TEACHING, INDUSTRIAL, ETC.

1990	Mechanical Design Consultant, Pennsylvania State University, University Park, PA
1988-1992	VAX Computer System Manager, , Department of Mechanical Engineering Pennsylvania State University, University Park, PA
1985-1988	Instructor, Mechanical Engineering, Bridgeport Engineering Institute, Bridgeport, CT,
1981-1988	Design Engineer, Mechanical Flight Controls, Sikorsky Aircraft, Stratford, CT
1980-1981	Associate Engineer/Scientist, McDonnell-Douglas Corporation, Long Beach, CA

5. CONSULTING, PATENTS, ETC.

***Consulting**:*
John Deere & Co.
Fisher Controls
Winegard Company
Positech, Inc
American Meter
R.J. Hudson

***Patents*:**
U.S. Patent Number 5,675,487, October 7, 1997.
Patterson, J., and Luecke, G. R. "System for Controlling Energy Through Windows"
U.S. Patent Number 4,555,219, August 24, 1984.
Jeffery, P. J., and Luecke, G. R. "Hub Mounted Actuators for Blade Pitch Control,"

6. STATE(S) IN WHICH REGISTERED

Licensed Professional Engineer-State of Iowa, 1997-present

7. PRINCIPAL PUBLICATIONS WITHIN LAST 5 YEARS

Yongjun Hou, Greg R. Luecke, "Passivity Control of Teleoperation Systems with Time Delay", Proceedings of the 12^{th} International Conference on Advanced Robotics, Seattle WA July18-20, 2005.

Saeid Habibi, Greg R. Luecke, "Inner-loop Feedback for Deadband Compensation in Electromechanical Flight Surface Actuation Systems", Proceedings of the ASME International Mechanical Engineering Conference and Exhibition, Orlando, FL Nov 15-17, 2005.

Yongjun Hou, Greg R. Luecke, "Passivity Control of Teleoperation Systems with Time Delay", The 10th IASTED International Conference on Robotics and Automation (RA 2004), Honolulu, HI, August, 2004, pg 233-238.

Yongjun Hou, Greg R. Luecke, "Control of the Tight Rope Balancing Robot", International Symposium on Intelligent Control, Houston, TX, October, 2003, p 896 - 901

Luecke, G.R: "Multi-tiered control for undergraduate mechatronics", Mechatronics, v 12, n 2, February , 2002, p 311-321

Luecke, G. R., "Haptic Interaction for Control Interface Prototyping" Proceedings of the IASTED International Conference Control and Applications, May 20-22, 2002, pg, 266-272

Luecke, G. R., "Stability effects of singularities in force controlled robotic assist devices" Proceedings of the SPIE International Symposium on Intelligent Systems and Advanced Manufacturing-Telemanipulator and Telepresence Technologies VIII, Boston, MA, Oct. 25-29, 2001.

8. SCIENTIFIC & PROFESSIONAL SOCIETIES OF WHICH A MEMBER

American Society of Mechanical Engineers
IEEE
SAE - Faculty Advisor

9. HONORS & AWARDS

1998 SAE Faculty Advisor Award
1996 Ralph R. Teetor Educational Award, SAE
1992 Faculty Fellow-Iowa Center for Emerging Manufacturing and Technology

10. INSTITUTIONAL & PROFESSIONAL SERVICE IN LAST 5 YEARS

Professional Society Activities:

Reviewer for
IEEE Transactions on IEEE Transactions on Control Systems Technology;
IASTED Conference on Control System Technology
IEEE Conference on Decision and Control
International Journal of Robotics Review
ASME IMECE
Journal of Computing and Information Science in Engineering
Journal of Robotic Systems
Journal of Dynamic Systems, Measurement and Control
SAE ABET Relations Committee, 2002-2004
Vice-Chair-Student Activities, SAE Mississippi Valley Section

Institutional Service Activities:

ME Graduate Committee, F2003, S2004, F2005
College of Engineering International Task Team, 2002-2004
College of Engineering Professional Development Committee, 2004-2007
Engineering College Curriculum Committee, 2001F

11. PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST 5 YEARS

Visiting professor, Australian National University, Canberra, AU, July 2003 -January 2004

IOWA STATE UNIVERSITY
Mechanical Engineering Department
Ames, IA 50011
Vita

1. PERSONAL DATA

Name: J. Adin Mann III

Address: 2074 Black Engineering Building
Iowa State University, Ames, IA 50011

Phone: 515-294-2877

2. EDUCATION

Ph.D. - The Pennsylvania State University, Acoustics, May 1988
B.S. - Iowa State University, Engineering Science, May 1984

3. ACADEMIC RECORD WITH ISU

Associate Professor, 1995-present
Mechanical Engineering, 2002-present
Director of Graduate Education, 2003-present
Aerospace Engineering and Engineering Mechanics, 1995-2003
Assistant Professor, 1989-1995

4. OTHER RELATED EXPERIENCE: TEACHING, INDUSTRIAL, ETC.

Fisher Controls International, Marshalltown, Iowa, June 2002 – August 2002 (continue as technical consultant)
NASA Glenn Research Center, Cleveland, Ohio, February 1999-May 1999
Royal Appliance Mfg. Co., Cleveland, Ohio, June 1998-May 1999
NAVY-ASEE Summer Faculty Research Program, Naval Research Lab, Washington, D.C., Summer 1990
Postdoctoral Research, Centre Techniques des Industries Mechanique, Senlis, France, 1988-1989
Visiting Scientist, Physikalisch - Technische Bundesanstalt, Braunschweig (West Germany), Fall 1986
American Lung Association Summer Research Fellowship, Department of Physics, Case Western Reserve University, Cleveland, Ohio, Summer 1984

5. CONSULTING, PATENTS, ETC.

Consulting:

John Deere Dubuque Works, January 2005 – July 2005, Develop a computational model of tone noise from cooling fans.
Fisher Controls International, June 2001 – present, Develop model for the sound radiation from bypass sparges in an air-cooled power plant.
Ingersoll-Rand Sir Compressor Division, Davidson NC, April-June 2004, Implement computer code for a measurement system.
Ametek, Spring-Summer 2001, Develop program to evaluate motor noise and provide design ideas for new product development.
Beam Industries, Fall 1999- Fall 2000, Design a noise control solution to a product line.

Patents:

J. Adin Mann, Robert McKee, Doug Zlatic, “Impeller Housing with Reduced Noise and Improved Airflow,” U.S. Patent Number 6,171,054, January 9, 2001.
Stephen Rittmueller, J. Adin Mann III, David Holger, and Douglas Johnson, "Muffler to reduce exhaust noise from central vacuum cleaners," U.S. Patent Number 6,052,863, April 25, 2000.
Matthew Moore, J. Adin Mann III, Jerald Vogel, and Ambar Mitra, “Measurement of Dynamic Air Pressure on a Ground Surface Beneath a Multiple Spindle Lawn Mower System”, U.S. Patent Number 6,065,347, May 23, 2000.
Stephen Rittmueller, Douglas Johnson, Steven Lauritsen, J. Adin Mann III, and David Holger, “Central Vacuum with Acoustical Damping”, U.S. Patent Number 5,737,797, April 14, 1998.

6. STATE(S) IN WHICH REGISTERED

7. PRINCIPAL PUBLICATIONS WITHIN LAST 5 YEARS

Christopher P. Masini and J. Adin Mann III, "Application of System Engineering Processes to Analyze and Predict Engine Cooling Fan System Noise for Off-highway Machines" Proc of NoiseCon, 2005.

Denis G. Karczub, Richard Eberhart, Fred W. Catron, Allen C. Fagerlund, J. Adin Mann III, "Piping Noise Transmission Loss Calculations Using FEA," Proc of NoiseCon, 2005.

Fred W. Catron and J. Adin Mann III, "Comparison of Models for Piping Transmission Loss Estimations," Proc of NoiseCon, 2005.

John W. Laage **,** Ashli J. Armstrong, Daniel J. Eilers, Michael G. Olsen, and J. Adin Mann III, "Air Flow Measurement Techniques Applied to Noise Reduction of a Centrifugal Blower," Proc of NoiseCon, 2005.

Todd A. Thompson and J. Adin Mann III, "Evaluating the Bonding Condition of NASA Spray on Foam Insulation (SOFI) Using Audio Frequency Sound Absorption Measurements," Proc of NoiseCon, 2005.

J. Adin Mann III, Allen C. Fagerlund, Charles Depenning, and Fred W. Catron, "Measuring High Frequency Valve Noise to Evaluate Interference with Ultrasonic Flow Meters," Proc of NoiseCon, 2005.

John W. Laage, Pranay Mahendra, Paul J. Melzer, Michael G. Olsen, and J. Adin Mann III, Dale Yarbough, and Chen Yu, "Measurement Tools for Studying Fan Noise," Proc. NoiseCon, 2004.

J. Adin Mann III, Allen Fagerlund, Charles DePenning, Fred Catron, Richard Eberhart and Denis Karczub, "Predicting the External Noise from Multiple Spargers in an Air-Cooled Power Plant", Proc NoiseCon, 2003. Invited talk in special session on power plant noise.

Kristin Bleedorn, Margaret Mathison, Matthew McKee, Ryan Satterly, Dale Yarbough, Chen Yu, Edward L. Zechmann, J. Adin Mann III, "Measuring the Noise Levels and Identifying the Primary Noise Sources of a Commercial Table Saw," Proc. Noise Con, 2002. Invited talk in special session on product noise control.

Edward Zechmann and J. Adin Mann III, "Projecting with Nearfield Acoustic Holography Past Intermediate Sources," Proc. Inter-Noise, 2002.

8. SCIENTIFIC & PROFESSIONAL SOCIETIES OF WHICH A MEMBER

Institute of Noise Control Engineering

9. HONORS & AWARDS

Lloyd E. Anderson Superior Service to Industry, ISU Extension, 2002
North East Association of Graduate Schools Dissertation Award, 1991

10. INSTITUTIONAL & PROFESSIONAL SERVICE IN THE LAST 5 YEARS

Professional Society Activities:

Council for the Accreditation of Occupational Hearing Conservation (CAOHC) (2005 – present)
Board Member representative for the Institute of Noise Control Engineering
Chair, Industrial Noise subcommittee, Institute for Noise Control Engineering (2000-2003)

Institutional Service Activities:

<u>University Committees</u>
Honors Committee, Fall 2000-Spring 2003

<u>College Committees</u>
Engineering Minor Committee (Spring 2005)
College of Engineering Honors Program Committee:
Member: Fall 1999 – Spring 2003
Chair: Fall 2000 – Spring 2003

<u>Department Committees</u>
Course Development Committees (CDC):
ME 370 (2003-present) ME 270 (2004) Design (2005-present)
Graduate Program Committee:
Chair (2003) Member as DOGE (2003-present)
ME/IMSE Merger Committee (2003)

11. PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST 5 YEARS

IOWA STATE UNIVERSITY
Mechanical Engineering Department
Ames, IA 50011
Vita

1. PERSONAL DATA

Name: Gregory M. Maxwell, Associate Professor

Address: 3029 Black Engineering, Ames, IA 50011 **Phone:** 515-294-8645

2. EDUCATION

Ph.D. - Mechanical Engineering, Purdue University, 1984
M.S. - Nuclear Engineering, Purdue University, 1977
B.S. - Physics, Purdue University, 1973

3. ACADEMIC RECORD WITH ISU

Associate Professor, May 1991-present
Assistant Professor, August 1985

4. OTHER RELATED EXPERIENCE: TEACHING, INDUSTRIAL, ETC.

Engineer, Carrier Corporations, Research Division, Syracuse, New York, 1983-1985
Engineer, Oak Ridge National Laboratory, Engineering Technologies Division, Oak Ridge, TN, 1976-1979

5. CONSULTING, PATENTS, ETC.

6. STATE(S) IN WHICH REGISTERED

7. PRINCIPAL PUBLICATIONS WITHIN LAST 5 YEARS

Manz, H., P. Loutzenhiser, T. Frank, P.A. Strachan, R. Bundi, and G. Maxwell. Series of Experiments for Empirical Validation of Solar Gain Modeling in Building Energy Simulation Codes—Experimental Setup, Test Cell Characterization, Specifications and Uncertainty Analysis. (Accepted for publication in *Building and Environment* on July 12, 2005 and available online at www.sciencedirect.com)

Loutzenhiser, P. and G. Maxwell, “Shortcomings of Building Energy Simulation Codes in Modeling Outside Airflow Rates for Variable-air-volume Systems with Fixed Damper Positions”, Nordic Symposium on Building Physics, Reykjavik, Iceland, June 13-15, 2005.

Rivera, P and G. Maxwell, “Simulation of Compressed Air Systems”, ACEEE Summer Studies, Rye New York, July 2003.

Maxwell, G. and Tim O’Neil, “The Iowa State University Industrial Assessment Center – A Winning Combination for Students, Faculty and Industry”, in the Proceedings of the Annual Conference of the American Society for Engineering Education, St. Louis, Missouri, June 2000.

8. SCIENTIFIC & PROFESSIONAL SOCIETIES OF WHICH A MEMBER

American Society of Heating, Refrigerating and Air-Conditioning Engineers

9. HONORS & AWARDS

"Professor of the Year" Award presented by Mechanical Engineering students, 2000
"Iowa State University Foundation Award for Outstanding Achievement in Teaching", 1999

10. INSTITUTIONAL & PROFESSIONAL SERVICE IN LAST 5 YEARS

Institutional Service Activities:

College Committees:
Honor and Awards
Scholarship

Department Committees:
Departmental Faculty Search
Department Scholarships
ISU ASHRAE Student Chapter Advisor, 1987-present

11. PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST 5 YEARS

Department of Energy Qualified Air Master Specialist, 2004

IOWA STATE UNIVERSITY
Mechanical Engineering Department
Ames, IA 50011
Vita

1. PERSONAL DATA

Name: Palaniappa (Pal) A. Molian, Professor

Address: 3031 Black Engineering Building, Ames, IA 50011-2161 **Phone:** 515-294-2101

2. EDUCATION

Ph.D. - Materials Science and Engineering, Oregon Graduate Institute of Science and Technology, Beaverton, Oregon, 1982

M.E. - Mechanical Engineering, Indian Institute of Science, Bangalore, India, 1977

B.E. - Mechanical Engineering, Indian Institute of Science, Bangalore, India, 1975

3. ACADEMIC RECORD WITH ISU

Professor of Mechanical Engineering, 1992-present
Associate Professor of Mechanical Engineering, 1987-1992
Assistant Professor of Mechanical Engineering, 1982-1987

4. OTHER RELATED EXPERIENCE: TEACHING, INDUSTRIAL, ETC.

Research Fellow, Oregon Graduate Institute of Science and Technology, 1979-1982
Development Engineer, India Pistons Ltd., Madras, India, 1977-1979

5. CONSULTING, PATENTS, ETC.

Consulting:

Iowa Laser Technology, Inc., Cedar Falls, Iowa, 1982-present
St.Jude Medical Center, Minneapolis, MN, 2000

***Patents*:**

Laser deposition of diamond films, U.S. Patent No. 07737, 906
Laser cutting technique for egg shells, U.S. Patent No. 5,285,750

6. STATE(S) IN WHICH REGISTERED

7. PRINCIPAL PUBLICATIONS WITHIN LAST 5 YEARS

1. Y. Dong and P. Molian, 2005. “In-situ formed nanoparticles on 3C-SiC film under femtosecond pulsed laser irradiation, Physica Status Solidi, 202, 6, 1066-1072, 2005.
2. Y. Dong, H. Sakata, P. Molian. 2005. “Femtosecond pulsed laser ablation of diamond-like carbon films on silicon,” Applied Surface Science 252, 2, 352 - 357, October 2005.
3. W. Jiang, P. Molian and H. Ferkel, 2005. “Rapid production of carbon nanotubes by high-power laser ablation”, ASME Transactions Journal of Manufacturing Science and Engineering, 127, 703-708, August 2005
4. W. Jiang, R. Nair, and P. Molian, 2005. “Functionally graded mold inserts by laser-based flexible fabrication: Processing, modeling, structural analysis, and performance evaluation,” Journal of Materials Processing Technology, 166, 2, 286-293, August 2005
5. F. Kustas, P. Molian, A. Sadhu Kumar, M. Besser, and D. Sordelet.2004. “Laser crystallization of amorphous sputter-deposited quasicrystalline coatings,” Surface Coatings and Technology, 188-189, 2004, 274-280

8. SCIENTIFIC & PROFESSIONAL SOCIETIES OF WHICH A MEMBER

American Society for Mechanical Engineers
American Society for Metals
The Metals, Minerals and Materials Society
Laser Institute of America
Society of Manufacturing Engineers

9. HONORS & AWARDS

Miller Faculty Fellow, 1999
Outstanding Reviewer for Journal of Manufacturing Science and Engineering, 1997

10. INSTITUTIONAL & PROFESSIONAL SERVICE IN THE LAST 5 YEARS

Institutional Service Activities:

Faculty Senate - Governance Structures and Documents (2002-2003)
Curriculum Committee, 2001- 2004
Promotion and Tenure Committee, 2002-2005
ME/IMSE merger committee, 2004
Mid-term Evaluation Committee for Assistant Professor Sriram Sundararajan (chair), 2005
Mid-term Evaluation Committee for Assistant Professor Shankar Subramanian, 2005
Special Promotion and Tenure Committee for Dr. Atul Kelkar, 2004
Mid-term Evaluation Committee for Assistant Professor Li Cao, 2004
Laboratory Committee – 2004
Space Committee (Chair) - 2004
Special Promotion and Tenure Committee for Dr. Mark Bryden, 2003
Honors and Awards Committee (Chair), 1999-2004
Special Promotion and Tenure Committee for Dr. Srinivas Garimella, 2002
Curriculum Committee, 1987-1988, 2000-2003
ME 324 Curriculum Development Committee, (Chair), 2000-Present
Promotion and Tenure Committee (Chair), 1988-1989, 1993-94, 1997-2000

11. PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST 5 YEARS

Attended short courses on advanced materials and manufacturing
Industry summer internship and visits
Laboratory development
Reviewer of texts, journal papers and research proposals
Speaker for Society for Manufacturing Engineers, American Society for Metals, The Metals, Materials and Minerals Society and American Welding Society
Reviewer of Ph.D. theses from foreign countries
Assisted Iowa industries for obtaining SBIR/STTR projects

IOWA STATE UNIVERSITY
Mechanical Engineering Department
Ames, IA 50011
Vita

1. PERSONAL DATA

Name: Ron M. Nelson, Professor

Address: 2024 Black Engineering, Ames, IA 50011 **Phone:** 515-294-6886

2. EDUCATION

Ph.D. - Mechanical Engineering, Stanford University, 1981
M.S. - Mechanical Engineering, Iowa State University, 1972
B.S. - Mechanical Engineering, Iowa State University, 1970

3. ACADEMIC RECORD WITH ISU

Professor, 1995-present
Associate Professor, 1986-1995
Assistant Professor, 1980-1986

4. OTHER RELATED EXPERIENCE: TEACHING, INDUSTRIAL, ETC.

Research Assistant, Stanford University, 1975-1980
Adjunct Professor with Peace Corps in Ecuador, 1972-1975
Research Assistant, Iowa State University, 1970-1972

5. CONSULTING, PATENTS, ETC.

Consulting:
Maytag Corporation, Newton, Iowa, 2005
Gateway Center, Ames, Iowa, 2004, 2005
Gregory Racette, Attorney, 1999, 2002

6. STATE(S) IN WHICH REGISTERED

Iowa

7. PRINCIPAL PUBLICATIONS WITHIN LAST 5 YEARS

Navale, R. L and R. M. Nelson, "Use of Chilled Water Valve and Lumped Capacitance Modeling to Improve Controller Performance", ASHRAE 2006, Atlanta, GA (in-review).

Navale, R. L and R. M. Nelson, "Comparison of Neural Network and Generalized Regression Neural Network Models of a Cooling Coil in an Air Handling System", ASHRAE 2006 (in-review).

Navale, R. L and R. M. Nelson, "Use of Genetic Algorithms and Evolutionary Strategies to Develop an Adaptive Fuzzy Logic Controller for a HVAC Application – Part 1 Genetic Algorithm", ASHRAE 2006 (in-review) – Part 2 Evolutionary Strategies", ASHRAE 2006 (in-review) – Part 3 Comparison of the AFLC with a standard PIDL controller", ASHRAE 2006 (in-review).

Joshi, S. N., M. B. Pate, R. M. Nelson, J. H. House, and C. J. Klaassen, "An Experimental Evaluation of Duct-Mounted Relative Humidity Sensors: Part 3 – Repeatability, Hysteresis and Linearity Results", ASHRAE Transactions, Paper 4799, June 2005, presented at the ASHRAE Annual Meeting, Denver, CO, June 2005.

Joshi, S. N., M. B. Pate, R. M. Nelson, J. H. House, and C. J. Klaassen, "An Experimental Evaluation of Duct-Mounted Relative Humidity Sensors: Part 2 – Accuracy Results", ASHRAE Transactions, Paper 4798, June 2005, presented at the ASHRAE Annual Meeting, Denver, CO, June 2005.

Joshi, S. N., M. B. Pate, R. M. Nelson, J. H. House, and C. J. Klaassen, "An Experimental Evaluation of Duct-Mounted Relative Humidity Sensors: Part 1 – Test and Evaluation Procedures", ASHRAE Transactions, Paper

4757, February 2005, presented at the ASHRAE Winter Meeting, Orlando, FL, February 2005.

Bixby, D. C., M. J. Hewett, and R. M. Nelson, "Calculating Seasonal Efficiency for Boilers," ASHRAE Journal, Vol 46, No. 7, pp. 55-56, July 2004.

Chen, Z., R. M. Nelson, and D. Ashlock, "Comparison of methods for predicting monthly post-retrofit energy use in buildings," ASHRAE Transactions, Vol 109, Part 2, 2003, presented at ASHRAE Annual Meeting, Kansas City, MO, June 2003.

8. SCIENTIFIC & PROFESSIONAL SOCIETIES OF WHICH A MEMBER

American Society of Heating, Refrigerating and Air Conditioning Engineers
American Society of Mechanical Engineers
American Solar Energy Society
International Solar Energy Society
Iowa Renewable Energy Association
Sigma Xi

9. HONORS & AWARDS

10. INSTITUTIONAL & PROFESSIONAL SERVICE IN THE LAST 5 YEARS

Professional Society Activities:
Member, ASHRAE Technical Committee, TC1.1, Thermodynamics and Psychrometrics, 1993-present
Chairman, Program Subcommittee of TC 1.1, ASHRAE, 1996-present
Member, ASHRAE Technical Committee, TC1.5, Computer Applications, 1990-1994, 1996-present
Webmaster, ASHRAE Technical Committee, TC1.5, 2000-present
Member, ASHRAE Project Monitoring Subcommittee, RP1049, 1999-2004

University Committees:
Liaison for Departmental Disability, 2005-present
Member, ISU Energy Efficiency Task Force, 2001-present
Member, Interdepartmental Graduate Minor in Complex Adaptive Systems, Faculty, 1998-present
Member, Term Graduate Faculty Membership Committee, 2001-2003, Chairman, 2002-2003
Member, NBCIP Technical Director Search Committee for Iowa Energy Center, 2002

College Committees:
Assistant Director, ISU Industrial Assessment Center, 1998-present
Faculty Advisor, ISU PRISM (Solar Car), 1999-present

Department Committees:
Member, ME Program Improvement Coordinating Committee, 2005 – present.
Chairman, ME Curriculum Committee, 2003 – present.
Chairman, ME 231/332 Curriculum Development Committee, 2001- present.
Leader, Thermal Systems Group, Spring 1998-2003.
Member, Faculty Search Committee, August 1997-2003.
Member, Computers Committee, 1995-2002.
Member, ME 335 Curriculum Development Committee, 1999-2001.

11. PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST 5 YEARS

Completed Course on Direct Digital Controls, Iowa Energy Center, November 2001
Completed Course to become a USDOE Steam System Qualified Specialist, July 2004

IOWA STATE UNIVERSITY
Mechanical Engineering Department
Ames, IA 50011
Vita

1. PERSONAL DATE

Name: Theodore H. Okiishi, Associate Dean for Research & Outreach and Professor of Mechanical Engineering

Address: 104 Marston, Ames, IA 50011

2. EDUCATION

Ph.D – Iowa State University, Mechanical Engineering, 1965
M.S. – Iowa State University, Mechancial Engineering, 1963
B.S. – Iowa State University, Mechanical Engineering, 1960

3. ACADEMIC RECORD WITH ISU

4. OTHER RELATED EXPERIENCE: TEACHING, INDUSTRIAL, ETC.

Hydraulics Engineer (duty assignment as U.S. Army Corps of Engineers Officer), Combined Intelligence Center, Vietnam, Saigon, Republic of South Vietnam. 1966-1967
Research Engineer (duty assignment as U.S. Army Corps of Engineers Officer), NASA Lewis Research Center, Cleveland, Ohio. 1965-1966

5. CONSULTING, PATENTS, ETC.

Siemens Westinghouse, Orlando, Florida, 2003
University Energy Systems, Dayton, Ohio, 1986-1988
Rocketdyne Division of Rockwell International Corporation, Canoga Park, California, 1986-1988
Teledyne CAE, Toledo, Ohio, 1983
Vought Corporation, Dallas, Texas, 1981
Sundstrand Aviation Operations, Rockford, Illinois, 1981
Tech Development, Inc., Dayton, Ohio, 1970-1972
Caterpillar Tractor Company, Peoria, Illinois, 1967-1976
Compressor Controls Corporation, Des Moines, Iowa, 1976-1980

6. STATE(S) IN WHICH REGISTERED

Iowa (6301)
Ohio (E-41847)

7. PRINCIPAL PUBLICATIONS WITHIN LAST 5 YEARS

"An investigation of wake-shock interactions in a transonic compressor with DPIV and time-accurate CFD" Gorrell, S. E., S. Puterbaugh, J. Estevadeordal, T. H. Okiishi, and D. Car. Accepted for publication in the ASME *Journal of Turbo machinery*. 2005

"Stator-Rotor Interactions in a Transonic Compressor: Part 1: Effect of Blade Row Spacing on Performance, and Part 2: Description of a Loss Producing Mechanism," Gorrell, S.E., W. W. Copenhaver and T. H. Okiishi, ASME *Journal of Turbo machinery* 125:328-345, 2003.

"Wake Recovery Performance Benefit in a High-Speed Axial Compressor," Van Zante, D. E., J. J., Admczyk, A. J. Strazisar, and T. H. Okiishi, ASME *Journal of Turbo machinery* 124:275-284, 2002.

"Fundamentals of Fluid Mechanics," Munson, B. R., Young, D. F., and Okiishi, T.H, John Wiley and Sons, Inc., New York, NY, 5th Edition, 2006.

"A Brief Introduction to Fluid Mechanics," Young, D. F., B. R. Munson, and T. H Okiishi, John Wiley and Sons, Inc., New York, NY, 3rd Edition, 2004

8. SCIENTIFIC & PROFESSIONAL SOCIETIES OF WHICH A MEMBER

American Society of Mechanical Engineers
American Institute of Aeronautics and Astronautics
American Society for Engineering Education
Sigma Xi
American Association for the Advancement of Science

9. HONORS & AWARDS

American Society of Mechanical Engineers Dedicated Service Award, 2005
American Society of Mechanical Engr. Melville Medal ("highest ASME honor for
 Best current original paper"), 1989 and 1998
Iowa State University Alumni Association Faculty Citation, 1994
American Society of Mechanical Engineers Fellow, 1992
Iowa State University Cardinal Key, 1991
Iowa State University Engineering College Superior Teaching Award, 1987
Mechanical Engineering Department Professor of the Year, 1977, 1986, 1990
Iowa State University Engineering Council Outstanding M.E. Professor, 1983
Society of Automotive Engineers Ralph R. Teetor Award, 1976
NASA Cash Award and Certificate of Recognition for Development of Technology, 1975

10. INSTITUTIONAL & PROFESSIONAL SERVICE IN THE LAST 5 YEARS

Engineering College Industrial Advisory Council, 1995-present
Graduate Study and Research, 1995-present
Research Council, 1995-present
Technology Transfer Council, 1995-present
ISU Research Foundation Board of Directors, 1996-present
American Society of Mechanical Engineers
 Member of National Nominating Committee, 2006-2008
Vice-President and Member, Council on Engineering, 2001-2003
Editor, *Journal of Turbo machinery*, 1993-2003
Member, International Gas Turbine Institute Board of Directors,
 2001-2003 (Vice President)
Member of Turbo machinery and of Education Committees
American Society of Engineering Education
Member of National Nominating Committee, 2004-2006
Chair, Engineering Research Council Board of Directors, 2002-2004
Member, ASEE Board of Directors, 2002-2004
Vice President, ASEE Institutional Councils, 2003-2004

11. PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST 5 YEARS

Participated in the Academic Leadership Forum (Deans and Department Chairs from College of Business, Education and Engineering) from 2000-2003
American Society of Mechanical Engineers TURBO EXPO each year
American Society of Engineering Education Engineering (ASEE) Research Council Forum each year

IOWA STATE UNIVERSITY
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Vita

1. PERSONAL DATA

Name: James H. Oliver, Professor

Address: 1620 Howe Hall
Iowa State University, Ames, IA 50011-2274
Phone: 515-294-2649

2. EDUCATION

1986 **Ph.D.** in Mechanical Engineering, Michigan State University, East Lansing, Michigan
1981 **M.S.** in Mechanical Engineering, Michigan State University, East Lansing, Michigan
1979 **B.S.** in Mechanical Engineering, Union College, Schenectady, New York

3. ACADEMIC RECORD WITH ISU

2004- Professor
2001-2004 Associate Professor
1998-2000 On unpaid leave to work in software industry, resigned in 2000, rehired in 2001
1993-1998 Associate Professor
1991-1993 Assistant Professor

4. OTHER RELATED EXPERIENCE: TEACHING, INDUSTRIAL, ETC.

11/00 – 9/01 Vice President of Product Development, Cognicity, Inc., Minneapolis, Minnesota
1/98 – 11/00 Senior Director of Product Development, Engineering Animation Inc., Ames, Iowa
1988-1991 Assistant Professor, Department of Mechanical and Aerospace Engineering, University at Buffalo (SUNY)
1987-1988 Software Research Engineer, International Technigroup Inc, Cincinnati, OH.

5. CONSULTING, PATENTS, ETC.

Patents

J.H. Oliver, "Sculptured Surface Synthesis Based on Functional Design Constraints," US Patent Number 5,510,995, April 1996

J.H. Oliver and N.K. Nair, "Area-Preserving Transformation Algorithms for Mapping a Sculptured Surface onto a Plane," US Patent Number 5,561,754, October 1996

J.H. Oliver and Y.C. Huang, "Algorithms for Simulation and Dimensional Verification of Material Removal Processes," US Patent Number 5,710,709, January 1998

Consulting

Immersive Engineering Inc., Bloomfield Hills, MI
CIMLINC Inc., Troy, MI
Deneb Robotics Inc., Auburn Hills, MI
Engineering Animation Inc., Ames, IA
International TechneGroup Inc., Milford, OH
Jamestown Advanced Products Inc., Jamestown, NY
Outokumpu American Brass, Buffalo, NY
Wendell Engineers, P.C., Amherst, NY
Motor Wheel Corp. (Division of Goodyear Inc.), Lansing, MI

6. STATE(S) IN WHICH REGISTERED

none

7. PRINCIPAL PUBLICATIONS WITHIN LAST 5 YEARS

R. Sidharta, J.H. Oliver, and A.V. Sannier, "Augmented Tangible Interfaces for Product Assembly Planning," *International Journal of Product Lifecycle Management*, to appear, 2006

B. Walter, A. Sannier, D. Reiners and J.H. Oliver, "UAV Swarm Control: Calculating Digital Pheromone Fields with the GPU," *Journal of Defense Modeling and Simulation*, to appear, 2006

L.S. Wu, J.H. Oliver and A.V. Sannier, "Network-based vehicle collision detection and simulation," *Proceedings of IDETC/CIE 2005, ASME 2005 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference*, Long Beach, CA, September 2005

M.J. Heying, J.H. Oliver, S. Sundararajan, P. Shrotriya, and Q. Zou, "Virtual Training Simulator for Atomic Force Microscopy", *Proceedings of IDETC/CIE 2005, ASME 2005 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference*, Long Beach, CA, September 2005, (nominated for best paper award)

S. Kumar, D. Reiners and J.H. Oliver, "Interactive Scenegraph Performance Analysis, Diagnosis and Enhancement," *Proceedings of IDETC/CIE 2005, ASME 2005 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference*, Long Beach, CA, September 2005

8. SCIENTIFIC & PROFESSIONAL SOCIETIES OF WHICH A MEMBER

American Society of Mechanical Engineers (ASME)
Association of Computing Machinery (ACM)
Institute of Electrical and Electronics Engineers (IEEE)

9. HONORS & AWARDS

Best Paper Award, Interservice/Industry Training, Simulation, and Education Conference, 2005
Outstanding Faculty Award, Iowa State University Interfraternity Council, 2005
Sigma Xi - Scientific Research Society, accepted nomination as full member, 2003
Gustus L. Larson Memorial Award, ASME International, 1999
Young Engineering Faculty Research Award, Iowa State University, 1996
Boeing A.D. Welliver Faculty Summer Fellow, 1996
Computer-Aided Design (Journal) Referee Award, 1993
National Science Foundation (NSF) Young Investigator Award, 1992
Rockwell Excellence Award, Department of Mechanical Engineering, ISU, 1992
Nominated for NSF Presidential Faculty Fellow Award by Iowa State University, 1991
Carver Faculty Fellow, Iowa Center for Emerging Manufacturing Technology, 1991
SAE Ralph R. Teetor Educational Award, 1990

10. INSTITUTIONAL & PROFESSIONAL SERVICE IN THE LAST 5 YEARS

Professional Society Activities

Associate Editor, ASME Transactions, Journal of Computing and Information Science in Engineering, 2005-2008

Institutional Service Activities

Director of Graduate Education, Interdepartmental Graduate Major in Human Computer Interaction
Director, Virtual Reality Applications Center
Iowa Information Technology Council, Iowa Department of Economic Development (2005-)

11. PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST 5 YEARS

none

IOWA STATE UNIVERSITY
Mechanical Engineering Department
Ames, IA 50011
Vita

1. PERSONAL DATA

Name: Michael Gary Olsen, Assistant Professor

Address: 3025 Black Engineering, Ames, IA 50011 **Phone:** 515-294-0073

2. EDUCATION

University of Illinois at Urbana-Champaign

Ph..D. - Mechanical Engineering, January 1999
Advisor: J. Craig Dutton
Major Area: Experimental Fluid Mechanics
Thesis: Planar Velocity Measurements in an Incompressible and a Weakly Compressible Mixing Layer

M.S. - Mechanical Engineering, October 1995
Advisors: Richard O. Buckius and James E. Peters
Major Area: Combustion
Thesis: A Model for Sulfur Evolution during Single Particle Coal Combustion in a Drop Tube Furnace Facility

B.S. - Mechanical Engineering, May 1992

3. ACADEMIC RECORD WITH ISU

Assistant Professor, Department of Mechanical Engineering, August 2000 – present (5 years)

4. OTHER RELATED EXPERIENCE: TEACHING, INDUSTRIAL, ETC.

Post-Doctoral Research Associate,11/98 – 8/00
Beckman Institute for Advanced Science and Technology
University of Illinois at Urbana-Champaign
Advisors: Ronald J. Adrian, Theoretical and Applied Mechanics
David J. Beebe, Electrical and Computer Engineering

5. CONSULTING, PATENTS, ETC.

6. STATE(S) IN WHICH REGISTERED

7. PRINCIPAL PUBLICATIONS WITHIN LAST 5 YEARS

(Note: 16 Archival journal publications since 2001)

H. Li and M.G. Olsen, "MicroPIV measurements in square microchannels with hydraulic diameters from 200 μm to 640 μm," International Journal of Heat and Fluid Flow **27**, 123-134 (2006)

H. Feng, M.G. Olsen, Y. Liu, R.O. Fox, and J.C. Hill, "Investigation of turbulent mixing in a confined planar-jet reactor," AIChE Journal, **51**, 2649-2664 (2005)

L. Wang, M.G. Olsen, and R.D. Vigil, "Reappearance of azimuthal waves in turbulent Taylor-Couette flow at large aspect ratios," Chemical Engineering Science, **60**, 5555-5569 (2005)

C.J. Bourdon, M.G. Olsen, and A.D. Gorby, "Validation of analytical solution for depth of correlation in microscopic particle image velocimetry," Measurement Science and Technology, **15**, 318-327 (2004)

C.J. Bourdon, M.G. Olsen, and A.D. Gorby, "Power filter technique for modifying depth of correlation in microPIV experiments," Experiments in Fluids, **37**, 263-271 (2004)

M.G. Olsen and C.J. Bourdon, "Out-of-plane motion effects in microscopic particle image velocimetry," Journal of Fluids Engineering, 125, 895-901 (2003)

M.G. Olsen and J.C. Dutton, "Planar velocity measurements in a weakly compressible mixing layer," Journal of Fluid Mechanics, **486**, 51-77 (2003)

M.G. Olsen and J.C. Dutton, "Stochastic estimation of large structures in an incompressible mixing layer," AIAA Journal, **40**, 2431-2438 (2002)

M.G. Olsen and R.J. Adrian, "Measurement volume defined by peak finding algorithms in cross-correlation particle image velocimetry," Measurement Science and Technology, **12**, N14-N16 (2001)

8. SCIENTIFIC & PROFESSIONAL SOCIETIES OF WHICH A MEMBER

American Society of Mechanical Engineers
American Physical Society
American Institute of Aeronautics and Astronautics

9. HONORS & AWARDS

National Science Foundation CAREER Award, 2002

10. INSTITUTIONAL & PROFESSIONAL SERVICE WITHIN LAST 5 YEARS

Professional Society Activities:
(2001-present) Faculty Advisor, Tau Beta Pi Engineering Honor Society

Institutional Service Activities:
Mechanical Engineering Curriculum Committee, 2004-present
Mechanical Engineering Faculty Search Committee, 2002-present
Chair, Course Development Committee for ME 335 (undergraduate fluid mechanics), 2002-present
Mechanical Engineering Computer and Laboratory Committee, 2000-present
Undergraduate Fluid Mechanics Laboratory Committee, 2000-2001
Faculty Senator, 2002-present
College of Engineering Untenured Faculty Policy Committee, 2002-2004
Faculty Senate Governance Committee, 2002-present

11. PROFESSIONAL DEVELOPMENT ACTIVITES WITHIN LAST 5 YEARS

IOWA STATE UNIVERSITY
Mechanical Engineering Department
Ames, IA 50011
Vita

1. PERSONAL DATA

Name: Michael B. Pate, Professor

Address: 2028 Black Engineering, Ames, IA 50011 **Phone:** 515-294-9691

2. EDUCATION

Ph.D. - Purdue University, 1982
M.S. - University of Arkansas, 1978
B.S. - United States Naval Academy, 1970

3. ACADEMIC RECORD WITH ISU

Professor, 1990-present
Associate Professor, 1987-1990
Assistant Professor, 1982-1987

4. OTHER RELATED EXPERIENCE: TEACHING, INDUSTRIAL, ETC.

Engineer, Advanced Reactor Systems Department, General Electric Company, Sunnyvale, California
Nuclear Submarine Officer, U.S. Navy, 1970-1975

5. CONSULTING, PATENTS, ETC.

6. STATE(S) IN WHICH REGISTERED

7. PRINCIPAL PUBLICATIONS WITHIN LAST 5 YEARS

Refereed Journals and Proceeding Articles:

Joshi, S. N., M. B. Pate, R. M. Nelson, J. H. House, and C. J. Klaassen, "An Experimental Evaluation of Duct-Mounted Relative Humidity Sensors: Part 3 – Repeatability, Hysteresis and Linearity Results", ASHRAE Transactions, Paper 4799, June 2005.

Joshi, S. N., M. B. Pate, R. M. Nelson, J. H. House, and C. J. Klaassen, "An Experimental Evaluation of Duct-Mounted Relative Humidity Sensors: Part 2 – Accuracy Results", ASHRAE Transactions, Paper 4798, June 2005.

Joshi, S. N., M. B. Pate, R. M. Nelson, J. H. House, and C. J. Klaassen, "An Experimental Evaluation of Duct-Mounted Relative Humidity Sensors: Part 1 – Test and Evaluation Procedures", ASHRAE Transactions, Paper 4757, February 2005.

Wade Heubsch, M.B. Pate, "A comparative study of shell-side condensation on integral-fin tubes with R-114 and R-236ea," ASHRAE Transactions, Jan 2004

Predrag Popovic, M.B. Pate, R. Shimon and N.E. Shnur, "The Effects of Lubricant Miscibility and Viscosity on the Performance of an HFC-134a Refrigeration System," ASHRAE Transactions, June 2000, Vol. 106, 2000, p. 668-678.

Hyenn-Mee Kang and M.B. Pate, "Miscibility Comparison for Three Refrigerant Mixtures and Four Component Refrigerants," ASHRAE Transactions SE-99-14, June 1999, Vol. 105, 1999, p.973-982.

8. SCIENTIFIC & PROFESSIONAL SOCIETIES OF WHICH A MEMBER

American Society of Mechanical Engineers (ASME)
American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE)
American Society of Engineering Education (ASEE)
American Education Research Association (AERA)

9. HONORS & AWARDS

Superior Engineering College Teacher Award 2005
Outstanding Faculty Member at Greek Week Recognition (2002, 2003, 2004, 2005)
Best Outstanding Professor Award, Engineering Leadership Council 2004
Engineer's Week Outstanding Professor Award 2004
ME Professor of the Year Award 2003
ASHRAE Symposium Paper Award 1996
Best ASHRAE Technical Paper Award 1996
Engineering College Outstanding Young Researcher Award, August 1992

10. INSTITUTIONAL & PROFESSIONAL SERVICE IN LAST 5 YEARS

Professional Society Activities:
Active member of ASME Committee K-19, Environmental Heat Transfer
Active Member of ASHRAE Committee TC 8.9 Residential Refrigerators and Household Freezers

Institutional Service Activities:
College Committees
Engineering College Curriculum Committee (2004-Present)

Department Committees
Chairman, ME Department Laboratory Committee, August 2004-Present
Member, Promotion and Tenure Committee, August 2004-present
Chairman, Promotion and Tenure Committee for Michael Olsen September –December 2005

11. PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST 5 YEARS

- NSF sponsored workshop "Conducting Rigorous Research in Engineering Education" conducted at the Colorado School of Mines one-week in August 2004
- Assessment Workshop at Alverno College, 3 days, June 2005.
- 7th Annual Wakonse Conference on College Teaching, invited to be ISU Wakonse Fellow May 2006
- Book Reading/Discussion Groups, Teach and Learning Circles, sponsored by CELT (2004, 2005)
- LEA/RN Teaching Discussion group, Facilitator Jan Wiersema, biweekly Fall 2005.
- Participant in PEER Review of Teaching Academy, organized by Dr. Thomas Brauman and Dr. Barbara Licklider, Miller Grant, biweekly, Spring 2006.

IOWA STATE UNIVERSITY
Mechanical Engineering Department
Ames, IA 50011
Vita

1. PERSONAL DATA

Name: Richard H. Pletcher, Professor and Director, Computational Fluid Dynamics Center
Address: 3024 Black Engineering, Ames, IA 50011 **Phone:** 515-294-2656

2. EDUCATION

Ph.D. - Mechanical Engineering, Cornell University, 1966
M.S. - Mechanical Engineering, Cornell University, 1962
B.S. - Mechanical Engineering, Purdue University, 1957

3. ACADEMIC RECORD WITH ISU

Professor, 1976-present
Director, Computational Fluid Dynamics Center, 2006
Associate Manager, Computational Fluid Dynamics Center, 1984-2005
Associate Professor, 1970-1976
Assistant Professor, 1967-1970

4. OTHER RELATED EXPERIENCE: TEACHING, INDUSTRIAL, ETC.

Instructor, Cornell University, 1961-1964
Senior Research Engineer in the Propulsion Section at the United Aircraft Research Laboratories, East Hartford, Connecticut, 1965-1967
Active duty as Ltjg. and Ensign, United States Navy; 1957-1960

5. CONSULTING, PATENTS, ETC.

Consulting:
Caterpillar Tractor Company
ARO, Inc., General Electric Company
Allison Gas Turbines
Institute for Computational Mechanics in Propulsion (NASA)

6. STATE(S) IN WHICH REGISTERED

Iowa

7. PRINCIPAL PUBLICATIONS WITHIN LAST 5 YEARS

Lee, J. S., X. Xu, and R. H. Pletcher, "Effects of Wall Rotation on Heat Transfer to Annular Turbulent Flow: Outer Wall Rotating," *Journal of Heat Transfer,* Vol. 127, pp. 830-838, 2005.

Xu, X., J. S. Lee, and R. H. Pletcher, "A Compressible Finite Volume Formulation for Large Eddy Simulation of Turbulent Pipe Flows at Low Mach Number in Cartesian Coordinates," *Journal of Computational Physics,* Vol. 203, pp. 22-48, 2005.

Xu, X., J.S. Lee, R. H. Pletcher, A.M. Shehata, and D. M. McEligot, "Large Eddy Simulation of Turbulent Forced Gas Flows in Vertical Pipes with High Heat Transfer Rates," *International Journal of Heat and Mass Transfer*, Vol. 47, pp. 4113-4123, 2004.

Lee, J. S., X. Zu, and R. H. Pletcher, "Large Eddy Simulation of the Effects of Inner Wall Rotation on Heat Transfer in Annular Turbulent Flow," *Numerical Heat Transfer,* Part A, Vol. 46, pp. 323-341, 2004.

Qin, Zhaohui and R. H. Pletcher, "Large Eddy Simulation of Turbulent Heat Transfer in a Square Duct," IMECE2004-60807, Proceedings of IMECE04, ASME International Mechanical Engineering Congress, 2004.

Lee, J. S., N. Meng, R.H. Pletcher, Y. Liu, "Numerical Study of the Effects of Rotation on Heat Transfer in Channels with and without Ribs," International Journal of Heat and Mass Transfer, Vol. 47, pp. 4673-4684, 2004.

Lee, J. S., X. Xu, and R. H. Pletcher, "Large Eddy Simulation of Heated Vertical Annular Pipe Flow in Fully Developed Turbulent Mixed Convection," *International Journal of Heat and Mass Transfer,* Vol. 47, pp.

437-446, 2004.

Liu, K. and R. H. Pletcher, “A Procedure to Establish Inflow Conditions for LES of Spatially Developing Turbulent Boundary Layers,” Proceedings of HT-FED04 2004 ASME Heat Transfer/Fluids Engineering Summer Conference, 2004.

Dailey, L. D., N. Meng, and R. H. Pletcher, “Large Eddy Simulation of Constant Heat Flux Turbulent Channel Flow with Property Variations: Quasi-Developed Model and Mean Flow Results,” *Journal of Heat Transfer,* Vol. 125, pp. 27-38, 2003.

Lee, J. S., X. Xu, and R. H. Pletcher, “LES of Compressible Turbulent Annular Pipe Flow with a Rotating Wall,” Proceedings of the IMECE’03, 2003 ASME International Mechanical Engineering Congress Exposition, IMECE2003-41841, 2003.

Avancha, R. V. R. and R. H. Pletcher, “Large Eddy Simulation of the Turbulent Flow Past a Backward-Facing Step with Heat Transfer and Property Variations,” International Journal of Heat and Fluid Flow, Vol. 23, pp. 601-614, 2002.

Lee, J. S., Y. Liu, and R. H. Pletcher, “Large Eddy Simulation of the Effects of Rotation on Heat Transfer in a Ribbed Channel,” Heat Transfer 200*2*, *Proceedings of the Twelfth International Heat Transfer Conference*, Elsevier, 2002.

Xu, X., J. S. Lee, and R. H. Pletcher, “Cartesian Based Finite Volume Formulation for LES of Mixed Convection in a Vertical Turbulent Pipe Flow,” Proceedings of the IMECE’02, 2002 ASME International Mechanical Engineering Congress Exposition, IMECE2002-HT-32748, 2002.

Lee, J. S., X. Xu, and R. H. Pletcher, “Large Eddy Simulation of Mixed Convection in a Vertical Turbulent Annular Pipe Flow,” Proceedings of IMECE’02, 2002 ASME International Mechanical Engineering Congress Exposition, IMECE2002-HT-32746, 2002.

Lee, J. S. and R. H. Pletcher, "Large Eddy Simulation of Variable Property Turbulent Flow in a Vertical Channel with Buoyancy Effects and Heat Transfer," NHTC2001-20246, Proceedings of the 35th National Heat Transfer Conference, June, 2001.

Wang, X., X. Xu, and R. H. Pletcher, “Large Eddy Simulation of Supercritical CO2 Pipe Flow with Constant Wall Heat Flux”, AIAA 2005-4995, paper presented at the 17th AIAA Computational Fluid Dynamics Conference, Toronto, Ontario, June 6-9, 2005.

Liu, K. and R. H. Pletcher, “Large Eddy Simulation of Discrete-Hole Film Cooling in a Flat Plate Turbulent Boundary Layer,” AIAA 2005-4944, Paper presented at the 38th AIAA Thermophysics Conference, Toronto, Ontario, June 6-9, 2005.

Liu, K. and R. H. Pletcher, “Large Eddy Simulation of Turbulent Boundary Layers Subjected to Free-Stream Turbulence,” AIAA Paper 2005-669.

Avancha, R. V. R., and R. H. Pletcher, "Large Eddy Simulation of the Turbulent Flow Past a Backward Facing Step with Heat Transfer and Property Variations," presented at the Second International Symposium on Turbulence and Shear Flow Phenomena, Stockholm, Sweden, June 2001.

8. SCIENTIFIC & PROFESSIONAL SOCIETIES OF WHICH A MEMBER

ASME, AIAA, ASEE, APS, Sigma Xi, Phi Kappa Phi, Tau Beta Pi, Pi Tau Sigma, Sigma Delta Chi

9. HONORS & AWARDS

Elected Associate Fellow American Institute of Aeronautics and Astronautics, 2002
Received Certificate of Recognition for Creative Development of a Technical Innovation from NASA, 1992
David R. Boylan Eminent Faculty Award for Research, 1991
Iowa State University Award for Excellence in Teaching, 1989
Elected Fellow of the American Society of Mechanical Engineers, 1986
Listed in Who’s Who in Engineering, Who’s Who in the Midwest and several other biographical volumes

10. INSTITUTIONAL & PROFESSIONAL SERVICE IN THE LAST 5 YEARS

11. PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST 5 YEARS

IOWA STATE UNIVERSITY
Mechanical Engineering Department
Ames, IA 50011
Vita

1. PERSONAL DATA

Name: Pranav Shrotriya, Assistant Professor

Address: Mechanical Engineering Department
2025 Black Engineering Building
Iowa State University
Ames, IA 50011

Phone: 515-294-9719

2. EDUCATION

Ph.D. - Theoretical and Applied Mechanics, University of Illinois at Urbana-Champaign, January 2001
M.S. - Theoretical and Applied Mechanics, University of Illinois at Urbana-Champaign, May 1997
B.S. - Technology in Mechanical Engineering, Indian Institute of Technology, Mumbai, India, May 1995

3. ACADEMIC RECORD WITH ISU

Assistant Professor, Mechanical Engineering, September 2003 to present

4. OTHER RELATED EXPERIENCE: TEACHING, INDUSTRIAL, ETC.

Post-Doc Research Associate, Brown University, July 2002 to August 2003
Post-Doc Research Associate, Princeton University, December 2000 to June 2002

5. CONSULTING, PATENTS, ETC.

Kim, K.-S, Wang, J. and Shrotriya, P., "Absolute and real-time curvature sensor insensitive to tilt and vibration," Patent Disclosure, Brown University, 4/21/2003. U.S. Patent filed 2003.

6. STATE(S) IN WHICH REGISTERED

7. PRINCIPAL PUBLICATIONS WITHIN LAST 5 YEARS

Shrotriya, P., N. R. Sottos and A. F. Skipor, "Residual stress development during relamination of woven composite circuit boards." Journal of Composite Materials **35**(10): 905-927 (2001).

Allameh, S. M., P. Shrotriya, A. Butterwick, S. Brown, N. Yao and W. Soboyejo, "Surface topography evolution and fatigue fracture of polysilicon." Journal of Materials Science **38**(20): 4145-4155 (2003).

Allameh, S. M., P. Shrotriya, A. Butterwick, S. B. Brown and W. O. Soboyejo, "Surface topography evolution and fatigue fracture in polysilicon MEMS structures," Journal of Microelectromechanical Systems **12**(3): 313-324 (2003).

Lou, J., P. Shrotriya, T. Buchheit, D. Yang and W. O. Soboyejo, "A nano-indentation study on the plasticity length scale effects in LIGA Ni MEMS structures," Journal of Materials Science **38**(20): 4137-4143 (2003).

Lou, J., P. Shrotriya, T. Buchheit, D. Yang and W. O. Soboyejo, "Nanoindentation study of plasticity length scale effects in LIGA Ni microelectromechanical systems structures," Journal of Materials Research **18**(3): 719-728 (2003).

Shrotriya, P., S. Allameh, S. Brown, Z. Suo and W. O. Soboyejo, "Fatigue damage evolution in silicon films for micromechanical applications," Experimental Mechanics **43**(3): 289-302 (2003).

Shrotriya, P., S. M. Allameh, J. Lou, T. Buchheit and W. O. Soboyejo, "On the measurement of the plasticity length scale parameter in LIGA nickel foils," Mechanics of Materials **35**(3-6): 233-243 (2003).

Shrotriya, P., R. Wang, N. Katsube, R. Seghi and W. O. Soboyejo, "Contact damage in model dental multilayers: An investigation of the influence of indenter size," Journal of Materials Science-Materials in Medicine **14**(1): 17-26 (2003).

Zhu, Q., P. Shrotriya, N. R. Sottos and P. H. Geubelle, "Three-dimensional viscoelastic simulation of woven composite substrates for multilayer circuit boards," Composites Science and Technology **63**(13): 1971-1983 (2003).

Shrotriya, P., S. M. Allameh and W. O. Soboyejo, "On the evolution of surface morphology of polysilicon

MEMS structures during fatigue," Mechanics of Materials **36**(1-2): 35-44 (2004).

Shrotriya, R. and N. R. Sottos, "Local time-temperature-dependent deformation of a woven composite," Experimental Mechanics **44**(4): 336-353 (2004).

Zhou, J., P. Shrotriya and W. O. Soboyejo, "On the deformation of aluminum lattice block structures: from struts to structures," Mechanics of Materials **36**(8): 723-737 (2004).

Zhou, J., P. Shrotriya and W. O. Soboyejo, "Mechanisms and mechanics of compressive deformation in open-cell Al foams," Mechanics of Materials **36**(8): 781-797 (2004).

Chandrasekaran, S., J. Check, S. Sundararajan and P. Shrotriya, "The effect of anisotropic wet etching on the surface roughness parameters and micro nanoscale friction behavior of Si(100) surfaces," Sensors and Actuators a-Physical **121**(1): 121-130 (2005).

Huang, M., X. Niu, P. Shrotriya, V. Thompson, D. Rekow and W. O. Soboyejo, "Contact damage of dental multilayers: Viscous deformation and fatigue mechanisms," Journal of Engineering Materials and Technology-Transactions of the ASME **127**(1): 33-39 (2005).

Lou, J., P. Shrotriya and W. O. Soboyejo, "A cyclic microbend study on LIGA Ni microelectromechanical systems thin films," Journal of Engineering Materials and Technology-Transactions of the ASME **127**(1): 16-22 (2005).

Shrotriya, P. and N. R. Sottos, "Viscoelastic response of woven composite substrates," Composites Science and Technology **65**(3-4): 621-634 (2005).

J. Wang. P. Shrotriya and K.-S. Kim, "Surface Residual Stress Measurement Using Curvature Interferometry," to appear in Experimental Mechanics **46** (2006).

8. SCIENTIFIC & PROFESSIONAL SOCIETIES OF WHICH A MEMBER

Material Research Society
American Society of Mechanical Engineers

9. HONORS & AWARDS

National Science Foundation Career Award, 2006-20011
James O. Smith Award for Outstanding Teaching Assistant, 2000
Institute of Mechanics and Materials (IMM) Pre-Doctoral Fellowship, 1997-1999

10. INSTITUTIONAL & PROFESSIONAL SERVICE IN THE LAST 5 YEARS

Professional Society Activities:

Member, Multifunctional Material Subcommittee, ASME, Organized symposium on biomedical and biological materials at ASME-IMECE, 2005 and 2006

Institutional Service Activities:

Departmental faculty search committee
Departmental Academic Standards Committee

11. PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST 5 YEARS

Iowa State University
Mechanical Engineering Department
Ames, IA 50011
Vita

1. PERSONAL DATA

Name: Shankar Subramaniam, Assistant Professor

Address: 3020 Black Engineering, Ames, IA 50011 **Phone:** 515-294-3698

2. EDUCATION

Ph.D. - Aerospace Engineering, Cornell University, 1997
M.S. – Aerospace Engineering, University of Notre Dame, 1990
B. Tech – Aeronautical Engineering, Indian Institute of Technology, Bombay, 1988

3. ACADEMIC RECORD WITH ISU

Assistant Professor of Mechanical Engineering Department, 2002-present

4. OTHER RELATED EXPERIENCE: TEACHING, INDUSTRIAL, ETC.

Assistant Professor of Mechanical and Aerospace Engineering Department, State University of New Jersey at Piscataway (1999-2002)
Postdoctoral Research Associate Fluid Dynamics Group T-3, Theoretical Division, Los Alamos National Laboratory in Los Alamos (1997-1999)

5. CONSULTING, PATENTS, ETC.

6. STATE(S) IN WHICH REGISTERED

7. PRINCIPAL PUBLICATIONS WITHIN LAST 5 YEARS

"Modeling Interphase Turbulent Kinetic Energy Transfer in Lagrangian-Eulerian Spray Computations", G.M. Pai and S. Subramaniam, *Atomization and Sprays* (in press) (2006)
"A Multiscale Model for Dilute Turbulent Gas–particle Flows based on the Equilibration of Energy Concept", Y. Xu and S. Subramaniam, Physics *of Fluids* (accepted) (2006)
"Momentum transfer between polydisperse particles in granular flow", D. Gao, S. Subramaniam, R.O. Fox, G. S. Grest and D. K. Hoffman, *Journal of Fluids Engineering*, 128 (1), pp. 62-68 (2006)
"Accurate Numerical Solution of the Spray Equation using Particle Methods", G. M. Pai and S. Subramaniam, *Atomization and Sprays* 16 (2): 159-194, (2005)
"Objective decomposition of the stress tensor in granular flows", D. Gao, S. Subramaniam, *Physical Review E*, **71**, 021302, (2005)
"Statistical modeling of sprays using the droplet distribution function approach", S. Subramaniam, *Physics of Fluids*, vol. **13** (3), p. 624—642 (2001)

8. SCIENTIFIC & PROFESSIONAL SOCIETIES OF WHICH A MEMBER

Institute for Liquid Atomization and Spray Systems (ILASS) , American Physical Society, American Society of Mechanical Engineers

9. HONORS & AWARDS

DOE Early Career Principal Investigator Award	2002
NASA New Jersey Space Grant Consortium Award	2001
President's Silver Medal, IIT Bombay	1988
National Talent Search Scholarship, India	1982

10. INSTITUTIONAL & PROFESSIONAL SERVICE WITHIN LAST 5 YEARS

Professional Society Activities:

Editorial Board Member: *Atomization and Sprays*

ILASS-AMERICAS, Organizer, Technical Program, Annual Meeting of the Institute for Liquid Atomization and Spray Systems, 2006-2007

Dilute Gas-Solids Flows, Track co-chair Workshop on Multiphase Flow Research, National Energy Technology Laboratory, Morgantown, WV, June 6-7, 2006

DOE GLUE, Member, Executive Committee, Project *Granular Flow and Kinetics (2003-2004)*

Argonne National Laboratory, Organizer, Second Workshop on Granular Flow and Kinetics Co-Chair, Technical Committee on Computational Modeling, International Liquid Atomization and Spray Systems Society (ILASS), 2002-present

International Liquid Atomization and Spray Systems Society (ILASS), Chair, Honors and Awards Committee 2002-present

General Fluid Dynamics, Session Chair APS-DFD (1997), ILASS (numerous)

University Service: Panelist for *Preparing Future Faculty* Program

College of Engineering Committees: Honors and Awards Committee (2005-present)

ME Departmental Committees: Graduate Program Committee (2003-2005), Governance Document Committee (2003-2005), ME 335 Curriculum Development Committee (2003-2005), Tuition Surcharge Committee (2006), Organized Departmental Seminar (2004-2005)

Reviewer for professional journals such as ASME, Physics of Fluids, International Journal of Multiphase Flow, Journal of Computational Physics, Journal of Fluid Mechanics, Atomization and Sprays, International Combustion Symposium, Combustion Science and Technology, Energy and Fuels

Funding Agencies: National Science Foundation, Department of Energy, German-Israeli Foundation

11. PROFESSIONAL DEVELOPMENT ACTIVITES WITHIN LAST 5 YEARS

Multiphase Flow Research and Development Consortium Meeting, 2002
CAREER Workshop, 2004

IOWA STATE UNIVERSITY
Mechanical Engineering Department
Ames, IA 50011
Vita

1. PERSONAL DATA

Name: Sriram Sundararajan, Assistant Professor
Address: 3036 Black Engineering, Ames, IA 50011 **Phone:** 515-294-1050

2. EDUCATION

Ph.D. - Mechanical Engineering, The Ohio State University, 2001
M.S. - Mechanical Engineering, The Ohio State University, 1997
B.E. - Mechanical Engineering, Birla Institute of Technology and Science, Pilani, India, 1995

3. ACADEMIC RECORD WITH ISU

Assistant Professor, January 2002-present

4. OTHER RELATED EXPERIENCE: TEACHING, INDUSTRIAL, ETC.

None

5. CONSULTING, PATENTS, ETC.

None

6. STATE(S) IN WHICH REGISTERED

N/A

7. PRINCIPAL PUBLICATIONS WITHIN LAST 5 YEARS

S. Sundararajan and B. Bhushan, "Development of a Continuous Microscratch Technique in an Atomic Force Microscope and its Application to Study Scratch Resistance of Ultra-thin Hard Amorphous Carbon Coatings," *Journal of Materials Research* **16** 437-445 (2001).
S. Sundararajan and B. Bhushan, "Static Friction Force and Surface Roughness Studies of Surface Micromachined Electrostatic Micromotors Using an Atomic Force/Friction Force Microscope," *Journal of Vacuum Science and Technology A* **19**, 1777-1785 (2001).
S. Sundararajan, B. Bhushan, T. Namazu and Y. Isono, "Mechanical Property Measurements of Nanoscale Structures Using an Atomic Force Microscope," *Ultramicroscopy* **91 (1-4)**, 111-118 (2002).
S. Sundararajan and B. Bhushan, "Development of AFM-based Techniques to Measure Mechanical Properties of Nanoscale Structures," *Sensors and Actuators A* **101**, 338-351 (2002).
S. Chandrasekaran and S. Sundararajan, "Effect of Microfabrication Processes on Surface Roughness Parameters of Silicon Surfaces," *Surface and Coatings Technology* **188-189**, 581-587 (2004).
S. Chandrasekaran, J. Check, S. Sundararajan and P. Shrotriya, "The Effect of Anisotropic Wet Etching on the Surface Roughness Parameters and Micro/nanoscale Friction Behavior of Si (100) Surfaces," *Sensors and Actuators A*, **121(1)**, 121-130 (2005).
J. Check, K.S. Kanaga Karuppiah and S. Sundararajan, "Comparison of the Effect of Surface Roughness on the Micro/nanotribological Behavior of Ultra-high Molecular Weight Polyethylene (UHMWPE) in Air and Bovine Serum Solution," *Journal of Biomedical Materials Research A* **74**, 687-695 (2005).
Y. Zhang and S. Sundararajan, "The effect of autocorrelation length on real area of contact and friction behavior of rough surfaces," *Journal of Applied Physics*, **97 (10)**, 103526 (2005).
S. Sundararajan, J. L. Hall and M. Naim, "Instrument Statics," in *Instrumentation and Control: Fundamentals and Applications* 2^{nd} *ed.*, C. L. Nachtigal (Ed.), Wiley Series in Mechanical Engineering Practice, John Wiley and Sons, New York, (2005).

8. SCIENTIFIC & PROFESSIONAL SOCIETIES OF WHICH A MEMBER

American Society of Mechanical Engineers
Materials Research Society
Materials Information Society (ASM)
American Society of Engineering Education

9. HONORS & AWARDS

NATO-ASI Student Travel Award – to attend NATO-ASI Advanced Study Institute on Micro/Nanotribology and its Applications, Sesimbra, Portugal, June 1996.

NSF Student Travel/Research Award – for research at the Fraunhofer Institute for Non-Destructive Testing, Saarbrucken, Germany, April-May 1999.

The Ohio State University Presidential Fellowship, January –December 2001.

Undergraduate Research Poster Award (1st place), NanoExpo 2003, University of Wisconsin, Madison (with undergraduate student Paul Hattan)

Miller Faculty Fellow (award for innovations in teaching), Iowa State University, academic year 2004-05.

10. INSTITUTIONAL & PROFESSIONAL SERVICE IN THE LAST 5 YEARS

Professional Society Activities:

Organizing Committee Member, ASM International Surface Engineering Congress, 2003 – present.
Session Chair, Tribological Coatings and Micro/Nanotribology, ASM Surface Engineering Congress, 2004 – present.
Session Chair, Multifunctional Materials: Bio-inspired and Biomaterials, ASME International Mechanical Engineering Congress and Exposition, 2005, 2006.
Led a delegation of 11 nanotribology researchers from various U.S. universities and national labs to the 3rd European Science Foundation Nanotribology Workshop in Portugal, September 2004.

Institutional Service Activities:

University Committees
Faculty Senate Representative for Mechanical Engineering, 2003-2006
Faculty Senate Academic Affairs Council Member, 2003 -2006

Department Committees
Computer and Laboratory Committee, 2003-2004
Laboratory Committee, 2004-2006
Faculty Search Committee, *CombiSci* position hire, 2003-2004
Curriculum Design Committee for ME 325: Machine Design 2003-2004
Curriculum Design Committee for ME 370: Engineering Measurements and Instrumentation, 2005-current
Chair Evaluation Committee, 2004 (ad-hoc committee)

11. PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST 5 YEARS

N/A

IOWA STATE UNIVERSITY
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Vita

1. PERSONAL DATA

Name: Judy M. Vance, Professor and Chair

Address: 2025 H.M. Black Engineering Bldg, Iowa State University, Ames, IA 50011 **Phone:** 515-294-9474

2. EDUCATION

Ph.D. - Iowa State University, Mechanical Engineering, 1992
M.S. - Iowa State University, Mechanical Engineering, 1987
B.S. - Iowa State University, Mechanical Engineering, 1980

3. ACADEMIC RECORD WITH ISU

Chair, 2003–present
Professor, 2003–present
Associate Professor, 1997-2003
Assistant Professor, 1987-1997
  Mechanical Engineering, 1992-1997
  Freshman Engineering, 1987-1992
Adjunct Instructor, 1984-1987

4. OTHER RELATED EXPERIENCE: TEACHING, INDUSTRIAL, ETC.

Mechanical Engineer, John Deere Des Moines Works, Ankeny, IA, 1979-1984
Co-Op Student, Maytag, Newton, IA, 1978

5. CONSULTING, PATENTS, ETC.

none

6. STATE(S) IN WHICH REGISTERED

Iowa - E.I.T. 1980

7. PRINCIPAL PUBLICATIONS WITHIN LAST 5 YEARS

Duncan, Thomas J. and Vance, Judy M., “Interactive Interrogation of Computational Mixing Data in a Virtual Environment,” *ASME Journal of Mechanical Design*, in press, 2006.

Chipperfield, Kurt A., Vance, Judy M. and Fischer, Andrew, “Fast Meshless Reanalysis Using Combined Approximations, Pre-Conditioned Conjugate Gradient, and Taylor Series,” *AIAA Journa*l, in press, 2006.

Kim, ChangEun and Vance, Judy M., “Collision Detection and Part Interaction Modeling to Facilitate Immersive Virtual Reality Assembly Methods,” *ASME Journal of Computing and Information Sciences in Engineering*, Vol. 4, No. 2, June 2004, pp. 83-90.

Kelsick, Jason, Vance, Judy M., Buhr, Lori and Moller, Cheryl, "Discrete Event Simulation Implemented in a Virtual Environment," *ASME Journal of Mechanical Design*, Vol. 125, No. 3, 2003, pp. 428-433.

Larochelle, Pierre M., Vance, Judy M. and Kihonge, John, "Interactive Visualization of the Line Congruences Associated with Four Finite Spatial Poses for Spatial Mechanism Design," *ASME Journal of Computing and Information Sciences in Engineering*, Vol. 2, No. 3, September 2002, pp. 208-215.

Kihonge, John N., Vance, Judy M. and Larochelle, Pierre M., "Spatial Mechanism Design in Virtual Reality with Networking," *ASME Journal of Mechanical Design*, Vol. 124, No. 3, September 2002, pp. 435-440.

Perles, Brian P. and Vance, Judy M., "Interactive Virtual Tools for Manipulating NURBS Surfaces in a Virtual Environment," *ASME Journal of Mechanical Design*, Vol. 124, No. 2, June 2002, pp. 158-163.

Volkov, Sergei and Vance, Judy M., "Effectiveness of Haptic Sensation for the Evaluation of Virtual Prototypes," *ASME Journal of Computing and Information Sciences in Engineering*, Vol. 1, No. 2, June 2001, pp. 123-128.

Kraal, Juliet C. and Vance, Judy M., "VEMECS: A Virtual Reality Interface for Spherical Mechanism Design," *Journal of Engineering Design*, Vol. 12, No. 3, 2001, pp. 245-354.

Jayaram, Sankar, Vance, Judy, Gadh, Rajit, Jayaram, Uma, and Srinivasan, Hari, "Assessment of VR Technology and its Applications to Engineering Problems," *ASME Journal of Computing and Information Science in Engineering*, Vol. 1, No. 1, March 2001, pp. 72-83.

8. SCIENTIFIC & PROFESSIONAL SOCIETIES OF WHICH A MEMBER

American Society of Mechanical Engineers; Society of Women Engineers; American Society of Engineering Education; Society of Manufacturing Engineers; Sigma Xi; American Institute of Aeronautics and Astronautics; Women Engineering Program Advocates Network

9. HONORS & AWARDS

Fellow, American Society of Mechanical Engineers (ASME), 2004
ISU Engineering Student Council Leadership Award, 2001
VEISHEA Faculty of the Year Nomination, 1999
Best Paper Award, 1998 MSC Americas Users' Conference, October 1998
College of Engineering Superior Teaching Award, 1998
Selected to attend the National Academy of Engineering First German-American Frontiers of Engineering Symposium in Dresden, Germany, March 1998
Mechanical Engineering Professor of the Year, 1996-1997
National Science Foundation Career Award, 1996
Sigma Xi, 1995
U.S. Department of Agriculture Women's History Week Award, 1994
Iowa Center for Emerging Manufacturing Technology Faculty Fellow, 1992
ASEE Dow Outstanding Young Faculty Award, 1989

10. INSTITUTIONAL & PROFESSIONAL SERVICE IN THE LAST 5 YEARS

Professional Society Activities:

National Science Foundation Engineering Directorate Advisory Committee, 2003-present
Women in Engineering Leadership Institute, President, 2000-2004;Conference organizer 2004-present
Associate Technical Editor for the ASME Journal of Mechanical Design, 1999-2002
ASME Design Division Executive Committee Member, 2003-present
ASME Design Division Constitution and Bylaws Committee Chair, 2001-2005
ASME Design Automation Executive Committee, 1997-2002
Society of Women Engineers National Nominating Committee member, 1997-2001

Institutional Service Activities:

University Committees

Provost’s Keeping Our Faculty Committee, 2005
President's Advisory Committee on Budget and Planning, 2002-present
Engineering Dean’s Search Committee, 2004
Provost Task Force on Institutes and Centers, 2004
Provost Task Force on Recruitment and Retention of Women and Minority Faculty, 2004
Committee on Computational Research and Information Technology (CRIT) 2002
University Committee on Women Task Force, 2002-2004
Preparing Future Faculty Committee, 2001-2002
Miller Grant Selection Committee, 1999-2001
Graduate Council, 1998-2001
Center for Teaching Excellence Board 1998-2001, Chair 2000-2001

College Committees

Academic Council, 2003-present
Research and Graduate Studies, 2002-2003
Dean's ME DEO Review Committee, 2000

Department Committees

ME Recruitment Committee, 1996/97,1997/98, 2000/01, 2001/02, 2002/03
ME Graduate Committee, 1995-96, 1998-2000, 2002-2003
ME 325 Curriculum Development Committee, Chair, 2001-2003
ME 416 Course Coordinator, 1995-2000
ME Effective Teaching Committee, 1992-2000; Chair, 1995-2000

11. PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST 5 YEARS

Harvard Management Development Program, 2004
American Council on Education, Chairing the Academic Department, 2004
Women in Engineering Leadership Conferences, 2000-2005

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1. PERSONAL DATA

Name: Eliot Winer, Assistant Professor
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2. EDUCATION

Ph.D. - Mechanical Engineering, University at Buffalo, 1999
M.S. - Mechanical Engineering, University at Buffalo, 1994
B.S. - Aerospace Engineering, The Ohio State University, 1992

3. ACADEMIC RECORD WITH ISU

Assistant Professor, November 2003-present

4. OTHER RELATED EXPERIENCE: TEACHING, INDUSTRIAL, ETC.

Adjunct Assistant Professor, Department of Mechanical and Aerospace Engineering, University at Buffalo, 2002-present
Partner, Visual Design Systems, LLC., Buffalo, New York, 2000-present
Deputy Director, New York State Center for Engineering Design and Industrial Innovation (NYSCEDII), funded by the Assembly of the State of New York, 2000-2003
Research Assistant Professor, School of Engineering and Applied Sciences, University at Buffalo, 2000-2003
Postdoctoral Fellow, Department of Mechanical and Aerospace Engineering, University at Buffalo, 1999-2000
Research Assistant, Department of Mechanical and Aerospace Engineering, University at Buffalo, 1996-1999
Senior Programmer/Analyst, EdgeNet, Inc., Buffalo, New York, 1995-1999
Programmer/Analyst, Information Technology Services, Canisius College, 1995-1996

5. CONSULTING, PATENTS, ETC.

None

6. STATE(S) IN WHICH REGISTERED

None

7. PRINCIPAL PUBLICATIONS WITHIN LAST 5 YEARS

Foo, J.L., Winer, E.H., “Automated Medical Image Segmentation using Probabilistic Techniques,” *IEEE Transactions on Biomedical Imaging*, under review.
Kanukolanu, D., Lewis, K.H,, and Winer, E.H., “Robust Design of Coupled Sub-Systems using Visualization,” *ASME Journal of Computer and Information Science in Engineering*, to appear
Winer, E.H., Bloebaum, C.L., “Development of Visual Design Steering as an Aid in Large Scale Multidisciplinary Design Optimization - Part I: method development,” *Journal of Structural and Multidisciplinary Optimization*, vol. 23, no. 6, July 2002, pp. 412-424.
Winer, E.H., Bloebaum, C.L., “Development of Visual Design Steering as an Aid in Large Scale Multidisciplinary Design Optimization - Part II: method validation,” *Journal of Structural and Multidisciplinary Optimization*, vol. 23, no. 6, July 2002, pp. 425-435.
Winer, E.H., Bloebaum, C.L., “Visual Design Steering for Optimization Solution Improvement,” *Journal of Structural and Multidisciplinary Optimization*, vol. 22, no. 3, October 2001, pp. 219-229.

8. SCIENTIFIC & PROFESSIONAL SOCIETIES OF WHICH A MEMBER

American Institute of Aeronautics and Astronautics (AIAA), Student member & member, 1985-present
American Society of Mechanical Engineering (ASME), Member, 1998-present

9. HONORS & AWARDS

Entrepreneurial Spirit Award, University at Buffalo Office of Science, Technology Transfer and Economic Outreach, 2003
Promising Inventor's Award, State University of New York Research Foundation, 2003

10. INSTITUTIONAL & PROFESSIONAL SERVICE IN THE LAST 5 YEARS

Professional Society Activities
Member, AIAA Multidisciplinary Design Optimization (MDO) Technical Committee, 2003-present

Institutional Service Activities
University IT Advisory Committee, 2006
ME 270 Curriculum Committee, 2004-2006
Computing Committee, 2004-2006
ME Design Curriculum Committee, 2005-2006
Presenter, University Scholar's Day 2005-2006
ENG 101, Lecture on Mechanical Engineering, Fall 2004
Faculty Mentor to Freshman Honors Students, Fall 2004

11. PROFESSIONAL DEVELOPMENT ACTIVITIES IN THE LAST 5 YEARS

Center for Excellence in Teaching and Learning, Learning Circle on Scholarship in Research, 2005
NSF Grant Writing Workshop, 2004, 2005

Appendix I-D

Assessment Materials

MECHANICAL ENGINEERING

Appendix I-D.1: Program Outcomes

PO No.	Description of PO	Dimensions	Definition
PO1	Fundamental Knowledge	a. Mathematics	An ability to apply knowledge of mathematics, including calculus, linear algebra, and statistics
		b. Physics	An ability to apply knowledge of physics
		c. Chemistry	An ability to apply knowledge of chemistry
PO2	Engineering Skills	a. Analysis	An ability to identify, formulate, and solve problems in thermal and mechanical systems using techniques, skills, and modern tools of the engineering profession
		b. Synthesis	An ability to design a system, component, or process associated with thermal and mechanical systems using techniques, skills, and tools of the engineering profession
		c. Experiment	An ability to design and conduct experiments and to analyze and interpret data associated with thermal and mechanical systems using techniques, skills, and tools of the engineering profession
PO3	Career Success	a. Team work	The ability to develop sufficient synergy in a group to produce quality projects & presentations.
		b. Communication	Communication skills reflect professionalism of the student through use of proper grammar, appropriate mannerisms or writing style, and skillful use of visual aids.
		c. Life-long learning	Shows initiative in use of information resources, explores and implements new engineering practices, and actively seeks new learning.
PO4	Social Awareness	a. Contemporary issues	An appreciation of issues that challenge modern society and occupy the attention of citizens who are well informed about their nation and the world. Students should be cognizant of the interplay of technological, social, and political factors in resolving or exacerbating problems facing society.
		b. Ethical and professional responsibilities	An understanding of the ethical and professional responsibilities of the ME profession

ME Curriculum Coverage of Program Outcomes Core Courses

PROGRAM OUTCOMES	ME 231	ME 270	ME 332	ME 335	ME 436	ME 324	ME 325	ME 421	ME 102	ME 370
PO1 Fundamental Knowledge a. Mathematics	✓	✓	✓	✓	✓	✓	✓	✓		✓
PO1 Fundamental Knowledge b. Physics	✓	✓	✓	✓	✓	✓	✓	✓		✓
PO1 Fundamental Knowledge c. Chemistry	✓		✓			✓				
PO2 Engineering Skills a. Analysis	✓	✓	✓	✓	✓	✓	✓	✓		✓
PO2 Engineering Skills b. Synthesis		✓	✓	✓	✓		✓	✓		
PO2 Engineering Skills c. Experiment		✓		✓	✓	✓	✓	✓		✓
PO3 Career Success a. Team Work		✓		✓		✓	✓	✓		✓
PO3 Career Success b. Communication		✓	✓	✓		✓	✓	✓		✓
PO3 Career Success c. Life-long learning		✓								
PO4 Social Awareness a. Contemporary issues	✓	✓	✓	✓	✓	✓	✓	✓		✓
PO4 Social Awareness b. Professional responsibility		✓								

(modified on 12/6/05

ME Curriculum Coverage of Program Outcomes Significant Design Experience Courses

PROGRAM OUTCOMES	ME 415	ME 442	ME 446	ME 449
PO1 Fundamental Knowledge a. Mathematics	✓		✓	✓
PO1 Fundamental Knowledge b. Physics	✓		✓	✓
PO1 Fundamental Knowledge c. Chemistry			✓	✓
PO2 Engineering Skills a. Analysis	✓	✓	✓	✓
PO2 Engineering Skills b. Synthesis	✓	✓	✓	✓
PO2 Engineering Skills c. Experiment				
PO3 Career Success a. Team Work	✓	✓	✓	✓
PO3 Career Success b. Communication	✓	✓	✓	✓
PO3 Career Success c. Life-long learning	✓	✓	✓	✓
PO4 Social Awareness a. Contemporary issues	✓	✓	✓	✓
PO4 Social Awareness b. Professional responsibility	✓	✓	✓	✓

Appendix I-D.2: Course Objectives and Mapping to Program Outcomes

ME 231 - Engineering Thermodynamics I – Course Objectives
Ron Nelson, 12/6/05

General Objectives. The purpose of ME 231 is to:

1. Introduce students to thermodynamic terminology and concepts.
2. Teach students to understand and apply the principles of conservation of mass and energy and production of entropy.
3. Teach students to understand and apply thermodynamic property relationships for pure substances.
4. Familiarize students with some common equipment used in energy systems.
5. Reinforce students' knowledge and use of problem solving methods by solving a variety of thermodynamic process and systems applications.
6. Provide opportunities for students to work on group projects and communicate results.

Specific Objectives. Upon completion of ME 231, students should be able to:

1. Use thermodynamic terminology and concepts appropriately.
2. Define appropriate system boundaries for analyzing a variety of thermodynamic components and systems.
3. Determine and calculate the appropriate energy transfers and system properties to solve closed system processes and cycles.
4. Determine and calculate the appropriate mass and energy transfers and properties to solve steady flow open system applications with any number of heat, work, or mass flows crossing the system boundary.
5. Determine and calculate appropriate mass and energy transfers and properties to solve transient open system applications.
6. Use tables, charts, equations, and software to fix states of a pure substance and determine relationships among pressure, temperature, specific volume, internal energy, enthalpy, and entropy.
7. Determine when a process is reversible, irreversible, or impossible.
8. Calculate states and performance parameters for vapor power cycles based on the Rankine cycle with superheat, reheat, and regeneration.
9. Appreciate thermodynamics in the context of contemporary issues and the interplay of technological, social, and political factors in resolving or exacerbating problems facing society.

Course Objectives Matched to Student Outcomes
Course Number and Name ME 231 Engineering Thermodynamics I
Matching Adjusted to PO List by R. Nelson   Date 12/6/05

	Program Outcomes (Adopted Spring 2001)										
Course Objectives (Specific)	*Fundamental Knowledge*			*Engineering Skills*			*Career Success*			*Social Awareness*	
	Math PO1a	Physics PO1b	ChemistryPO1c	Analysis PO2a	Synthesis PO2b	Experi-ment PO2c	Team Work PO3a	Communi-cation PO3b	Life-Long Learning PO3c	Contemp-orary Issues PO4a	Profession-al Respons-ibilities PO4b
1	✓	✓	✓	✓							
2	✓	✓		✓							
3	✓	✓		✓							
4	✓	✓		✓							
5	✓	✓		✓							
6	✓	✓		✓							
7	✓	✓		✓							
8	✓	✓		✓							
9	✓	✓		✓						✓	
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ME 332 – Engineering Thermodynamics II – Course Objectives
Ron Nelson, 12/6/05

General Objectives. The purpose of ME 332 is to:

Apply the fundamentals of thermodynamics to selected machines, cycles, and processes. The selected applications emphasize the thermodynamic fundamentals of mass conservation, energy conservation, and the Second Law so that students will develop the skills to analyze other systems as needed.

Specific Objectives: Upon completion of ME 332, students should be able to:

1. Calculate states and performance parameters for gas power cycles based on the Otto, Diesel, and gas turbine cycles.
2. Explain important phenomena and do calculations for the steady flow of compressible fluids. The flows studied will include variable area isentropic flows, constant area flows with friction and heat transfer, and normal shocks.
3. Compute COPs and power requirements for simple vapor compression cycle refrigeration systems. These systems will include split evaporators and multiple compressors with intercooling.
4. Determine properties for ideal gas mixtures including the equation of state, u, h, and s and perform energy and mass balances for processes using nonreactive gas mixtures. Students will use commercially available computer software to analyze properties and compare design scenarios.
5. Calculate the common psychrometric properties associated with air-water vapor mixtures and use these properties in mass and energy balances to analyze heating, ventilating, and air conditioning processes.
6. Apply mass and energy balances on chemically reacting systems to analyze combustion processes. Students will be able to relate the heat transfer and exit (or final) temperature so that given one, they will be able to calculate the other.
7. Design and analyze thermodynamic systems.
8. Communicate the results of a system analysis.
9. Appreciate thermodynamics in the context of contemporary issues and the interplay of technological, social, and political factors in resolving or exacerbating problems facing society.

Course Objectives Matched to Student Outcomes
Course Number and Name ME 332 Engineering Thermodynamics II
Matching Adjusted to PO List by R. Nelson Date 12/6/05

	Program Outcomes (Adopted Spring 2001)										
Course Objectives (Specific)	*Fundamental Knowledge*			*Engineering Skills*			*Career Success*			*Social Awareness*	
	Math PO1a	Physics PO1b	Chemistry PO1c	Analysis PO2a	Synthesis PO2b	Experi-ment PO2c	Team Work PO3a	Communi-cation PO3b	Life-Long Learning PO3c	Contemp-orary Issues PO4a	Profession-al Respons-ibilities PO4b
1	✓	✓		✓							
2	✓	✓		✓							
3	✓	✓		✓							
4	✓	✓		✓							
5	✓	✓		✓							
6	✓	✓	✓	✓							
7					✓						
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9										✓	
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16											

ME 335 - Fluid Mechanics – Course Objectives
Mike Olsen, 12/6/05

General Objectives. The purpose of ME 335 is:

1. Enable students to recognize different categories of fluid flow.
2. Enable students to simplify and formulate solutions to fluid flow problems.
3. Provide the student with tools to solve fluid flow problems.
4. Enable student to appreciate distinction between ideal and real world problems.
5. Provide student with a working knowledge of fluid instrumentation.

Specific Objectives. Upon completion of ME 335, students should be able to:

1. Identify the following types of fluid flow problems: internal vs. external, steady vs. unsteady, viscid vs. inviscid, and compressible vs. incompressible.
2. Analyze demonstrations and/or perform experiments to understand different flow regimes (e.g., laminar vs. turbulent pipe flow, rotational vs. irrotational flow). Students will be able to apply data analysis techniques, including curve fits, root finding, extremization, statistics, and propagation of error, to experimental data obtained from fluid flows.
3. Understand in depth the fundamental physical concepts of fluid forces (body, surface, inertial), momentum transfer, viscosity, stress, deformation, vorticity, streamlines, streaklines and pathlines.
4. Understand advanced mathematical concepts of material derivative, Eulerian and Lagrangian reference systems, fluid acceleration, and velocity and pressure fields.
5. Apply the physical principles of mass, momentum, and energy balance using integral and differential methods as appropriate to model specific fluid flow problems including: hydrostatics, potential flows, pipe flows, boundary layer flows, drag-lift and thrust problems.
6. Determine relevant dimensionless parameters in a fluid flow problem using the Buckingham Pi Theorem and/or model equations; to carry out order of magnitude estimates to determine relevance of variables; and to use dimensional analysis to correlate data and to perform model studies (scaling).
7. Solve elementary fluid flow models either by (i) analytically solving model differential equations, (ii) numerically solving model differential equations, or (iii) using pre-existing known solutions (includes experimental results presented in generalized tables and figures).
8. Work in a team environment and communicate technical topics.
9. Appreciate fluid dynamics in the context of contemporary issues and the interplay of technological, social, and political factors in resolving or exacerbating problems facing society.

Course Objectives Matched to Student Outcomes
Course Number and Name ME 335 Fluid Mechanics
Matching Adjusted to PO List by M. Olsen Date 12/6/05

	Program Outcomes (Adopted Spring 2001)										
Course Objectives (Specific)	*Fundamental Knowledge*			*Engineering Skills*			*Career Success*			*Social Awareness*	
	Math PO1a	Physics PO1b	Chemistry PO1c	Analysis PO2a	Synthesis PO2b	Experi-ment PO2c	Team Work PO3a	Communi-cation PO3b	Life-Long Learning PO3c	Contemp-orary Issues PO4a	Profession-al Respons-ibilities PO4b
1	✓	✓									
2	✓	✓		✓	✓	✓					
3	✓	✓		✓							
4	✓	✓		✓							
5	✓	✓		✓							
6	✓	✓		✓							
7	✓	✓				✓					
8	✓	✓		✓			✓	✓			
9										✓	
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ME 436 - Heat Transfer – Course Objectives
Battaglia, Heindel and Pate, 10/13/05

General Objectives. The purpose of ME 436 is to:

1. Provide the students an understanding of the modes and rates of thermal energy transfer due to temperature differences over and above energy conservation concepts
2. Help the students develop skills to analyze conduction, convection and radiation heat transfer
3. Enable the students synthesize the understanding of heat transfer principles into the design of heat exchange devices
4. Introduce student groups to the application of numerical techniques to solve heat transfer problems, and communication of their results through project reports
5. Facilitate an understanding of thermal sciences principles through the use of experimental techniques and report writing in groups

Specific Objectives. Upon completion of ME 436, students should be able to:

1. Identify the primary mode(s) of heat transfer applicable to a specific situation and perform energy balances across control volumes and surfaces.
2. Recognize symmetry and the simplifications it provides in heat transfer problem solution.
3. Translate a physical situation into the appropriate form of the conduction equation and the corresponding boundary and initial conditions to compute temperature distributions and heat flows in objects that may or may not be generating heat.
4. Compute the enhancement of heat transfer resulting from the use of extended surfaces.
5. Develop the ability to recognize the conditions necessary for the application of approximate and detailed techniques for the computation of temperature variations with time and space in solids.
6. Identify the flow regimes and boundary conditions in external and internal flows and use pertinent non-dimensional variables to compute heat transfer coefficients while distinguishing between local and average coefficients.
7. Obtain an awareness of the various empirical correlations for forced and natural convection and recognize their applicability to different physical situations.
8. Predict heat transfer due to radiation from ideal and actual surfaces and enclosures, while accounting for directional and spectral variations in surface properties.
9. Gain an appreciation of the different types of heat exchangers and their applicability to particular situations.
10. Predict heat exchanger performance given size and inlet conditions, and also design the geometry of a heat exchanger required to deliver a desired heat transfer rate.
11. Compute spatial and temporal temperature variations and heat flows in 1- or 2-dimensional objects using the appropriate numerical techniques.
12. Measure thermal conductivities of solids, and compute heat transfer coefficients and heat duties from measured temperatures and flow rates and report and discuss experimental results.
13. Appreciate heat transfer in the context of contemporary issues and the interplay of technological, social, and political factors in resolving or exacerbating problems facing society.

Course Objectives Matched to Student Outcomes
Course Number and Name ME 436 Heat Transfer
Matching Adjusted to PO List by Battaglia, Heindel and Pate Date 10/13/05

	Program Outcomes (Adopted Spring 2001)										
Course Objectives (Specific)	*Fundamental Knowledge*			*Engineering Skills*			*Career Success*			*Social Awareness*	
	Math PO1a	Physics PO1b	Chemistry PO1c	Analysis PO2a	Synthesis PO2b	Experi-ment PO2c	Team Work PO3a	Communi-cation PO3b	Life-Long Learning PO3c	Contemp-orary Issues PO4a	Profession-al Respons-ibilities PO4b
1	✓	✓		✓		✓	✓				
2	✓	✓		✓							
3	✓	✓		✓							
4	✓	✓		✓		✓	✓				
5	✓	✓		✓							
6	✓	✓		✓		✓	✓				
7	✓	✓		✓							
8	✓	✓		✓							
9	✓	✓		✓							
10	✓	✓		✓	✓						
11	✓	✓		✓							
12	✓	✓		✓		✓	✓				
13										✓	
14											
15											
16											
17											

ME 324 - Manufacturing Engineering – Course Objectives
Pal Molian, 12/6/05

General Objectives. The purpose of ME 324 is to:

1. Discuss basic manufacturing processes and stress their capabilities and limitations.
2. Relate the dependence of manufacturing process on material properties and of the integrity of manufactured part on processing method.
3. Apply computer integration concepts in manufacturing.

Specific Objectives. Upon completion of ME 324, students should be able to:

1. Identify the capabilities and limitations of different manufacturing processes.
2. Analyze the effect of a manufacturing process on the properties of the end product.
3. Use teamwork to produce a part and communicate the results, both in oral and written forms.
4. Appreciate manufacturing in the context of contemporary and societal issues.

Course Objectives Matched to Student Outcomes
Course Number and Name ME 324 Manufacturing
Matching Adjusted to PO List by P. Molian Date 12/6/05

	Program Outcomes										
Course Objectives (Specific)	*Fundamental Knowledge*			*Engineering Skills*			*Career Success*			*Social Awareness*	
	Math PO1a	Physics PO1b	Chemistry PO1c	Analysis PO2a	Synthesis PO4	Experi-ment PO2c	Team Work PO3a	Communi-cation PO3b	Life-Long Learning PO3c	Contemp-orary Issues PO4a	Profession-al Respons-ibilities PO4b
1	✓	✓	✓	✓		✓					
2	✓	✓	✓	✓		✓					
3						✓	✓	✓			
4										✓	

ME 325 - Machine Design – Course Objectives
Don Flugrad, 12/6/05

General Objectives. The purpose of ME 325 is to:

Introduce students to concepts of configuration design, parametric design, and concurrent design of machine components.

Specific Objectives. Upon completion of ME 325, students should be able to:

1. Apply design theory and methodology to the task of generating design alternatives.
2. Identify the functional characteristics of various machine elements.
3. Evaluate design alternatives using a utility function.
4. Design or select bearings, gears and shafts for a specific application.
5. Apply static and fatigue failure theories to the design of machine components.
6. Work effectively with team members in achieving final design results.
7. Communicate design results in written and oral reports.
8. Appreciate mechanism and machine design in the context of contemporary issues and the interplay of technological, social, and political factors in resolving or exacerbating problems facing society.

Course Objectives Matched to Student Outcomes
Course Number and Name ME 325 Mechanism Design
Matching Adjusted to PO List by D. Flugrad Date 12/6/05

	Program Outcomes (Adopted Spring 2001)										
Course Objectives (Specific)	*Fundamental Knowledge*			*Engineering Skills*			*Career Success*			*Social Awareness*	
	Math PO1a	Physics PO1b	Chemistry PO1c	Analysis PO2a	Synthesis PO4	Experi-ment PO2c	Team Work PO3a	Communi-cation PO3b	Life-Long Learning PO3c	Contemp-orary Issues PO4a	Profession-al Respons-ibilities PO4b
1	✓			✓	✓						
2	✓	✓		✓							
3	✓	✓		✓	✓						
4	✓			✓	✓						
5	✓			✓							
6							✓	✓			
7								✓			
8										✓	

ME 421 - Mechanical Systems and Control – Course Objectives
Greg Luecke, 12/6/05

General Objectives. The purpose of ME 421 is to:

1. Introduce students to the art and science of modeling, simulation, and control of dynamic systems.
2. Teach students to analyze and simulate dynamic systems.
3. Explain dynamic response of systems
4. Provide students opportunities to experimentally implement closed loop control.

Specific Objectives. Upon completing ME 421, students should be able to:

1. Define a suitable set of variables that describe the dynamics of a system and construct a simplified mathematical description using idealized elements.
2. Use the basic element and interconnection laws to develop a mathematical model based on the ordinary differential equations governing the motion of the system.
3. Determine the equilibrium conditions for non-linear systems and obtain a linearized model.
4. Arrange the governing differential equations of the model in a form that is suitable for computer simulation. Program the simulation for both linear and nonlinear models. Analyze the results of the simulation to assure appropriate behavior of the system.
5. Solve directly for the time-domain response of a first- or second-order system.
6. Identify and analyze modes and natural frequencies of 2 degrees-of-freedom systems.
7. Use Laplace transforms as a tool to find the complete time response for a model, determine the transfer function, identify system poles and zeros, and analyze stability and evaluate time constants, damping ratios, and system natural frequencies.
8. Use the system transfer function to find steady-state response to constant or sinusoidal input.
9. Use block diagrams to represent the system schematically.
10. Work together to document the activity and results of laboratory exercises.
11. Appreciate mechanical systems and control in the context of contemporary issues and the interplay of technological, social, and political factors in resolving or exacerbating problems facing society. Acquire an understanding of the ethical and professional responsibilities of engineers.

Course Objectives Matched to Student Outcomes
Course Number and Name ME 421 Mechanical Systems & Control
Matching Adjusted to PO List by G. Luecke Date 12/6/05

	Program Outcomes (Adopted Spring 2001)										
Course Objectives (Specific)	*Fundamental Knowledge*			*Engineering Skills*			*Career Success*			*Social Awareness*	
	Math PO1a	Physics PO1b	Chemistry PO1c	Analysis PO2a	Synthesis PO4	Experi-ment PO2c	Team Work PO3a	Communi-cation PO3b	Life-Long Learning PO3c	Contemp-orary Issues PO4a	Profession-al Respons-ibilities PO4b
1	✓	✓		✓							
2	✓			✓							
3	✓			✓							
4	✓			✓		✓					
5	✓			✓							
6	✓			✓							
7	✓			✓							
8	✓			✓							
9				✓							
10							✓				
11					✓					✓	✓
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16											

ME 370 – Measurement and Instrumentation – Course Objectives
Updated September 2005 by Heindel, Luecke, and Sundararajan

General Objectives**:** The purpose of ME 370 is to:

1. Familiarize students with theory of measurements and instrumentation.
2. Provide students with a "hands-on" experience with instruments and modern measurement methods.
3. Explain how limitations of instruments and measurement systems affect measured quantities.
4. Teach students to interpret and communicate data critically and objectively.

Specific Objectives**:** Upon completion of ME 370, the student will be able to:

1. Recognize basic measurement systems and identify basic terms related to measuring instruments and the measurement process.
2. Obtain theoretical knowledge and practical experience of various sensors such as: variable resistance and capacitance devices, strain gauges, thermocouples, and accelerometers.
3. Recognize a sensor and/or transducer system's dynamic limitations by learning how to identify first-order and second-order behavior, and to characterize damping and frequency response.
4. Understand the role of signal conditioning in enhancing measurements by experimenting with active and passive noise filters and operational amplifiers.
5. Use computers and software to control instruments, perform/automate data acquisition, manipulate data, and graphically present results.
6. Establish rigorous data treatment procedures by applying statistical and error propagation methods to experimental results.
7. Synthesize theoretical knowledge with the experience gained in the laboratory to perform measurements.
8. Develop effective communications skills by engaging in verbal interaction with team members and by submitting succinct and descriptive written reports.
9. Appreciate measurement and instrumentation in the context of contemporary issues and the interplay of technological, social, and political factors in resolving or exacerbating problems facing society.

Course Objectives Matched to Student Outcomes
Course Number and Name ME 370 Measurement & Instrumentation
Matching Adjusted to PO List by Ted Heindel   Date 9/20/05

	Program Outcomes (Adopted Spring 2001)										
Course Objectives (Specific)	*Fundamental Knowledge*			*Engineering Skills*			*Career Success*			*Social Awareness*	
	Math PO1a	Physics PO1b	Chemistry PO1c	Analysis PO2a	Synthesis PO4	Experi-ment PO2c	Team Work PO3a	Communi-cation PO3b	Life-Long Learning PO3c	Contemp-orary Issues PO4a	Profession-al Respons-ibilities PO4b
1				✓		✓					
2	✓	✓		✓		✓					
3	✓			✓							
4		✓		✓							
5				✓		✓		✓			
6	✓			✓		✓					
7				✓		✓	✓				
8							✓	✓			
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ME 270 - Cornerstone Design – Course Objectives
J. Oliver, E. Winer, S. Subramaniam, 10/17/05

General Objectives. The purpose of ME 270 is to:

1. Introduce the student to all aspects of the design process, e.g., conceptualization, synthesis, analysis, fabrication.
2. Train the students in the tools required to facilitate the design process, e.g., group dynamics, teamwork, creativity.
3. Provide opportunities for students to develop oral and written communication skills.
4. Introduce the student to professional practice, e.g., ethics, legal issues, intellectual property.

Specific Objectives. Upon completion of ME 270, students should be able to:

1. Identify a relevant design concept
2. Work in an industry simulated engineering team with different management levels
3. Perform analysis to target a specific business market
4. Create, rank, and eventually satisfy a list of design goals for the developed product
5. Use a wide variety of creative thinking methods and tools to develop unique, meaningful, and viable design options.
6. Incorporate appropriate analysis and optimization tools into the design process.
7. Schedule and plan multi-faceted tasks, coordinating disparate groups to complete the project.
8. Demonstrate an understanding of ethics, patents, and legal issues in the design process.
9. Assess the functional fitness of the final prototype to meet design criteria.
10. Present technical material using appropriate written, oral, and graphical techniques.
11. Plan for continuous improvement through future design iterations.

Course Objectives Matched to Student Outcomes

Course Number and Name ME 270 Intro to Mechanical Engineering Design

Matching Adjusted to PO List by J. Oliver, E. Winer, S. Subramaniam Date 10/17/05

	Program Outcomes (Adopted Spring 2001)										
Course Objectives (Specific)	*Fundamental Knowledge*			*Engineering Skills*			*Career Success*			*Social Awareness*	
	Math PO1a	Physics PO1b	Chemistry PO1c	Analysis PO2a	Synthesis PO4	Experi-ment PO2c	Team Work PO3a	Communi-cation PO3b	Life-Long Learning PO3c	Contemp-orary Issues PO4a	Profession-al Respons-ibilities PO4b
1				✓	✓						
2							✓	✓		✓	
3											
4		✓		✓							
5	✓			✓	✓						
6	✓			✓							
7							✓	✓		✓	
8										✓	✓
9				✓		✓					
10								✓			
11	✓			✓	✓			✓			

ME 415 - Mechanical Systems Design – Course Objectives
Don Flugrad, 12/6/05

Specific Objectives. Upon completion of ME 415 students should be able to:

1. Design one or more machines or assemblies that emphasize mechanical systems. Plan the sequential steps required in the over all design process.
2. Present results of the design process in written and oral form. Provide documentation of form and function, materials, manufacturing methods, safety, costs, assembly methods, serviceability, and conformance with codes and standards.
3. Use computer aided engineering techniques throughout the design process.
4. Apply concurrent engineering methods in the overall aspects of the design process.
5. Apply knowledge from fields other than mechanical, as needed, to design a complete and satisfactory machine or assembly.
6. Consult and work with industry and business personnel to achieve a final satisfactory design.
7. Work as part of a team to produce the desired results.
8. Evaluate and incorporate safety, economic, social, environmental, and legal considerations in the design process. Understand the impact of ethics, ergonomics, manufacturing, maintenance, and standards in developing credible products.
9. Appreciate mechanical design in the context of contemporary issues and the interplay of technological, social, and political factors in resolving or exacerbating problems facing society.

Course Objectives Matched to Student Outcomes
Course Number and Name ME 415 Mechanical Systems Design
Matching Adjusted to PO List by D. Flugrad Date 12/6/05

	Program Outcomes (Adopted Spring 2001)										
Course Objectives (Specific)	*Fundamental Knowledge*			*Engineering Skills*			*Career Success*			*Social Awareness*	
	Math PO1a	Physics PO1b	Chemistry PO1c	Analysis PO2a	Synthesis PO4	Experi-ment PO2c	Team Work PO3a	Communi-cation PO3b	Life-Long Learning PO3c	Contemp-orary Issues PO4a	Profession-al Respons-ibilities PO4b
1	✓	✓			✓						
2								✓			✓
3	✓			✓	✓				✓		
4	✓						✓	✓		✓	
5	✓	✓		✓	✓				✓		
6				✓	✓		✓	✓	✓		
7							✓	✓			
8					✓				✓	✓	✓
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ME 442 - Heating, Ventilating and Air-Conditioning Design – Course Objectives
Greg Maxwell, 12/6/05

General Objectives. The purpose of ME 442 is to:

1. Introduce to students the practice of HVAC design
2. Relate the design practice through practical design problems.
3. Examine the ethics and responsibilities of HVAC design practice.
4. Apply modern computer based design software to HVAC design practice.
5. Practice writing and oral communication skills in presenting HVAC designs.

Specific Objectives. Upon completion of ME 442, students will be able to:

1. Select heating and cooling coils for an HVAC system.
2. Design a piping system including selection of system components (including pumps, valves, chillers, cooling towers, and expansion tanks).
3. Design a room-air distribution system including selection and placement of supply, return and exhaust diffusers and grills.
4. Design an air distribution system using both high and low-velocity duct design methods.
5. Select components for an air distribution system including terminal boxes and fans.
6. Determine the proper indoor air conditions (temperature, humidity and ventilation rate) for building occupants based on level of activity and ASHRAE standards.
7. Utilize a commercial software program to perform thermal analyses on buildings and determine design heating and cooling loads.
8. Design an HVAC system for a building given design constraints that impact system selection.
9. Appreciate ME 442 in the context of contemporary issues and the interplay of technological, social, and political factors in resolving or exacerbating problems facing society.
10. Acquire an understanding of the ethical and professional responsibilities of engineers.
11. Practice working in design teams.

Course Objectives Matched to Student Outcomes
Course Number and Name ME 442 Heating and Air Conditioning Design
Matching Adjusted to PO List by G. Maxwell Date 12/6/05

	Program Outcomes (Adopted Spring 2001)										
Course Objectives (Specific)	*Fundamental Knowledge*			*Engineering Skills*			*Career Success*			*Social Awareness*	
	Math PO1a	Physics PO1b	Chemistry PO1c	Analysis PO2a	Synthesis PO4	Experi-ment PO2c	Team Work PO3a	Communi-cation PO3b	Life-Long Learning PO3c	Contemp-orary Issues PO4a	Profession-al Respons-ibilities PO4b
1				✓							
2					✓						
3					✓						
4				✓	✓						
5				✓							
6				✓				✓	✓		
7				✓					✓		
8					✓			✓		✓	
9											✓
10											
11							✓				
12											
13											
14											
15											
16											
17											

ME 446 - Power Plant Design – Course Objectives
K. M. Bryden, 12/6/05

General Objectives. The purpose of ME 446 is to:

Provide students with a realistic design experience that will require them to exercise the knowledge gained in previous engineering courses and develop the skills needed to function in an industrial design environment. These skills include engineering problem formulation and solution, oral and written communication, team decision-making, and ethical conduct. Students will also have the opportunity to further develop their knowledge of power plant operation and design.

Specific Objectives. Upon completion of ME 446 students should be able to:

1. Understand the engineering design and fundamental basis for new concept power plants being considered for implementation in the near future.
2. Given a statement of need, develop a proposed solution that meets the need. The proposed solution will include engineering specifications and a plan to develop the solution to a final product.
3. Apply their existing knowledge of thermal and mechanical systems to an engineering design problem and show that they are capable of acquiring new knowledge as needed to solve the problem.
4. Work in teams that delegate responsibility evenly and appropriately, share information, and coordinate tasks so that the project flows smoothly.
5. Produce well-organized and well-documented written material. Students will be able to present this material orally in a clear, interesting, and well-organized manner.
6. Demonstrate that they have acquired new knowledge in the field of power plant operation and design beyond the level of their previous engineering training.
7. Demonstrate the ability to use energy systems design and analysis tools.
8. Appreciate ME 446 in the context of contemporary issues and the interplay of technological, social, and political factors in resolving or exacerbating problems facing society. Understand the societal and environmental impact of power generation and power plant design.
9. Acquire an understanding of the ethical and professional responsibilities of engineers.

Course Objectives Matched to Student Outcomes
Course Number and Name ME 446 Power Plant Design
Matching Adjusted to PO List by K. M. Bryden Date 12/6/05

	Program Outcomes (Adopted Spring 2001)										
Course Objectives (Specific)	*Fundamental Knowledge*			*Engineering Skills*			*Career Success*			*Social Awareness*	
	Math PO1a	Physics PO1b	Chemistry PO1c	Analysis PO2a	Synthesis PO4	Experi-ment PO2c	Team Work PO3a	Communi-cation PO3b	Life-Long Learning PO3c	Contemp-orary Issues PO4a	Profession-al Respons-ibilities PO4b
1					✓						✓
2				✓							
3				✓					✓		
4							✓	✓			
5								✓			
6								✓			
7	✓	✓	✓	✓	✓				✓		
8					✓					✓	
9					✓						✓
10											
11											
12											
13											
14											
15											
16											
17											

ME 449 - Internal Combustion Engine Design – Course Objectives
Kong, 12/6/05

General Objectives. The purpose of ME 449 is to:

Provide students with a realistic design experience that will require them to exercise the knowledge gained in previous engineering courses and develop the skills needed to function in an industrial design environment. These skills include engineering problem formulation and solution, oral and written communication, team decision-making, and ethical conduct. Students will also have the opportunity to further develop their knowledge of internal combustion engines.

Specific Objectives. Upon completion of ME 449 students should be able to:

1. Given a statement of need, develop a proposed solution that meets the need. The proposed solution will include engineering specifications and a plan to develop the solution to a final product.
2. Apply their existing knowledge of thermal and mechanical systems to an engineering design problem and show that they are capable of acquiring new knowledge as needed to solve the problem.
3. Work in teams that delegate responsibility evenly and appropriately, share information, and coordinate tasks so that the project flows smoothly.
4. Produce well-organized and well-documented written material. Students will be able to present this material orally in a clear, interesting, and well-organized manner.
5. Demonstrate that they have acquired new knowledge in the field of internal combustion engines beyond the level attained in the prerequisite course, Internal Combustion Engines (ME 445).
6. Demonstrate competence in the use and interpretation of internal combustion engine simulation software.
7. Appreciate ME 449 in the context of contemporary issues and the interplay of technological, social, and political factors in resolving or exacerbating problems facing society.
8. Acquire an understanding of the ethical and professional responsibilities of engineers.

Course Objectives Matched to Student Outcomes
Course Number and Name 449 IC Engine Design
Matching Adjusted to PO List by Kong Date 12/6/05

	Program Outcomes (Adopted Spring 2001)										
Course Objectives (Specific)	*Fundamental Knowledge*			*Engineering Skills*			*Career Success*			*Social Awareness*	
	Math PO1a	Physics PO1b	Chemistry PO1c	Analysis PO2a	Synthesis PO4	Experi-ment PO2c	Team Work PO3a	Communi-cation PO3b	Life-Long Learning PO3c	Contemp-orary Issues PO4a	Profession-al Respons-ibilities PO4b
1	✓			✓	✓						
2	✓	✓	✓	✓					✓		
3							✓	✓			
4								✓			
5		✓						✓	✓		
6	✓	✓		✓	✓				✓	✓	
7					✓						✓
8											✓
9											
10											
11											
12											
13											
14											
15											
16											
17											

Appendix I-D.3. Instructions for Performing Student Assessments

Updated October 26, 2005
Prepared by Robert C. Brown

It is ***extremely*** important that all faculty who teach required ME courses and senior design electives participate in this assessment. The results will be used by the respective Course Development Committees (CDCs) for continuous quality improvement.

The bubble sheet has eleven (11) printed questions that address the program outcomes we have identified to ABET that are important for our undergraduate students. The students are to fill in the bubble sheet with the number (1=never ... 5=very often) that reflects the *opportunities* your course offered in the 11 question areas. You should explain to the students that some questions are not relevant to your course, but they should still fill in the bubble sheet accordingly (e.g., in ME 231, students do not conduct experiments so their response should be 1-never). These surveys are very important to ensure that our program outcomes are being covered in our curriculum.

It is important to realize that the student assessment is **NOT** used in individual instructor evaluations, but is used to determine if a particular course should be modified so our students achieve what we tell ABET they will achieve by the time they graduate.

Appendix I-D.4: Student Assessment Form

Student Assessment of Opportunities to Master PROGRAM OUTCOMES in ME Courses

The purpose of this questionnaire is to discover whether this course presented you opportunities to master outcomes the Department of Mechanical Engineering has targeted for undergraduate students. Please mark on the bubble sheet the number that best reflects the opportunities this course offered in the following activities REGARDLESS OF THEIR RELEVANCE TO THIS PARTICULAR COURSE.

Never **1**	**Seldom** **2**	**Occasionally** **3**	**Often** **4**	**Very Often** **5**

This course provided you opportunities to:

1. Apply knowledge of mathematics to engineering problems.
2. Apply knowledge of physics to engineering problems.
3. Apply knowledge of chemistry to engineering problems.
4. Identify, formulate, and solve problems in thermal and/or mechanical systems using techniques, skills, and modern tools of the engineering profession.
5. Design a system, component, or process associated with thermal and/or mechanical systems using techniques, skills, and modern tools of the engineering profession.
6. Design and conduct experiments and analyze and interpret data associated with thermal and/or mechanical systems using techniques, skills, and modern tools of engineering.
7. Work on teams.
8. Communicate in oral and/or written formats.
9. Engage in self-directed learning.
10. Develop awareness of contemporary issues (Contemporary issues are topics that challenge modern society and occupy the attention of citizens who are well informed about their nation and the world. Especially relevant to engineers is the interplay of technological, social, and political factors in resolving or exacerbating problems facing society).
11. Understand ethical and professional responsibilities.

Appendix I-D.5: Instructions for Performing Course Objectives Assessment

October 26, 2005
Prepared by Robert C. Brown

1. The goal of this assessment is to determine how many students are mastering course objectives in core and design courses.
2. Every instructor of every section of core course and design courses will perform this assessment every semester.
3. The approach is to allow faculty to customize this assessment to their class, as long as every course objective is evaluated. Accordingly, no detailed plan or standard template is available for this assessment.
4. An instructor is responsible for preparing a *plan for assessment* for his or her section of a course. A common plan for a multi-section course is possible but not required. This plan explains the methodology for assessment and the basis for judging whether a student as mastered a course objective. Some faculty may use a fairly conventional approach of using quizzes or exams to determine how well their students are mastering course objectives while others may use group projects, class discussion, or other forms of feedback from students to gather the necessary data to make this assessment.
5. An instructor is responsible for completing the course objectives assessment before the end of the semester in which the course is taught. Faculty should prepare a table showing the *percentage of students* judged to have mastered each course objective. This information is passed along to the CDC for that course, which maps this information back to program outcomes and uses it in preparing their CDC report to the ME Curriculum Committee.

Appendix I-D.6: Instructions for Design Panel Assessment

Adopted Fall 2001
Robert C. Brown

a. Each panelist will assess all design-related student outcomes (PO2b, PO3b, and PO4b) in the projects assigned to them. These assessments will be performed by the application of a standard rubric (*Design Panel Rubrics 2001)* developed for each design-related student outcome.

b. The panel will be divided into four subpanels consisting of a faculty member, a student, and an industrial representative. Each subpanel will be responsible for evaluating design projects from one design course (ME 270, ME 415, ME 442, or ME 449). Each panelist will be assigned a unique set of three student design projects for evaluation over the course of about two hours. This assessment will be performed on site although the project reports and rubrics will be sent to the panelist in advance of the meeting.

c. All panelists will begin by assessing a common student project taken from ME 415 as a calibration exercise. This exercise, lasting about one hour, will help assure use of uniform evaluation standards by the panelists. This calibration will be performed on site although the project report and rubrics will be sent to the panelist in advance of the meeting. The calibration exercise will be conducted late Thursday afternoon and the formal assessment performed on Friday morning.

d. A ME staff member will serve as a recorder to fill out electronic forms used to tabulate results. The data will be submitted to the designated staff person in a spread sheet (see *Design Panel Data Template*) designed to calculate the average, standard deviation, and confidence interval for each PO dimension based on the complete set of evaluations performed by the design panel. This information will be incorporated into assessment reports submitted to Course Development Committee

Appendix I-D.7: Rubrics for Design Panel Assessment

Adopted Fall 2001
ME Curriculum Committee

Program Outcome: Engineering Skills
Dimension: Synthesis
Number: PO 2b
Description: *An ability to design a system, component, or process associated with thermal and/or mechanical systems using techniques, skills, and modern tools of the engineering profession.*

Demonstrates an ability to identify design goals and constraints.				
Never meets expectations	Rarely meets expectations	Meets expectations	Exceeds expectations	Consistently exceeds expectations
1	2	3	4	5

Demonstrates clear, sound reasoning in preparing a design solution. Student explores reasonable alternative design options before arriving at the final design.				
Never meets expectations	Rarely meets expectations	Meets expectations	Exceeds expectations	Consistently exceeds expectations
1	2	3	4	5

Selects appropriate tools and uses them effectively in the design process.				
Never meets expectations	Rarely meets expectations	Meets expectations	Exceeds expectations	Consistently exceeds expectations
1	2	3	4	5

Program Outcome: Career Success
Dimension: Communication
Number: PO 3b
Description: *Communication skills reflect professionalism of the student through use of proper grammar, appropriate mannerisms or writing style, and skillful use of visual aids.*

Written or oral presentations are cohesive, organized, focused and interesting.				
Never meets expectations	Rarely meets expectations	Meets expectations	Exceeds expectations	Consistently exceeds expectations
1	2	3	4	5

Written presentations are neat, grammar is correct, technical information is accurate, and the work reflects pride of authorship. The writing level is appropriate to the targeted audience. **Or** **Oral presentations engage audiences with appropriate language and skillful use of visual aids. Presentation demeanor and response to audience members is consistently professional and respectful.**				
Never meets expectations	Rarely meets expectations	Meets expectations	Exceeds expectations	Consistently exceeds expectations
1	2	3	4	5

Program Outcome: Social Awareness
Dimension: Professional and ethical responsibilities
Number: PO 4b
Description: *An attendant understanding of the ethical and professional responsibilities of the ME profession.*

Understands the ethical and professional responsibilities of the ME profession.*				
Never meets expectations	Rarely meets expectations	Meets expectations	Exceeds expectations	Consistently exceeds expectations
1	2	3	4	5

*Although this may involve specific knowledge of codes and standards in design, it also includes a broader sense of how to approach ethical issues for which appropriate responses are not formally prescribed.

Appendix I-D.8: Invitation Letter for Design Panel Assessment

Adopted Fall 2001
Robert C. Brown

[Date]

[Name and Address of MEAC member, faculty member, or student participant]

Dear [member]:

Thank you for agreeing to serve as a member of our Design Assessment Panel for the Department of Mechanical Engineering. This panel serves an extremely important role in our efforts to assess the performance of our students in the ABET design-related student outcomes. The Design Assessment Panel is scheduled to meet on Thursday, [date] at 5:00 p.m. to 6 p.m. and on Friday, [date] from 7:30 to 10:00 a.m. A complete agenda is enclosed.

Please find enclosed the two or three design projects assigned to you and a corresponding number of assessment rubric packets. One of the design projects has been designated as a “common” project that will be assessed as a calibration exercise during our Thursday afternoon session. The other one or two design projects represent your contribution to the overall assessment effort. These projects range from the sophomore (ME 270) to the senior (ME 415, ME 442 and ME 449) course level. However, you should <u>not</u> factor in a student’s classification when assessing projects; we want to monitor improvement in skills as students move through the curriculum. Please read each report prior to arrival on campus and, time permitting, perform a preliminary assessment of each report using the enclosed rubrics. At a minimum, please assess the “common” project in preparation for our calibration exercise on Thursday. If you have any questions, we can discuss them during the calibration exercise.

I would like to reiterate my sincere appreciation for your efforts in helping us to improve our undergraduate program in Mechanical Engineering.

Sincerely,

Judy Vance
Chair, Department of Mechanical Engineering

Enclosures

Appendix I-D.9: Graduating Senior Survey Form

ME Graduating Senior Survey – Fall 2005

We must continuously improve our undergraduate program in Mechanical Engineering. Please help us achieve this by responding to the following requests and questions.

Part I

The following questions provide us with a profile of your overall experience at ISU.

1. Please select your residence as a student: ☐ in-state ☐ out-of-state

2. How many Fall and Spring semesters of coop/internship experience do you have?

   ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4

3. Excluding coop/internship semesters, how many semesters did you take to complete your graduation requirement?

   ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12

4. If you answered more than 8 semesters of classes in question #3, please explain below.

5. Please indicate your plans after graduation. Have you accepted full-time employment or will you be going on for graduate study?

   ☐ Employment If yes, with whom?

   ☐ Graduate study If yes, where.

6. Academic advising.

   (a) Who was your advisor?

   ☐ Starns ☐ Beck ☐ Castleberry ☐ Other

   (b) What is your perception of the advising process?

   ☐ Excellent ☐ Adequate ☐ Poor

   (c) What recommendations do you have for improving our advising system?

   (d) What would you not change in the advising system?

7. Would you recommend the ISU Mechanical Engineering Program to prospective high school students?

   ☐ Yes ☐ No

   Why or why not?

Part II

The following questions will help us evaluate your educational experience in specific courses and organizations.

8. Please select the following organization(s) in which you participated during your undergraduate college experience.

☐ None	☐ ANS	☐ ASHRAE	☐ ASME
☐ NSBE	☐ Pi Tau Sigma	☐ SAE	☐ SHPE
☐ SME	☐ SWE	☐ Tau Beta Pi	
☐ Other			

9. Please indicate your experience(s) in the organizations from question 8.

a. ☐ yes ☐ no participate in team

b. ☐ yes ☐ no exercise leadership skills

c. ☐ yes ☐ no experience/increase my understanding of societal or human aspects of engineering

d. ☐ yes ☐ no experience/increase my understanding of legal aspects of engineering

e. ☐ yes ☐ no experience/increase my understanding of environmental aspects of engineering

f. ☐ yes ☐ no experience/increase my understanding of aesthetic aspects of engineering

10. Please rate the educational value that you received from the following courses taught by departments other than Mechanical Engineering

a. Mathematics	☐ Excellent	☐ Adequate	☐ Poor
b. Chemistry	☐ Excellent	☐ Adequate	☐ Poor
c. Physics	☐ Excellent	☐ Adequate	☐ Poor
d. Freshman English	☐ Excellent	☐ Adequate	☐ Poor
e. English 314	☐ Excellent	☐ Adequate	☐ Poor
f. Engineering Mechanics (274, 324, 345, 306)	☐ Excellent	☐ Adequate	☐ Poor
g. Engineering 101, 160, 170	☐ Excellent	☐ Adequate	☐ Poor
h. Materials (MatE 272)	☐ Excellent	☐ Adequate	☐ Poor
i. Electrical Engineering	☐ Excellent	☐ Adequate	☐ Poor
j. Statistics 30	☐ Excellent	☐ Adequate	☐ Poor
k. Soc/Hum Electives	☐ Excellent	☐ Adequate	☐ Poor

11.Please rate the educational value you received from the following core sequences taught by the Mechanical Engineering Department.

a. Thermofluids (231, 332, 335, 436)
☐ Excellent ☐ Adequate ☐ Poor

b. Machine design and controls (325, 421)
☐ Excellent ☐ Adequate ☐ Poor

c. Materials and Manufacturing (324)
☐ Excellent ☐ Adequate ☐ Poor

d. Laboratory (370)
☐ Excellent ☐ Adequate ☐ Poor

e. Design course (270, 415, 442, 446, 449)
☐ Excellent ☐ Adequate ☐ Poor

12. Please rate the educational value that you received from the following courses taught by the Mechanical Engineering Department.

a) Independent study (490) based on the value of the project.
☐ Excellent ☐ Adequate ☐ Poor ☐ N/a

b) Graduate level courses (5XX)
☐ Excellent ☐ Adequate ☐ Poor ☐ N/a

13. Please select the considerations or constraints used in developing the design in your capstone design course.

☐ Economic ☐ Manufacturability ☐ Safety
☐ Environmental ☐ Ethical ☐ Social
☐ Sustainability ☐ Health ☐ Political

Part III
The following observations apply to your overall undergraduate educational experience. Please select the degree to which you have been able to do the following.

1. Fundamental knowledge

a) Apply knowledge of mathematics to engineering problems
☐ Very often ☐ Often ☐ Occasionally ☐ Seldom ☐ Never

b) Apply knowledge of physics to engineering problems
☐ Very often ☐ Often ☐ Occasionally ☐ Seldom ☐ Never

c) Apply knowledge of chemistry to engineering problems
☐ Very often ☐ Often ☐ Occasionally ☐ Seldom ☐ Never

2. Engineering skills

a) Identify, formulate, and solve problems in thermal and/or mechanical systems using techniques, skills, and modern tools of the engineering profession.

☐ Very often ☐ Often ☐ Occasionally ☐ Seldom ☐ Never

b) Design a system, component, or process associated with thermal and/or mechanical systems using techniques, skills, and modern tools of the engineering profession.

☐ Very often ☐ Often ☐ Occasionally ☐ Seldom ☐ Never

c) Design and conduct experiments and analyze and interpret data associated with thermal and/or mechanical systems using techniques, skills, and modern tools of engineering.

☐ Very often ☐ Often ☐ Occasionally ☐ Seldom ☐ Never

3. Career success

a) Work on teams

☐ Very often ☐ Often ☐ Occasionally ☐ Seldom ☐ Never

b) Communicate in oral and/or written formats

☐ Very often ☐ Often ☐ Occasionally ☐ Seldom ☐ Never

c) Engage in self-directed learning.

☐ Very often ☐ Often ☐ Occasionally ☐ Seldom ☐ Never

4. Social awareness

a) Develop awareness of contemporary issues (Contemporary issues: topics that challenge modern society and occupy the attention of citizens who are well informed about their nation and the world. Students should be especially cognizant of the interplay of technological, social, and political factors in resolving or exacerbating problems facing society.)

☐ Very often ☐ Often ☐ Occasionally ☐ Seldom ☐ Never

b) Understand ethical and professional responsibilities.

☐ Very often ☐ Often ☐ Occasionally ☐ Seldom ☐ Never

Appendix I-D.10: Alumni Survey Forms: Cover Letter & Questionnaire

Modified Fall 2005
Robert C. Brown

<Date>

«FIRST_NAME» «LAST_NAME»
«ADDR_1»
«ADDR_2»
«ADDR_3»
«ADDR_4~
«ADDR_5»

Dear «FIRST_NAME»,

The Mechanical Engineering Department at Iowa State University is contacting selected alumni to assess their educational experience at Iowa State University. Specifically, it is our feeling that after practicing engineering for several years, you are in an excellent position to look back and to provide us with feedback regarding the mechanical engineering department. The feedback concerns whether the ME department provided you with the tools and skills necessary to work as an engineer in the real world. The attached questionnaire addresses these questions, and your answers will allow us to make those changes necessary to improve the process by which we prepare mechanical engineers for a successful professional career.

Your response is a key part of our continuous improvement process and critical to our ABET accreditation process. We greatly appreciate the time and effort you will put into completing this survey. It should take about 10 minutes to complete and a return envelope is provided for your convenience. Should you have questions you can contact Jodi Reinhart at 515-294-1431 or email her at reinhart@iastate.edu. If possible, we would like to receive the results of your survey by <Date>. Your participation is voluntary and your confidentiality is ensured.

Thank you in advance for your cooperation, and we look forward to hearing from you.

Sincerely,

Judy Vance
Chair and Professor of Mechanical Engineering

Enclosures: Alumni Outcomes Questionnaire Return Envelope

Alumni Questionnaire

PLEASE CIRCLE ONE

Do you think that your experience at ISU laid the foundation to:	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. Pursue a variety of careers. Although most graduates are expected to find employment in industry, government laboratories or consulting, the skills learned at ISU should also allow graduates to pursue graduate or professional studies in such fields as engineering, business, law or medicine.	**1**	**2**	**3**	**4**	**5**
2. Apply the problem solving skills you learned at Iowa State University to meet the challenging demands and increasing responsibilities of a successful career.	**1**	**2**	**3**	**4**	**5**
3. Continue to learn in your profession, using modern technology and communication skills to contribute as a team member or leader in solving important problems for your employer and for society.	**1**	**2**	**3**	**4**	**5**

Suggestions (to improve ME program, assessment process, etc.):

Noteworthy accomplishments you would like to tell us about (promotions, continuing education, patents, awards, honors, etc.):

Appendix I-D.11: Instructions on Performing Continuous Quality Improvement

Instructions for Continuous Quality Improvement of the ME Curriculum

1. Each CDC will receive every semester data from the various assessment tools including student assessments, design assessments, graduating senior surveys, and alumni surveys which encompass all program outcomes (fundamental knowledge, engineering skills, career success, and social awareness.
2. Each CDC will annually submit a *CDC Plan* to the Curriculum Committee by midterm of the fall semester that detail improvements planned for the following fall semester. This plan will be responsive to deficiencies identified by *Assessment Reports* for the fall and spring semesters of the previous calendar year.
3. The Mechanical Engineering Curriculum Committee will review the annual *CDC Plan* and negotiate changes with the CDCs during the last half of the fall semester. An annual *Continuous Improvement Report* on these plans, which includes commentary on the perceived appropriateness and effectiveness of proposed changes, will be prepared by MECC. This report will be presented to the faculty early in the spring semester.

Fall Semester	**Spring Semester**
Assessments: • Course Objectives • Student • Graduating senior • Alumni (biennial)	Assessments: • Design • Course Objectives • Student • Graduating senior
Actions: • CDC receives *assessment data* for previous semester • CDC prepares improvement plan for next calendar year and submits as *CDC Plan* • MECC reviews plans, negotiates changes with the CDCs, and prepares an annual *Continuous Improvement Report* describing changes to the curriculum.	Actions: • CDC receives *assessment data* for previous semester • All CDCs make changes to courses, which are implemented the following fall semester • MECC presents annual *Continuous Improvement Report* to the faculty

Appendix I-E

Assessment Results

MECHANICAL ENGINEERING

Appendix I-E.1: Student Assessment Results Fall 2005

Each question is assessed for the course providing opportunities.
Based on a scale of: 1-Never 2-Seldom 3-Occasionally 4-Often 5-Very Often

Student Assessment Questions:	231			270			324			325			332			335		
	$\bar{x}$	σ	$\pm$	$\bar{x}$	σ	$\pm$	$\bar{x}$	σ	$\pm$	$\bar{x}$	σ	$\pm$	$\bar{x}$	σ	$\pm$	$\bar{x}$	σ	$\pm$
Fundamental Knowledge																		
1a - Apply knowledge of mathematics to engineering problems	4.50	0.64	0.06	3.04	0.99	0.10	3.75	0.91	0.11	4.36	0.61	0.09	4.63	0.58	0.06	4.60	0.67	0.09
1b - Apply knowledge of physics to engineering problems	4.01	0.80	0.07.	3.11	0.89	0.09	3.09	1.04	0.12	3.97	0.66	0.10	4.05	0.89	0.09	4.26	0.86	0.11
1c - Apply knowledge of chemistry to engineering problems	3.00	1.02	0.09	1.79	0.81	0.08	2.60	0.95	0.11	3.88	0.75	0.11	3.72	0.79	0.08	2.53	1.14	0.15
Engineering Skills																		
2a - Identify, formulate, and solve problems in thermal and/or mechanical systems using techniques, skills, and modern tools of the engineering profession	4.39	0.73	0.06	2.92	1.10	0.11	3.26	0.97	0.12	4.16	0.65	0.09	4.32	0.73	0.07	4.05	0.94	0.12
2b - Design a system, component, or process associated with thermal and/or mechanical systems using techniques, skills, and modern tools of the engineering profession	2.99	1.30	0.12	3.23	1.11	0.11	2.66	1.07	0.13	2.95	1.03	0.15	3.33	1.03	0.10	2.75	1.29	0.17
2c - Design and conduct experiments and analyze and interpret data associated with thermal and/or mechanical systems using techniques, skills, and modern tools of engineering	2.16	1.24	0.11	2.76	1.12	0.11	2.75	1.10	0.13	4.02	0.79	0.11	2.56	1.26	0.13	3.83	0.88	0.11
Career Success																		
3a - Work on teams	2.34	1.42	0.13	4.93	0.29	0.03	3.70	0.99	0.12	3.43	0.89	0.13	3.42	1.37	0.14	3.48	1.04	0.13
3b - Communicate in oral and/or written formats	2.87	1.23	0.11	4.68	0.53	0.05	3.40	1.01	0.12	3.84	0.88	0.13	3.50	1.06	0.10	3.17	1.17	0.15
3c - Engage in self-directed learning	3.90	0.93	0.08	3.88	0.93	0.10	3.86	1.17	0.14	3.27	0.94	0.14	4.15	0.83	0.08	3.87	1.16	0.15
Social Awareness																		
4a - Develop awareness of contemporary issues	3.27	1.10	0.10	3.32	0.89	0.09	2.23	1.04	0.12	3.13	0.97	0.14	3.40	0.89	0.09	2.30	1.02	0.13
4b - Understand ethical and professional responsibilities	2.84	0.99	0.09	3.60	0.95	0.10	2.10	0.97	0.12	3.65	0.68	0.10	2.91	0.98	0.10	2.42	1.09	0.14

Student Assessment Questions:	370			415			421			436			442			449		
	$\bar{x}$	σ	±	$\bar{x}$	σ	±	$\bar{x}$	σ	±	$\bar{x}$	σ	±	$\bar{x}$	σ	±	$\bar{x}$	σ	±
Fundamental Knowledge																		
1a - Apply knowledge of mathematics to engineering problems	4.60	0.55	0.07				4.92	0.26	0.02	4.52	0.71	0.07	4.27	0.90	0.27	4.00	1.15	0.43
1b - Apply knowledge of physics to engineering problems	4.04	0.78	0.10				4.43	0.70	0.07	3.88	0.94	0.10	3.54	1.12	0.34	3.75	1.03	0.36
1c - Apply knowledge of chemistry to engineering problems	2.13	0.92	0.11				1.20	0.60	0.06	2.42	0.95	0.10	1.81	0.87	0.26	3.00	0.92	0.32
Engineering Skills																		
2a - Identify, formulate, and solve problems in thermal and/or mechanical systems using techniques, skills, and modern tools of the engineering profession	3.96	0.89	0.11				4.42	0.75	0.07	4.07	0.86	0.09	4.72	0.46	0.14	3.25	0.88	0.31
2b - Design a system, component, or process associated with thermal and/or mechanical systems using techniques, skills, and modern tools of the engineering profession	2.91	1.09	0.14				3.55	1.12	0.11	3.23	1.13	0.12	4.90	0.30	0.09	2.75	1.03	0.36
2c - Design and conduct experiments and analyze and interpret data associated with thermal and/or mechanical systems using techniques, skills, and modern tools of engineering	4.08	0.98	0.12				3.93	0.92	0.09	3.56	1.00	0.11	3.45	1.43	0.43	2.62	1.18	0.41
Career Success																		
3a - Work on teams	4.13	0.99	0.12				2.48	1.31	0.13	3.40	0.82	0.09	4.90	0.30	0.09	5.00	0.00	0.00
3b - Communicate in oral and/or written formats	4.03	1.01	0.13				3.50	1.07	0.11	3.38	0.93	0.10	4.27	0.78	0.23	3.37	0.51	0.18
3c - Engage in self-directed learning	3.77	0.84	0.10				4.00	0.92	0.09	4.02	0.95	0.10	4.45	0.93	0.28	4.12	0.83	0.29
Social Awareness																		
4a - Develop awareness of contemporary issues	2.63	0.91	0.11				4.17	1.08	0.11	2.60	1.00	0.11	3.72	1.27	0.38	2.37	1.06	0.37
4b - Understand ethical and professional responsibilities	2.62	0.95	0.12				3.71	1.06	0.11	2.43	1.12	0.12	3.63	1.12	0.33	2.37	0.74	0.26

Appendix I-E.2: Course Objectives Assessment Fall 2005

ME 270: Introduction to Mechanical Engineering Design

Course Objectives Assessment Plan and Results

Prepared by: Eliot Winer

Date Prepared: September 25, 2005

Course Objectives Assessment Plan

No.	Specific Course Objective	Assessment Tools	Percent of students reaching objective
1	Identify a relevant design concept	Group meetings, class examples, assignments	100%
2	Perform analysis to target a specific business market	Lectures, class examples, assignments	100%
3	Work in a industry simulated engineering team with different management levels	Group meetings, assignments, in-class exercises	100%
4	Create, rank, and eventually satisfy a list of design goals for the developed product	In-class examples, assignments, group meetings	90%
5	Use a wide variety of creative thinking methods and tools to develop unique, meaningful, and viable design options.	Group meetings, class examples, homework problems, lectures	80%
6	Incorporate appropriate analysis and optimization tools into the design process.	Group meetings, lectures, class examples	70%
7	Schedule and plan multi-faceted tasks, coordinating disparate groups to complete the project.	Group meetings, assignments, individual meetings	85%
8	Demonstrate an understanding of ethics, patents, and legal issues in the design process.	Lectures, class-examples, outside guest speakers	70%
9	Assess the functional fitness of the final prototype to meet design criteria	Group meetings, assignments, review by independent panel of experts	70%
10	Present technical material using appropriate written, oral, and graphical techniques.	assignments, lectures, class examples	90%
11	Plan for continuous improvement through future design iterations.	Group meetings, assignments	75%

ME 231 Engineering Thermodynamics I
Course Objectives Assessment

Prepared by: Francine Battaglia

Date Prepared: January 12, 2006

Course Description

The purpose of this course is to serve as an introduction to thermodynamics. Included are fundamental concepts based on zeroth, first and second laws of thermodynamics. Finding properties and calculating processes for ideal gases and sold-liquid-vapor phases of pure substances will be of extreme importance. Analyses of vapor power cycles will include power plants.

The following assessment is based on students achieving a score of 75% or better.

Course Objectives Assessment Plan

No.	Course Objective	Assessment Tools	Achievement
1.	Be able to explain thermodynamic terminology and concepts appropriately.	Final Exam *Problem #1*	85.4%
2.	Define appropriate system boundaries for analyzing a variety of thermodynamic components and systems.	Final Exam *Problem* #7; *turbine analysis*	82.9%
3.	Determine and calculate the appropriate energy transfers and system properties to analyze closed system processes and cycles.	Final Exam *Problem #3*	63.4%
4.	Determine and calculate the appropriate mass and energy transfers and properties to analyze steady state control volume applications with any number of heat, work, or mass flows crossing the system boundary.	Final Exam *Problem* #7; *energy balances*	78.0%
5.	Determine and calculate appropriate mass and energy transfers and properties to analyze selected transient control volume applications.	Final Exam *Problem #6*	26.8%

6.	Use tables, charts, equations, and software, in conjunction with appropriate property diagrams, to fix states of a pure substance and determine relationships among pressure, temperature, specific volume, internal energy, enthalpy, and entropy.	Final Exam *Problem* #7; *properties*	80.5%
7.	Determine when a process is reversible, irreversible, or impossible.	Final Exam *Problem #4*	82.9%
8.	Calculate states and performance parameters for vapor power cycles based on the Rankine cycle with superheat, reheat, and regeneration.	Homework problem *Assignment* #8; *Problem #3*	70.7%
9.	Appreciate thermodynamics in the context of contemporary issues and the interplay of technological, social, and political factors in resolving or exacerbating problems facing society.	Classroom participation	80.5%

ME 324 Manufacturing Engineering

Course Objectives Assessment Plan and Results

Prepared by: Shyam Bahadur

Date Prepared: Fall 2005

Specific Objectives. Upon completion of ME 324, students should be able to:

1. Identify the capabilities and limitations of different manufacturing processes. Assessed based on Exam 1 (#ld, 2), Exam2 (#1,3) & Term Paper. 90% of students found proficient.

2. Analyze the effect of a manufacturing process on the properties of the end product. Assessed based on Exam 1 (#3), Exam 2 (#lc, 2c, 3) & Term Paper. 85% of students found proficient.

3. Use teamwork to produce a part and communicate the results, both in oral and written forms. Assessed based on Term Paper. 100% of students found proficient.

4. Appreciate manufacturing in the context of contemporary and societal issues. Assessed based on Term Paper. 90% of students found proficient.

ME 325 Machine Design
Course Objectives Assessment Plan and Results
Prepared by: Pal Molian
Fall 2005

No.	Course Objective	Assessment Tools	Percentage of Students Mastered
1	Apply design theory and methodology to the task of generating design alternatives	Homework problems, Design Project I on selection of gear drives as opposed to belt and chain drives; Design Project II on selection of springs; direct interactions with students in the classroom (students spent 6 classes with professor on Design projects I and II)	64%
2	Identify the functional characteristics of various machine elements	Classroom interactions, office hours interactions, Test#3, Quizzes, Extra-credit work	76%
3	Evaluate design alternatives using a utility function	Test 1 (open-ended design problem), Homework , Design Project I	85%
4	Design or select bearings, gears and shafts for a specific application	Design Project I and Test #3	92%
5	Apply failure theories to the design of machine components	Tests 1 and 2 and Homework	73%
6	Work effectively with team members in achieving final design results	Design Projects I and II, Discussion with students	84%
7	Communicate design results in written and oral reports	Design Project Reports	75%
8	Appreciate machine design in the context of contemporary issues and the interplay of technological, social, and political factors in resolving or exacerbating problems facing Society	10 -15 minutes a week in the classroom with student participation	78%

ME 332 Engineering Thermodynamics
Course Objectives Assessment Plan and Results
Prepared by: William Bathie
Date Prepared: Fall 2005

No.	Course Objective	Assessment Tools	Assessment Report
1	Evaluate gas power cycles and gas turbines.	Homework problems, tests	70%
2	Explain important phenomena and calculate the steady flow of compressible fluids.	Homework problems, tests	75%
3	Compute COPs and power requirements for simple vapor compression cycle refrigeration systems.	Homework problems, tests	95%
4	Determine properties for ideal gases for processes using non-reactive gas mixtures.	Homework problems, tests	83%
4	Use commercially available computer software to analyze properties and compare design scenarios.	Group project, homework problems.	93%
5	Calculate the psychrometric properties associated with air-water vapor mixtures and use these properties in mass and energy balances to analyze and design heating, ventilating and air conditioning processes.	Homework problems, tests	90%
6	Apply mass and energy balances to chemically reacting systems to analyze and design combustion processes.	Homework problems, tests	87%

ME 335 Fluid Flow
Course Objectives Assessment Plan and Results
Prepared by: Shankar Subramaniam
Fall 2005

No.	Course Objective	Assessment Tools/Criteria for achievement	Assessment Results (total of76 students)		
			Successful	Unsuccessful	% Successful
1	Recognize different categories of fluid flow and classify them based on flow parameters	Class Participation, Homework> 60% AND Final Exam> 30%	42	34	55%
2	Simplify fluid flow problems and formulate solutions to mathematical models of these flows	Class work, Homework Problems> 60% AND Test score + Final Pt 2 > 50%	31	45	41%
3	Use a variety of tools to solve fluid flow problems	Class Work, Homework> 60%	43	33	56%
4	Understand fluid instrumentation	Lab score> 80%	68	8	89%
5	Learn the scientific approach to interpreting solutions of physical problems	Class participation, Homework> 60%	50	26	66%

ME 370 Engineering Measurements and Instrumentation
Course Objectives Assessment Plan and Results
Prepared by: Ted Heindel, Sriram Sundararajan
Date Prepared: Fall 2005

No.	Course Objective	Assessment Tools/Criteria for achievement	Assessment Results (108 students)		
			Successful	Unsuccessful	% Successful
1	Recognize basic measurement systems and identify basic terms related to measuring instruments and the measurement process.	Labs/cumulative score > 80%	103	5	95%
2	Obtain theoretical knowledge and practical experience of various sensors such as: variable resistance and capacitance devices, strain gauges, thermocouples, and accelerometers.	Exams/cumulative score > 65% AND Labs/Cumulative score > 75%	88	20	81%
3	Recognize a sensor and/or transducer system's dynamic limitations by learning how to identify first-order and second-order behavior, and to characterize damping and frequency response.	Labs/cumulative score > 80% OR Exam 2/Score > 65%	106	2	98%
4	Understand the role of signal conditioning in enhancing measurements by experimenting with active and passive noise filters and operational amplifiers.	Lab 7/Score >80% OR Exam 2/Score > 65%	106	2	98%
5	Use computers and software to control instruments, perform/automate data acquisition, manipulate data, and graphically present results.	Labs/Cumulative score > 80%	103	5	95%
6	Establish rigorous data treatment procedures by applying statistical and error propagation methods to experimental results.	Exams/Score > 65%	89	19	82%
7	Synthesize theoretical knowledge with the experience gained in the laboratory to perform measurements.	Homework/Cumulative score > 65%	71	37	66%
8	Develop effective communications skills by engaging in verbal interaction with team members and by submitting succinct and descriptive written reports.	Labs/Cumulative Score > 80%	103	5	95%
9	Appreciate measurement and instrumentation in the context of contemporary issues and the interplay of technological, social, and political factors in resolving or exacerbating problems facing society.	Homework/Cumulative Score > 65%	71	37	66%

ME 421 – Mechanical Systems and Control
Assessment of Course Objectives
Prepared by: Adin Mann

Course Objective	% Students Who Meet Minimum		Comment
	Raw	Remove Mid-Term	
Obtain mathematical models of simple systems involving mechanical, electrical, electromechanical, pneumatic, and fluid components using basic element and interconnection laws.	98		
Define a suitable set of variables that describe the dynamics of a system and construct a simplified mathematical description using idealized elements.	85		
Determine the equilibrium conditions for non-linear systems and obtain a linearized model.	80		
Arrange the governing differential equations of the model in a form that is suitable for computer simulation. Program the simulation for both linear and nonlinear models. Analyze the results of the simulation to assure appropriate behavior of the system.	72	83	Additional instruction met goal
Solve directly for the time-domain response of a first- or second-order system.	83		
Use Laplace transforms as a tool to find the complete time response for a model, determine the transfer function, identify system poles and zeros, analyze stability, and evaluate time constants, damping ratios, and system natural frequencies.	93		
Use the system transfer function to find steady-state response to constant or sinusoidal input	68	85	Additional instruction met goal
Use block diagrams to represent the system schematically.	85		
Work together to document the activity and results of laboratory exercises.	100		
Appreciate mechanical systems and control in the context of contemporary issues and the interplay of technological, social, and political factors in resolving or exacerbating problems facing society. Acquire an understanding of the ethical and professional responsibilities of engineers.	90		
Learn to design and implement a proportional feedback control system and analyze the effect of the closed lop control on system response and steady state error.	83		

ME 436 Heat Transfer
Course Objectives Assessment Plan and Results
Prepared by: Francine Battaglia
Fall 2005

The percent of students enrolled in the class that have met **every** course objective is **listed** in the column "Percent of Students".

Course Objective	Assessment Method	Percent of Students
1. Identify the primary mode(s) of heat transfer applicable to a specific situation and perform energy balances across control volumes and surfaces.	Quiz 2 HW 4	96
2. Recognize symmetry and the simplifications it provides in heat transfer problem solution.	HW 1 Exam 1 Prob 4	98
3. Translate a physical situation into the appropriate form of the conduction equation and the corresponding boundary and initial conditions to compute temperature distributions and heat flows in objects that may or may not be generating heat.	Exam 1 Prob 5 HW 2	100
4. Compute the enhancement of heat transfer resulting from the use of extended surfaces.	Exam 1 Prob 3 HW 6	98
5. Develop the ability to recognize the conditions necessary for the application of approximate and detailed techniques for the computation of temperature variations with time and space in solids.	HW 7 HW 8	100
6. Identify the flow regimes and boundary conditions in external and internal flows and use pertinent non-dimensional variables to compute heat transfer coefficients while distinguishing between local and average coefficients.	Exam 2 Prob 3 HW 11	100
Course Objective	Assessment Method	Percent of Students
7. Obtain an awareness of the various empirical correlations for forced and natural convection and recognize their applicability to different physical situations.	Exam 2 Prob 2 HW 10	100
8. Predict heat transfer due to radiation from ideal and actual surfaces and enclosures, while accounting for directional and spectral variations in surface properties.	HW 17 Quiz 5	100

9. Gain an appreciation of the different types of heat exchangers and their applicability to particular situations.	HW 14 HW 15	100
10. Predict heat exchanger performance given size and inlet conditions, and also design the geometry of a heat exchanger required to deliver a desired heat transfer rate.	HW 14 HW 15	100
11. Compute spatial and temporal temperature variations and heat flows in 1- or 2-dimensional objects using the appropriate numerical techniques.	HW 8 Exam 1 Prob 4	100
12. Measure thermal conductivities of solids, and compute heat transfer coefficients and heat duties from measured temperatures and flow rates and report and discuss experimental results.	Lab 1	98
13. Appreciate heat transfer in the context of contemporary issues and the interplay of technological, social, and political factors in resolving or exacerbating problems facing society.	HW 16 HW 3	100

Appendix I-E.3: Design Panel Assessment Report Spring 2005

Mechanical Engineering
Design Assessment Panel
April 22, 2005

Attendees

<u>Students</u>
Scott Hamm (ME 270)
Kathleen Spees (ME 415)
Adam Stecklein (ME 446)
Rustin Metzger ((ME 442)

<u>Faculty</u>
Greg Luecke(Me 442)
Adin Mann (ME 446)
Mike Pate (ME 270)
Pranav Shrotriya (ME 415)

<u>Advisory Board Members</u>
Jim Davis (ME 415)
Bob Sutton (ME 270)

Convener: Howard Shapiro

Agenda

7:30 a.m. Continental Breakfast – Introductions
7:40 Comments from Judy Vance
7:45 Teams and Goals for the Morning (Howard Shapiro)
- Review assigned reports using assessment rubric
- Discuss achievement of course objectives
- Identify strengths
- Identify opportunities for improvement

8:00 Assessment of Design Projects (Mike Pate will facilitate)
- Work individually
- Team discussion – consensus recommendations

9:30 Formulation of Recommendations
- Large group discussion

10:00 Adjourn

Process: The review teams read and assessed the projects using the design assessment panel rubrics developed by the department. As a departure from past practice, though, the teams did not compile scores on each project that are part of the final assessment. Rather, they compared notes and developed consensus opinions about strengths, weaknesses, and recommendations. The reason for this were 1) to keep the reviewers focused on whether the portfolios studied indicated that the objectives were being met, 2) the lack of enough samples or reviewers to do accurate quantitative statistical analysis, and 3) the need to use the time effectively for discussion rather than tearing apart individual reports. The group believed that this method worked well, and recommended that we continue to do it this way in the future.

<u>ME 270</u>

- Reports reflect a range of quality - could emphasize improvement of report quality and greater consistency in student work
- Stronger projects seem to extend to areas the students don't know much about, so they research them more deeply
- Projects emphasize aspects of engineering *and* business

- Stronger projects use a more continuous process to evaluate and refine their work – should be emphasized in the course
- Lack of systematic engineering process for assessing alternatives. The students seemed to simply find something that they thought would work but didn't use a careful selection process
- Could reduce the size of the groups – would mean more grading, but there would be more individual student accountability
- Objectives of the projects were good, and students made good efforts in trying to address the objective, notwithstanding the process for assessing alternatives

<u>ME 415</u>

- Reports reflect a range of quality
- Good level of analysis and good demonstration of student knowledge.
- Observations

 - more focus on customer requirements needed
 - need to use some sort of qualitative success factor to demonstrate achievement of design objectives
 - how well were objectives achieved?
 - research seemed superficial – quick check of the Web
 - difficult to find information: needed more consistent format
 - wordy – more charts and summaries, Executive summaries missing

<u>ME 442</u>

- Specifications too *specific* – need to be more open-ended
- Trade-offs and judgments not documented
- No development of constraints
- Could assemble components into systems
- More design iterations needed

<u>ME 446</u>

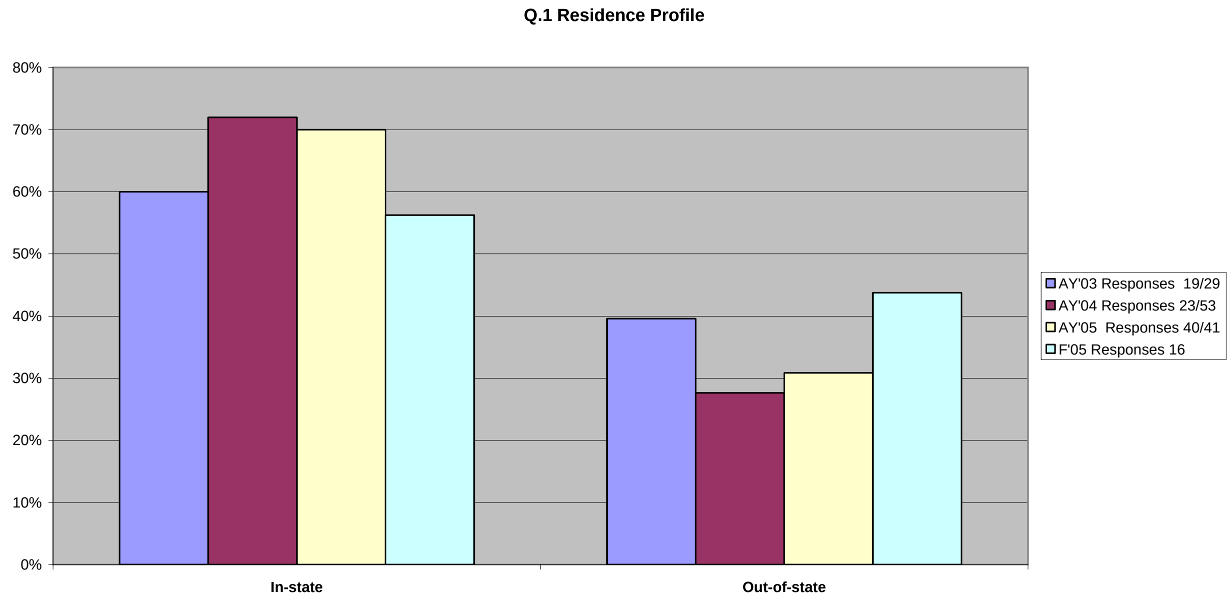
- Good emphasis on engineering practices/principles
- Not enough thinking/emphasis on thinking outside the technical realm – e.g. environmental
- Use of tools for decision making- good, but not well-explained
- Project economic trends
- Basic processes emphasized

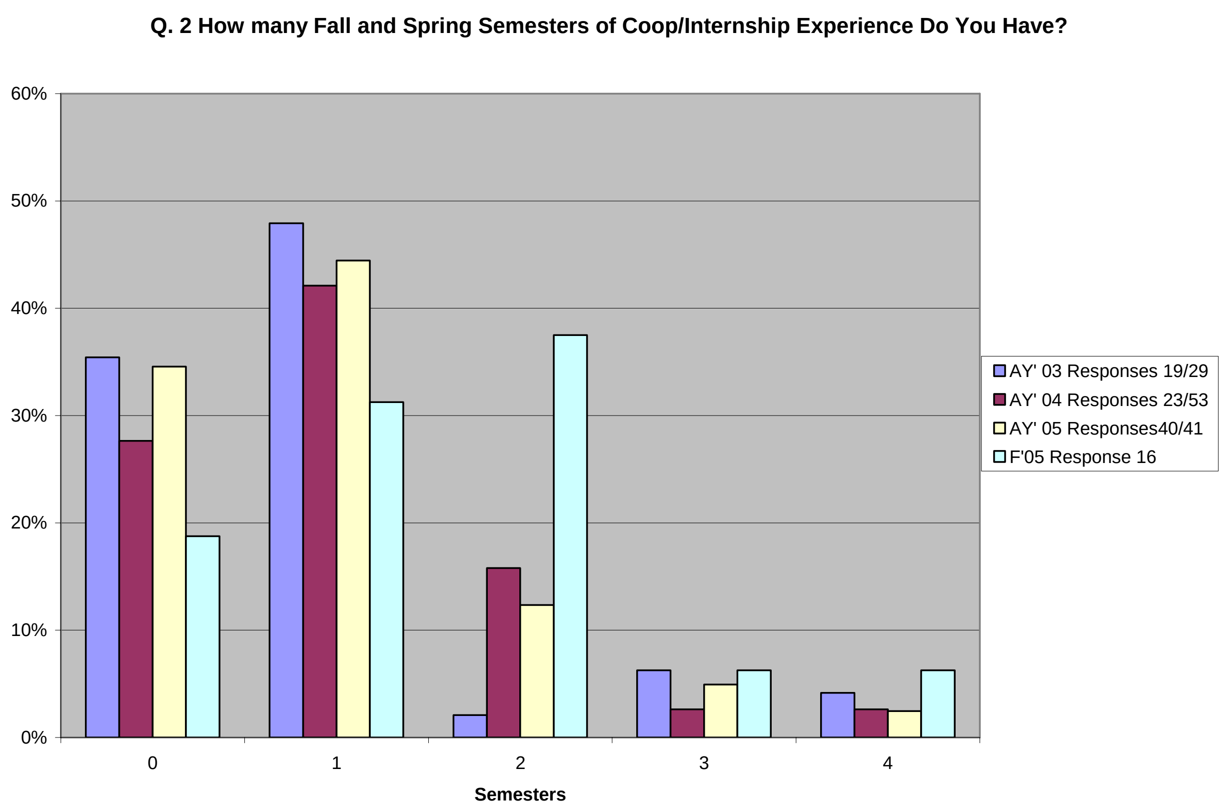
<u>General Observations</u>

- Need a uniform structure for reports that goes through the curriculum – use ISUComm consistently for communication expectations, rubrics, and assessment
- Increase the overall quality of reports: relates to the first bullet
- Look at the general and specific objectives of each course for longitudinal consistency and to allow for more longitudinal assessment of student achievement – specifically, the senior design courses all seem to have very different expectations and levels of student thinking

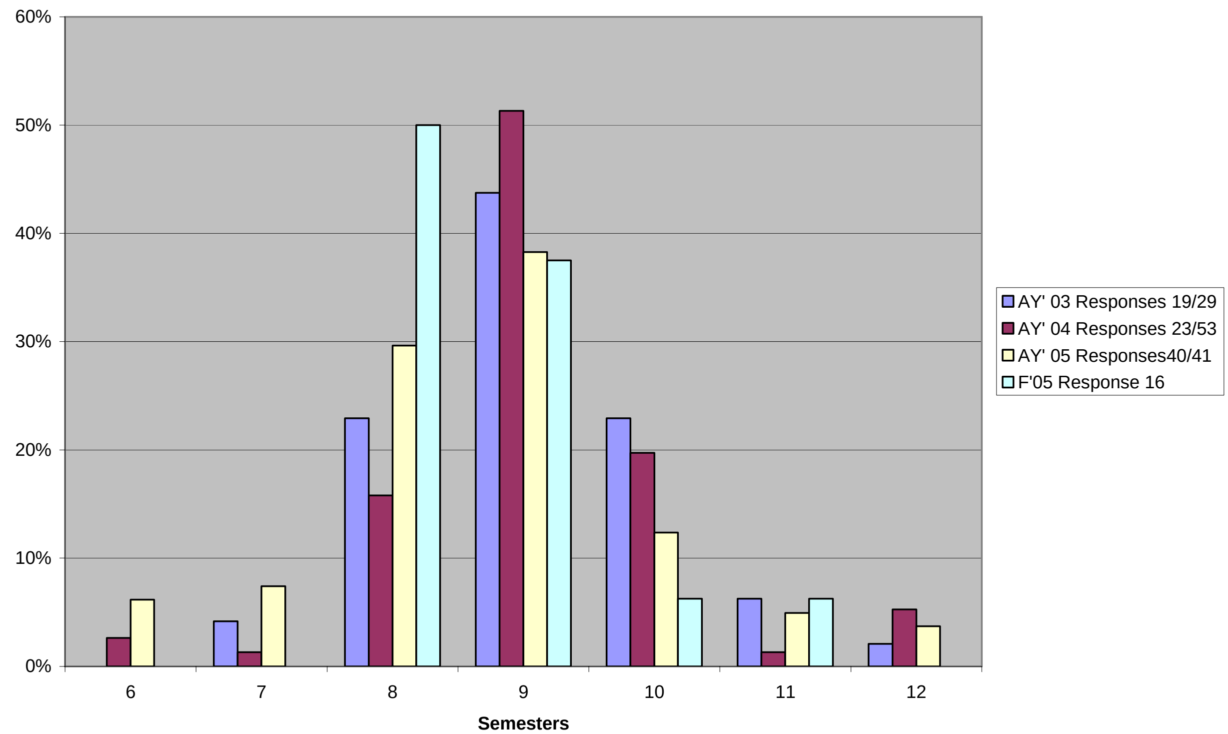
 - think about the ME 270 competencies as building capabilities through the curriculum that are reinforced later, particularly if a junior level design course is developed

Appendix I-E.4: Senior Survey Results

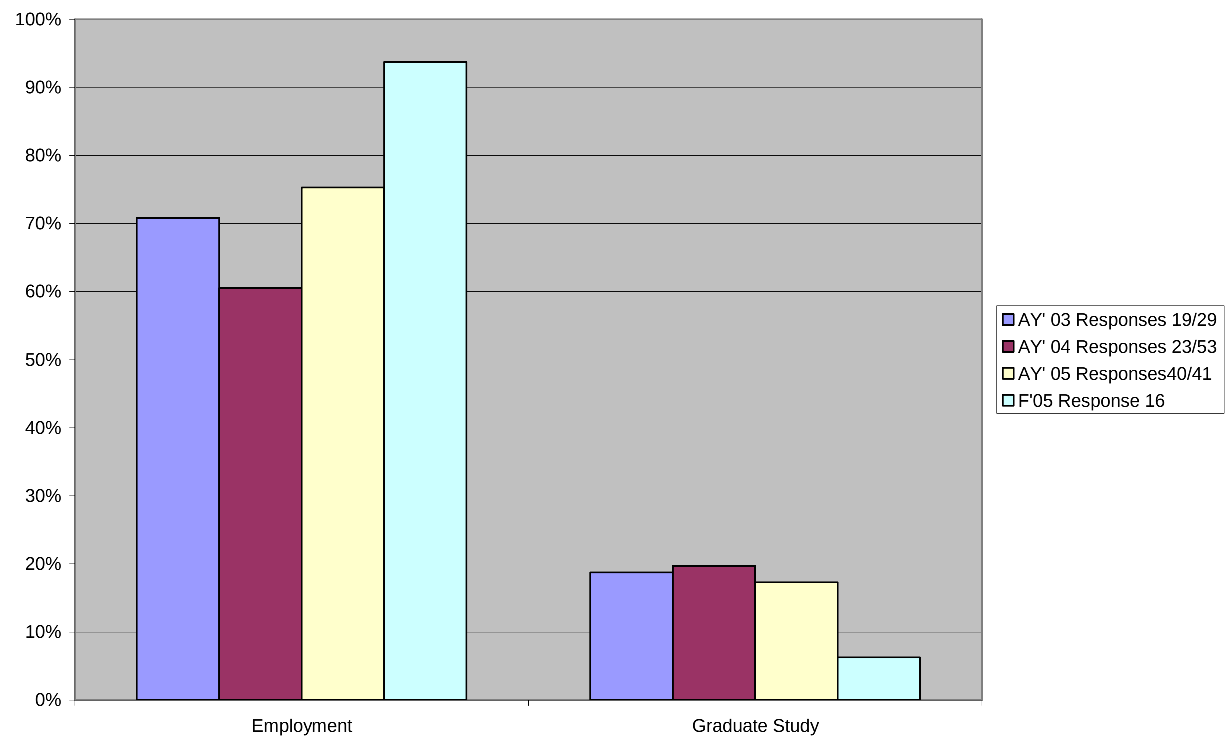




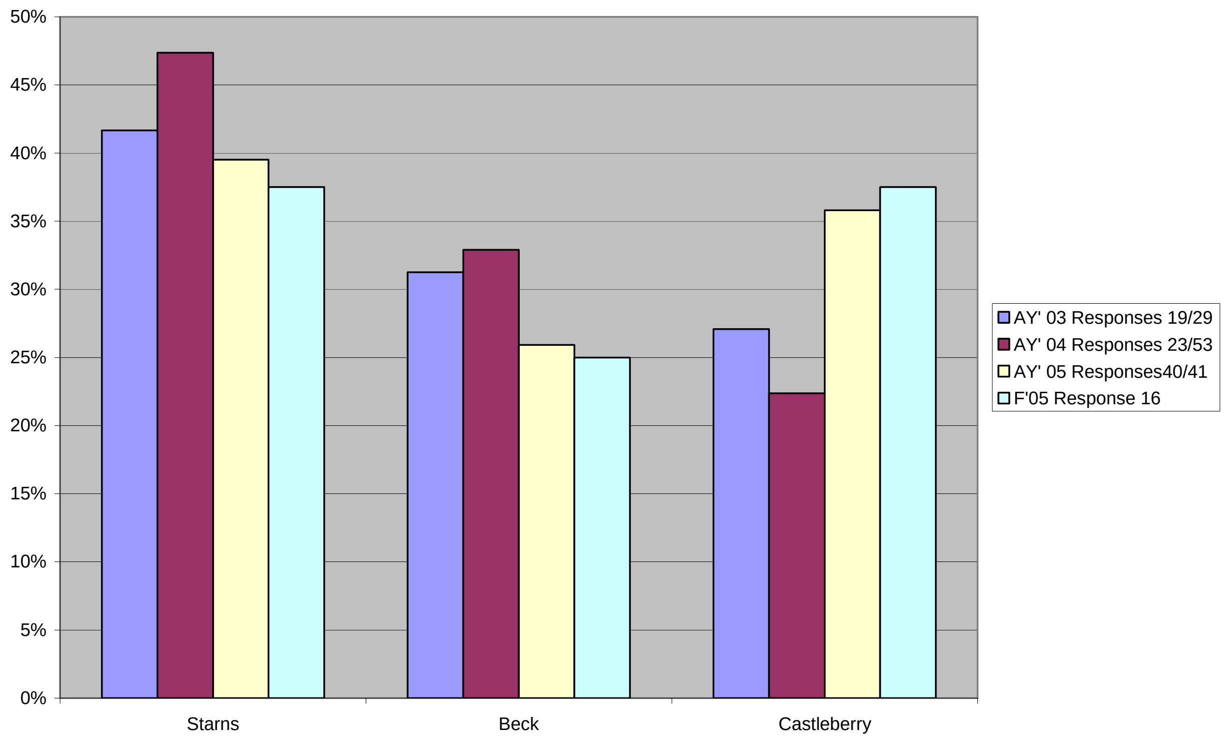
Q. 3 Number of Semesters Needed to Complete Graduation Requirement



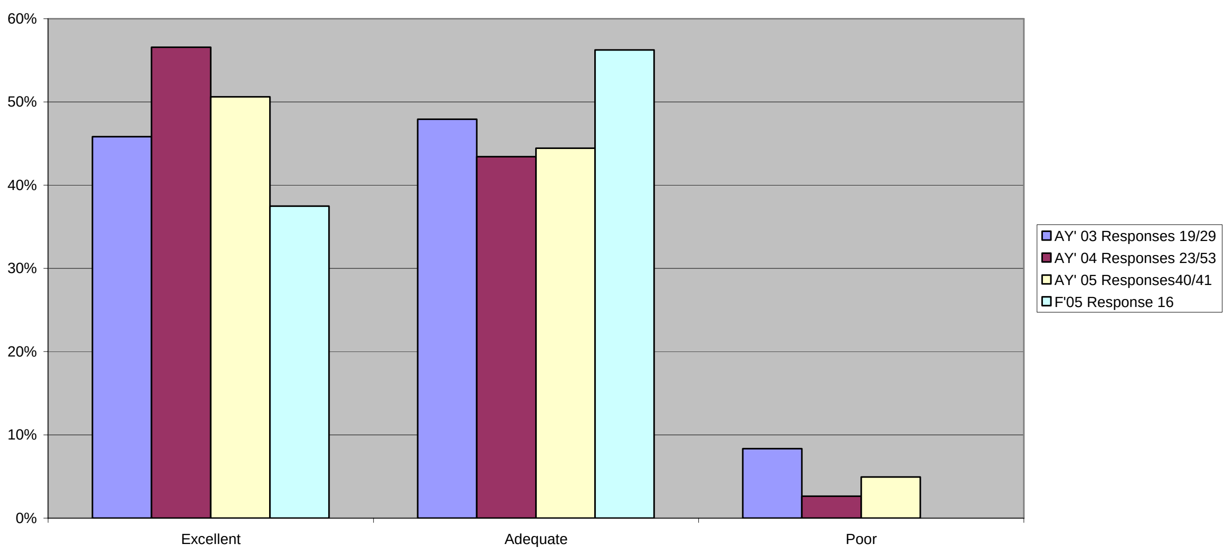
Q. 5 Employment or Graduate Study



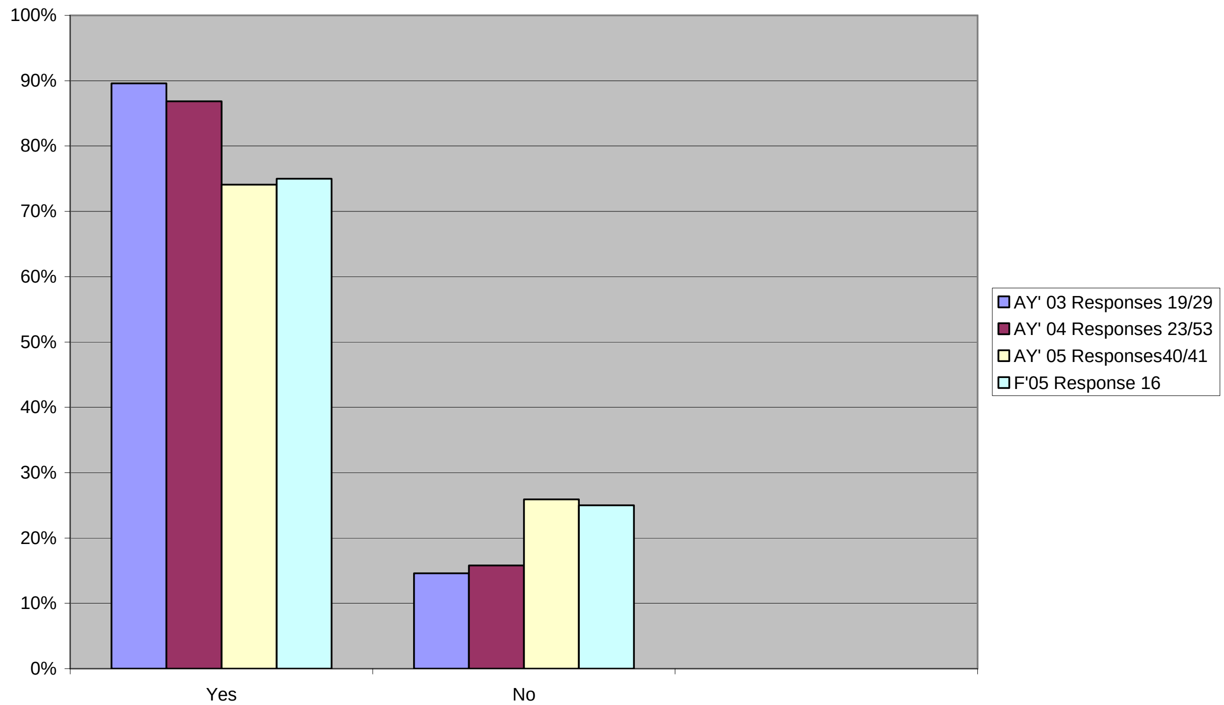
Q. 6a Who Was Your Advisor?



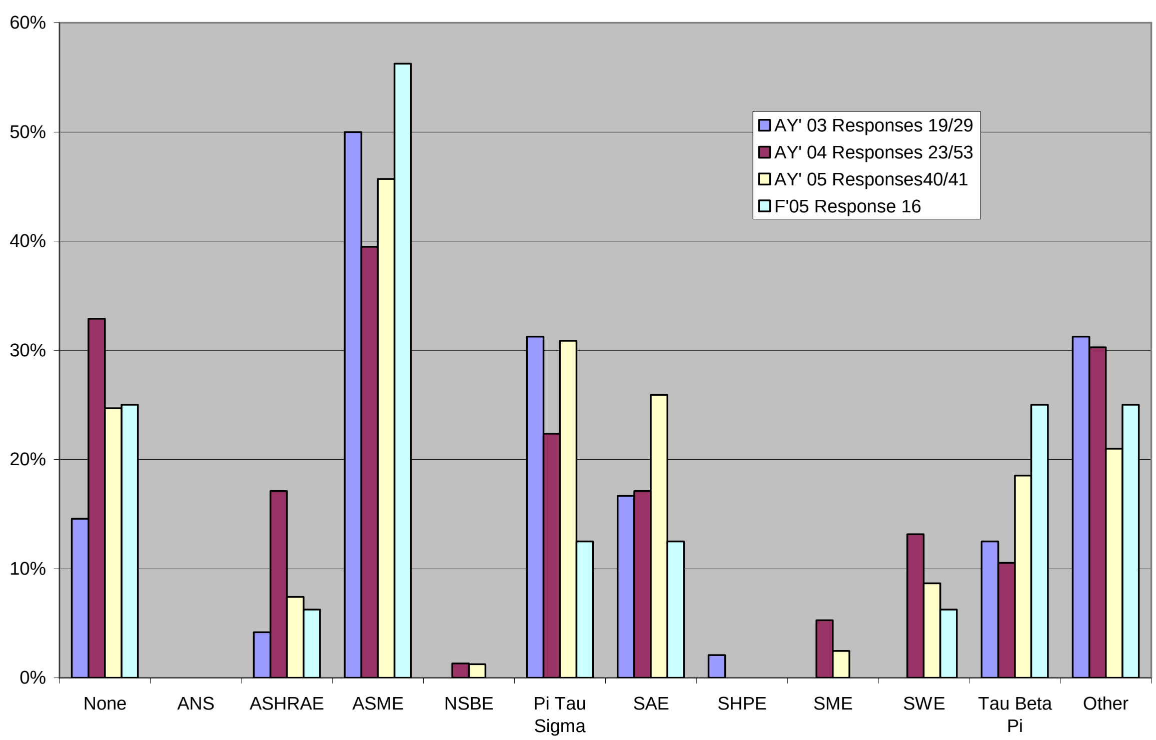
Q. 6b What was your perception of the advising process?



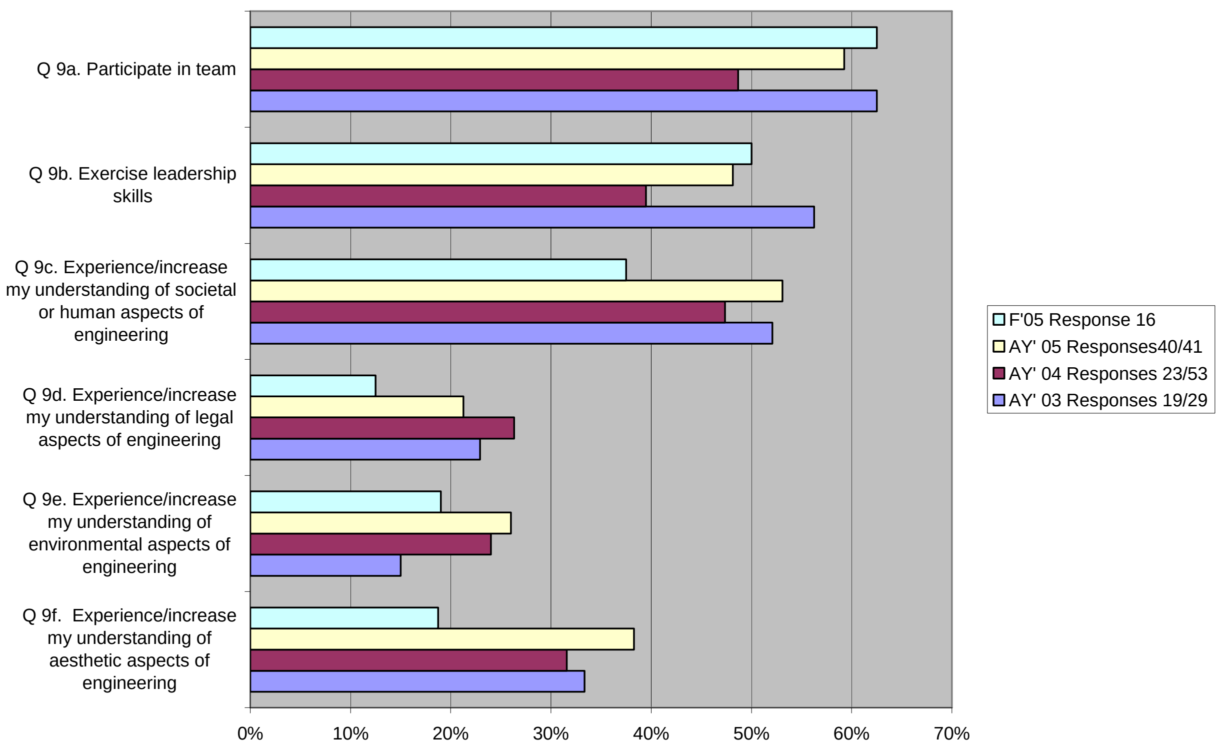
Q. 7 Would you Recommend the ISU Mechanical Engineering Program to Prospective High School Students?



Q. 8 Organization Participation

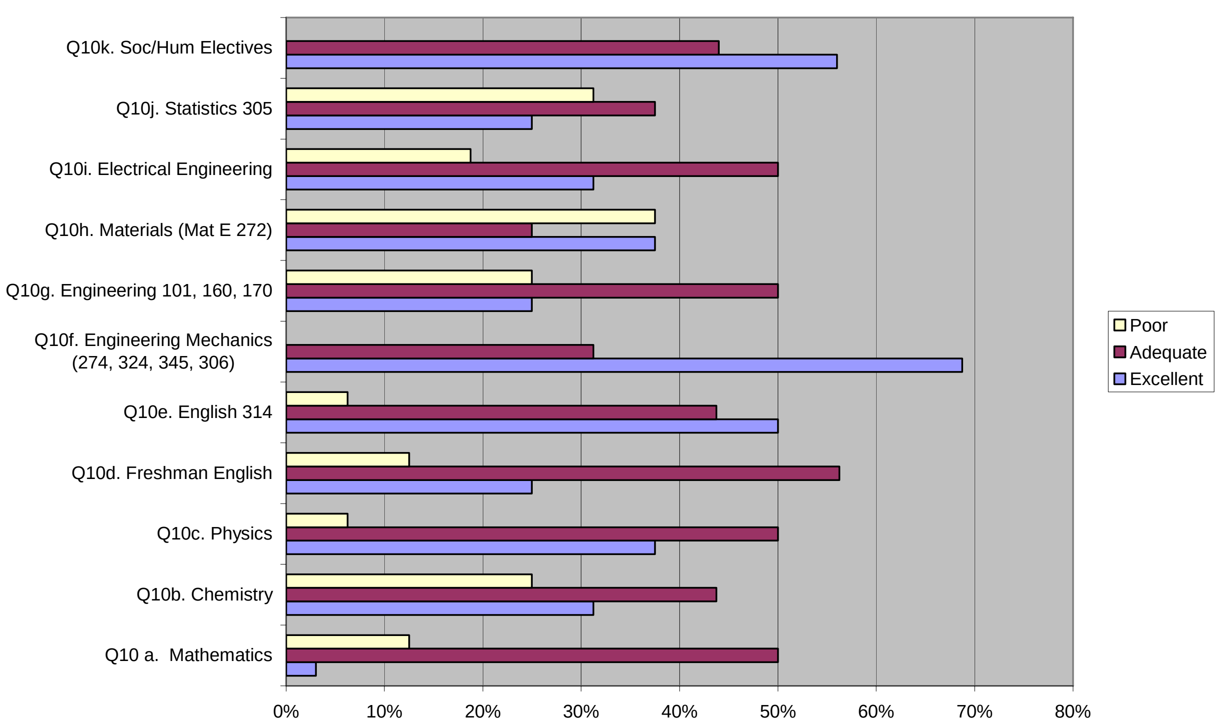


Q. 9 Experience in Organizations

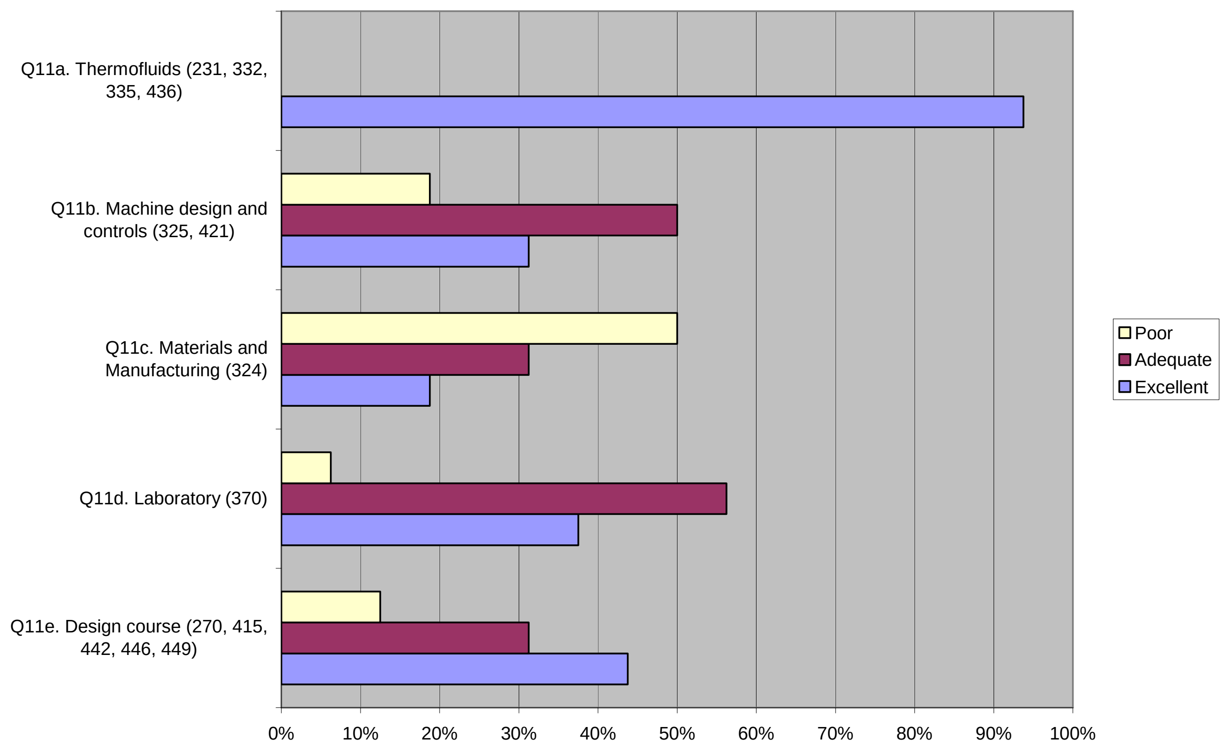


Q. 10 Educational Value that was received from the following courses taught by departments other than Mechanical Engineering

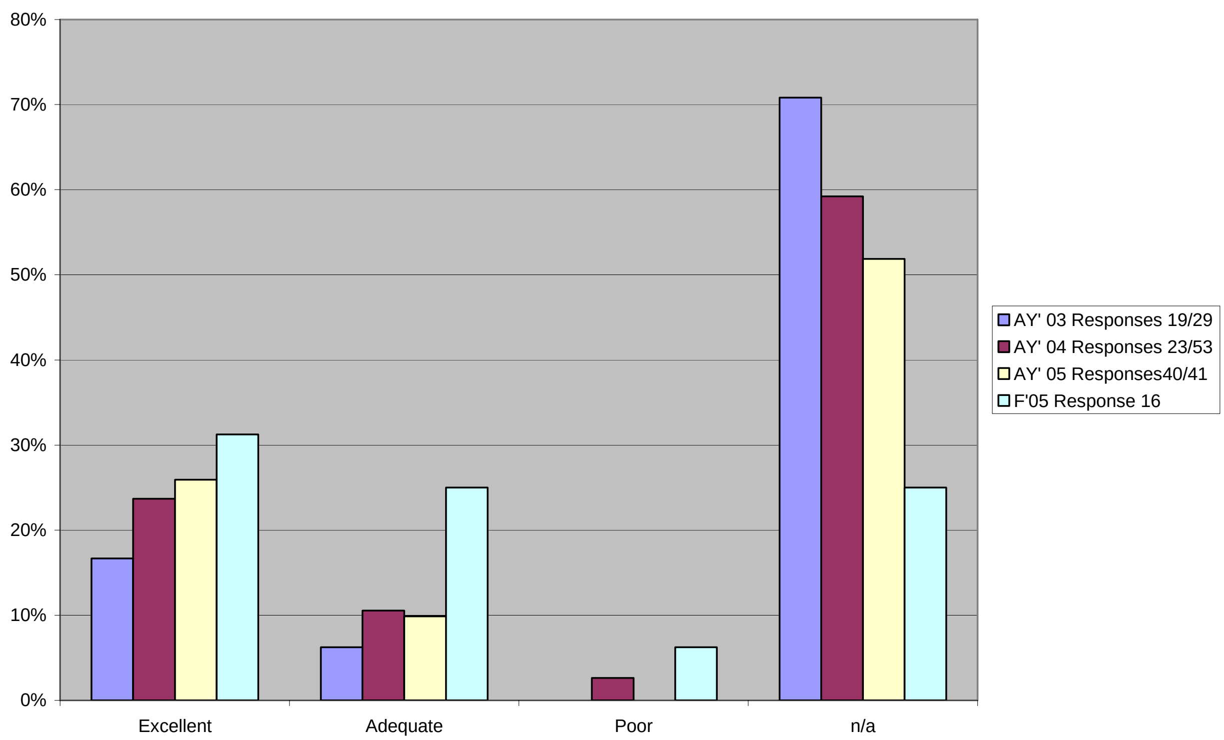
FALL 2005



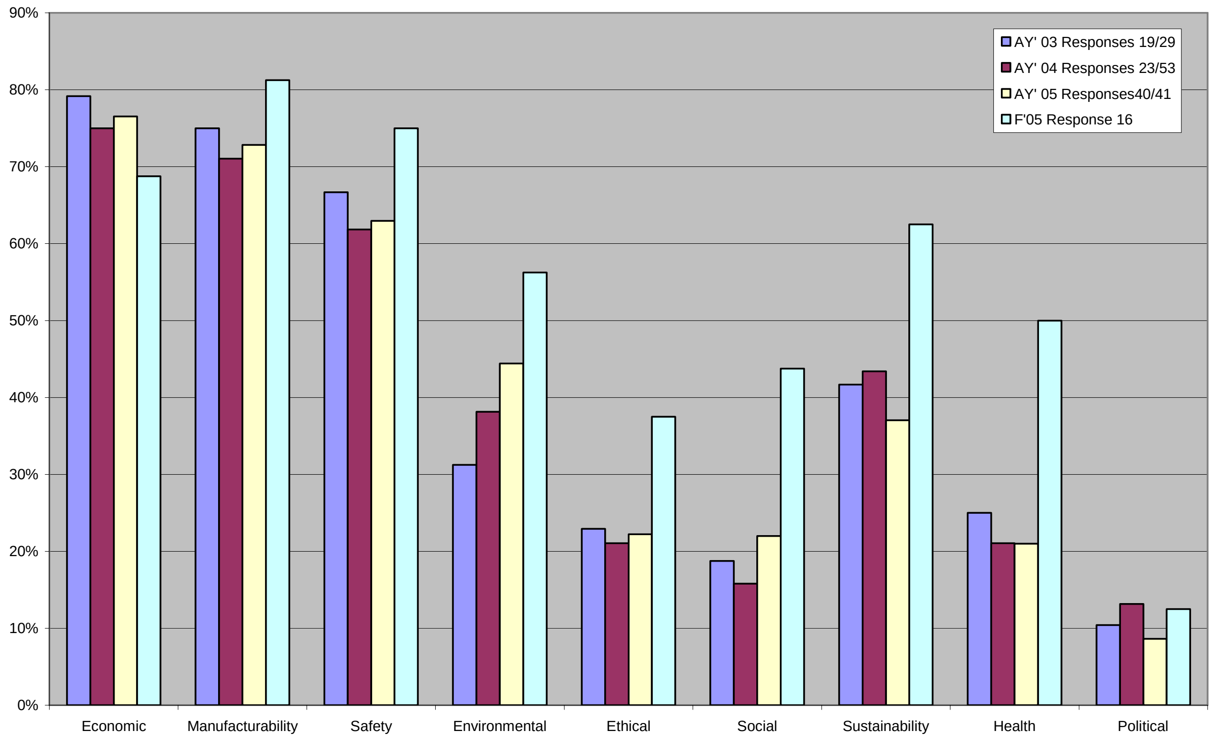
Q. 11 Rate the Value of Core Sequences Taught by the Mechanical Engineering Department.
FALL 2005



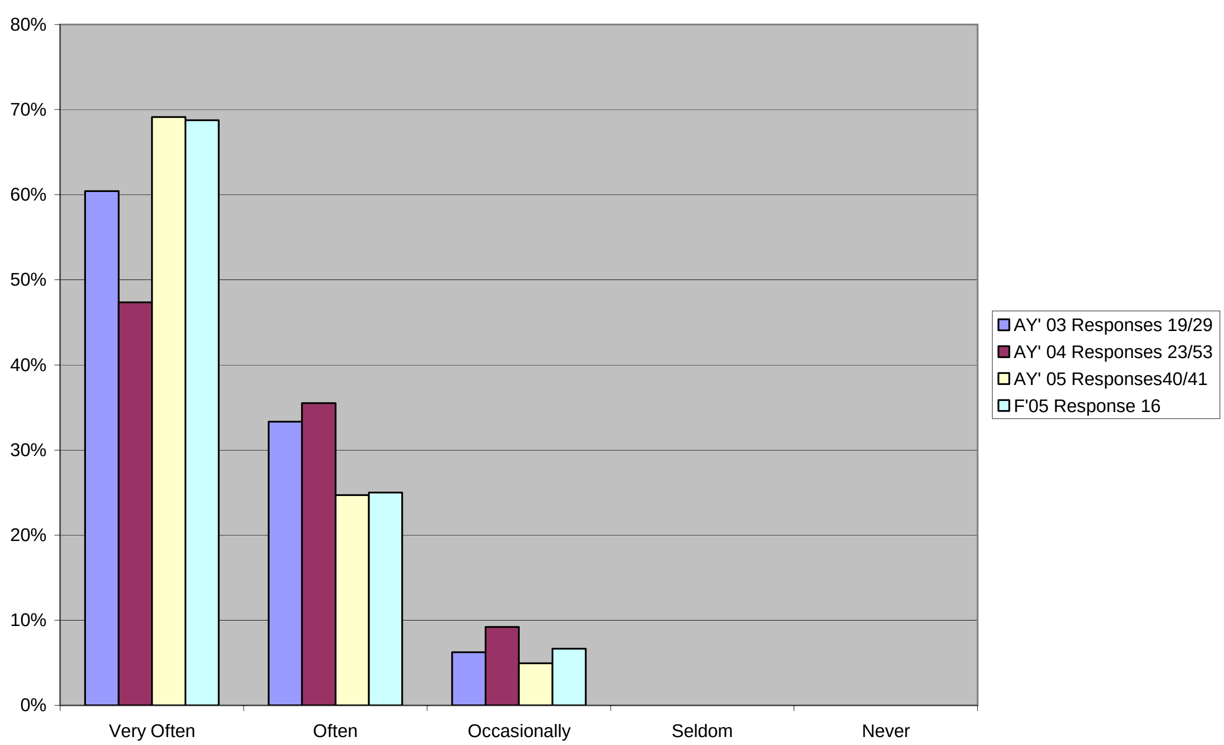
Q. 12a Rate the Educational Value that you received from Independent Study Courses (490).



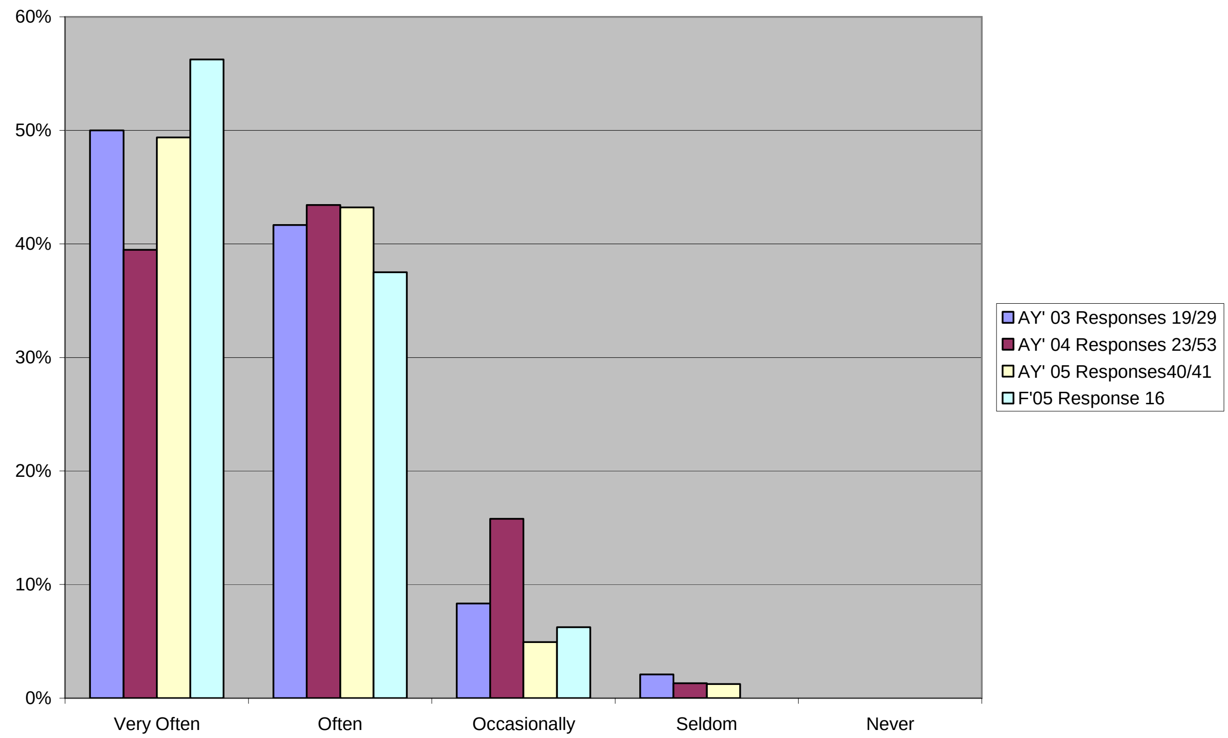
Q. 13 Considerations or Constraints used in Developing the Design in your Capstone Design Course.



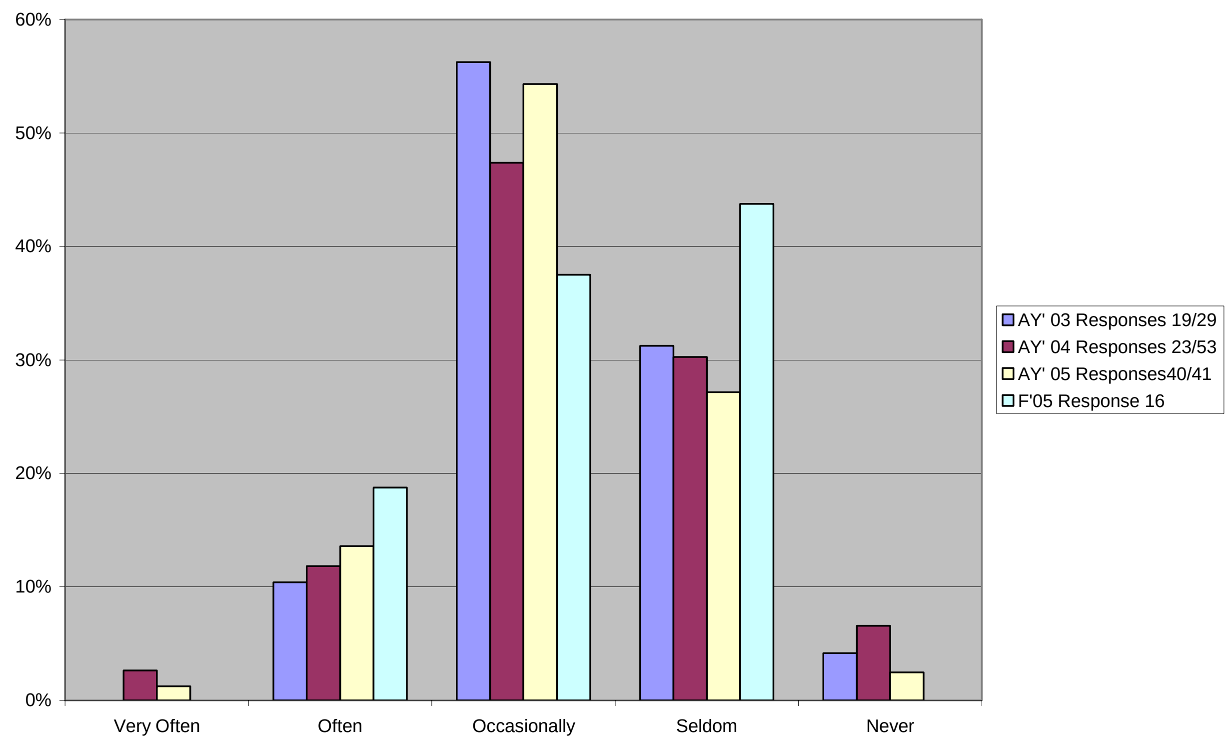
Part III 1a. Fundamental Knowledge - Math to Engineering Problems



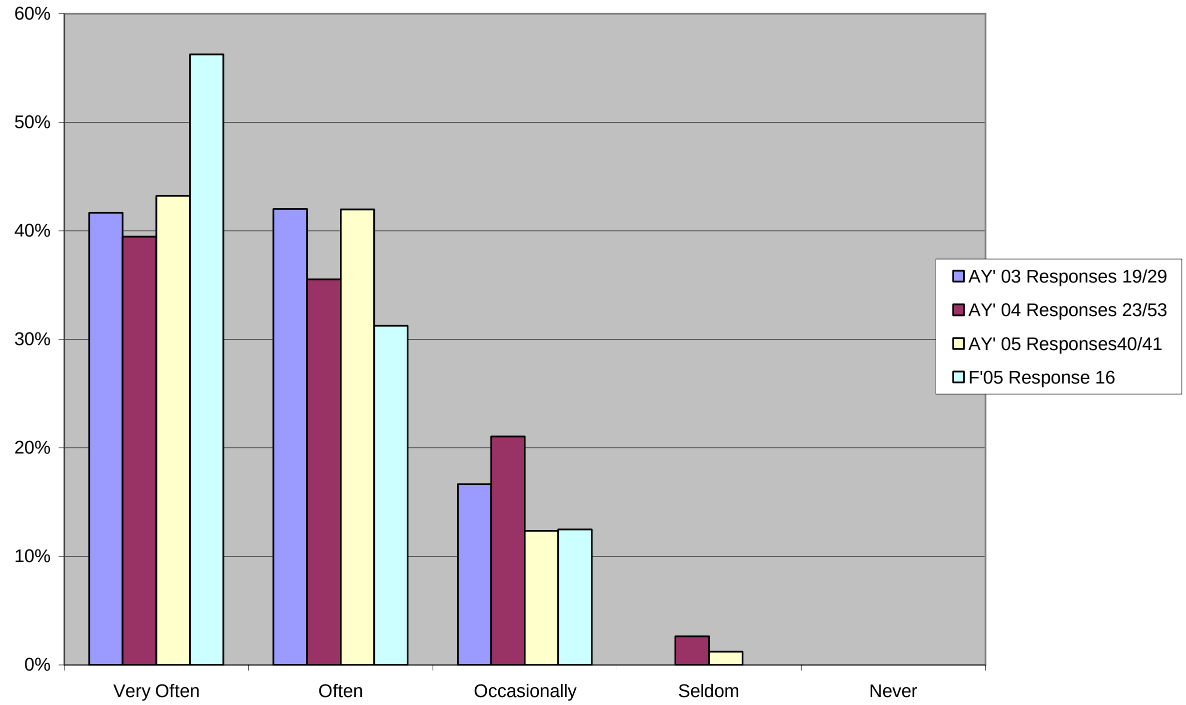
Part III Q. 1b Fundamental Knowledge: Physics to Engineering Problems



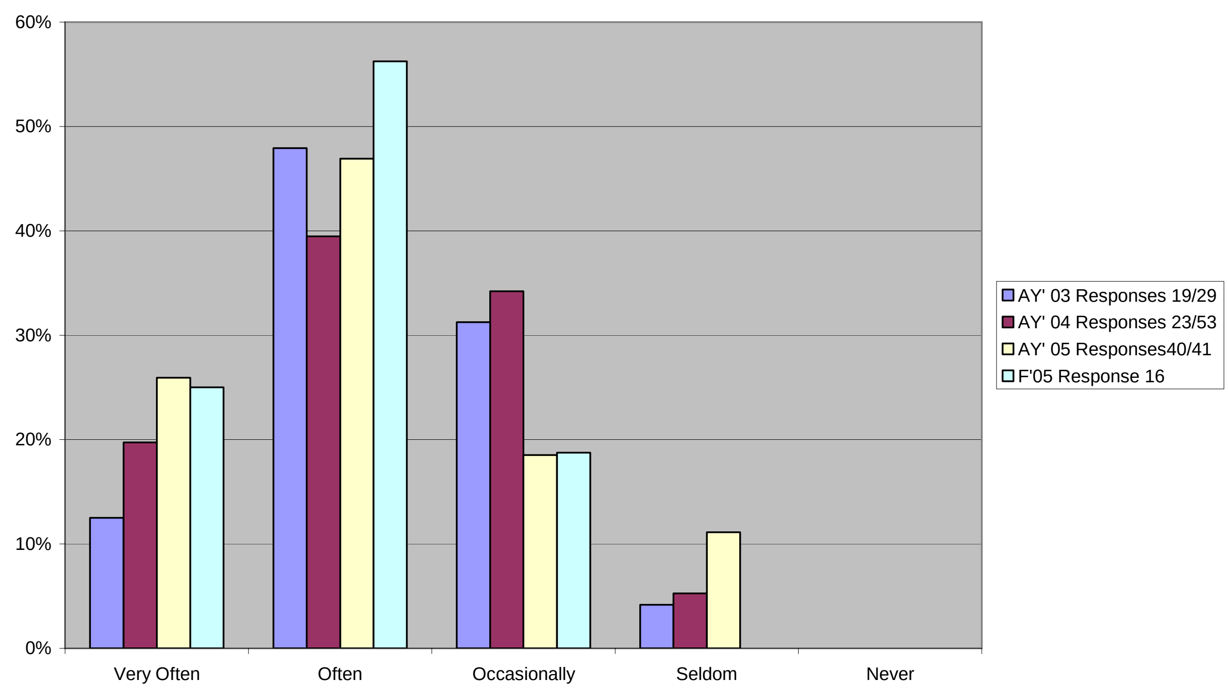
Part III Q. 1c Fundamental Knowledge: Chemistry to Engineering Problems



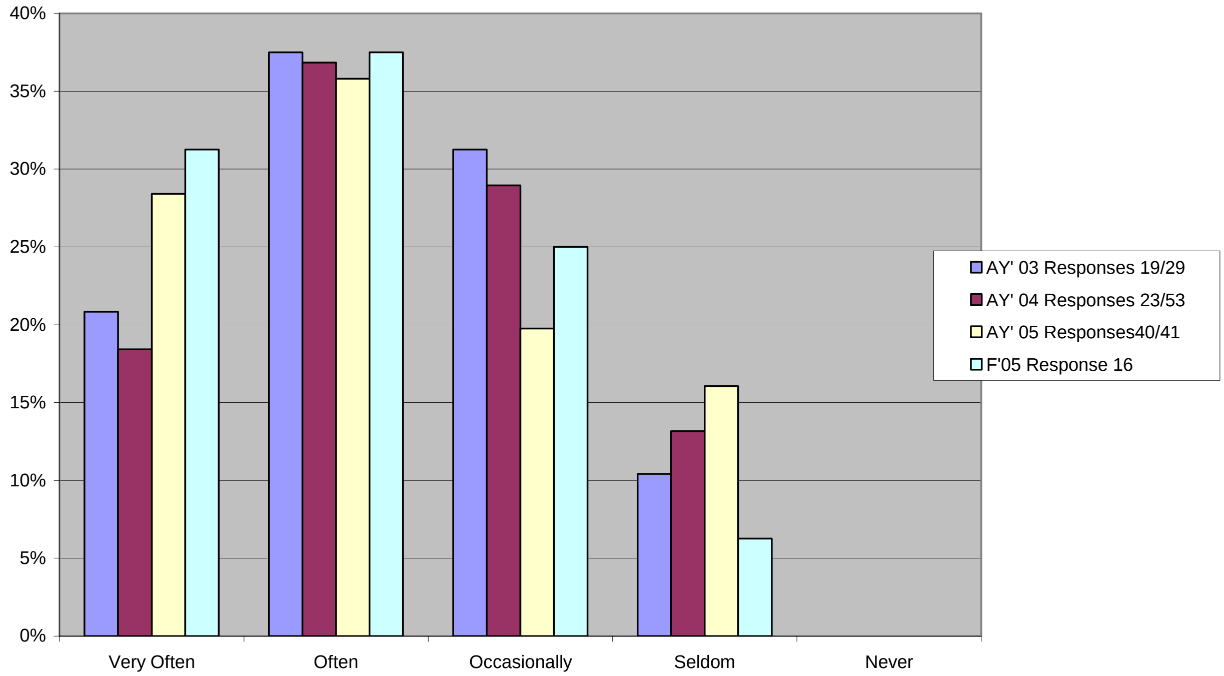
Part III Q. 2a Engineering Skills: Identify, formulate, and solve problems in thermal and/or mechanical systems using techniques, skills, and modern tools of the engineering profession.



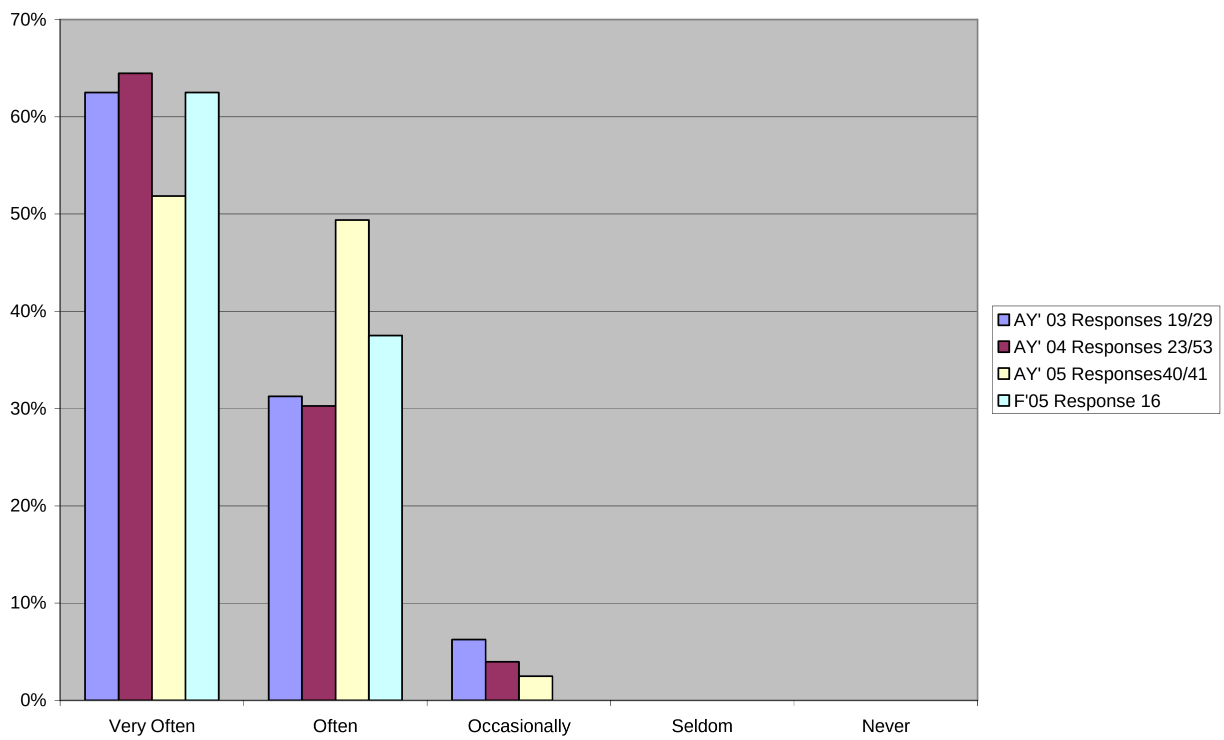
Part III Q. 2b Engineering Skills: Design a system, component or process associated with thermal and/or mechanical systems using techniques, skills and modern tools of the engineering profession.



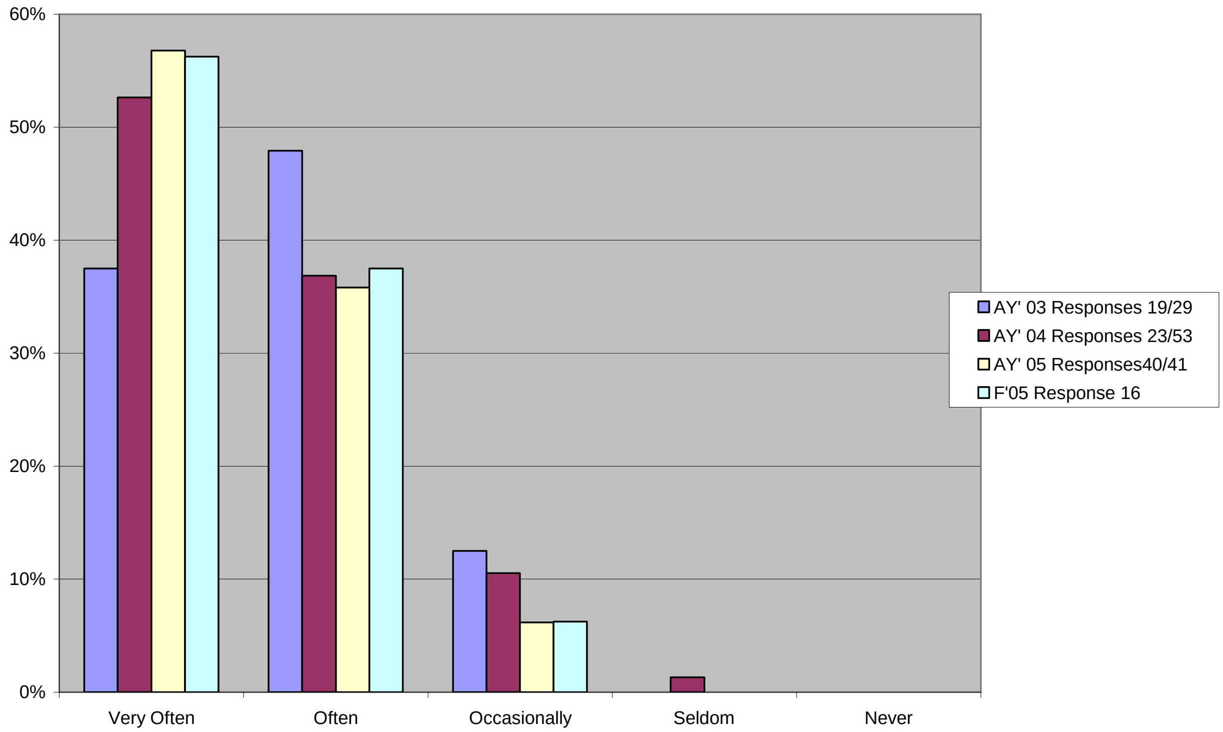
Part III Q. 2c Engineering Skills - Design and conduct experiments and analyze and interpret data associated with thermal and/or mechanical systems using techniques, skills, and modern tools of engineering.



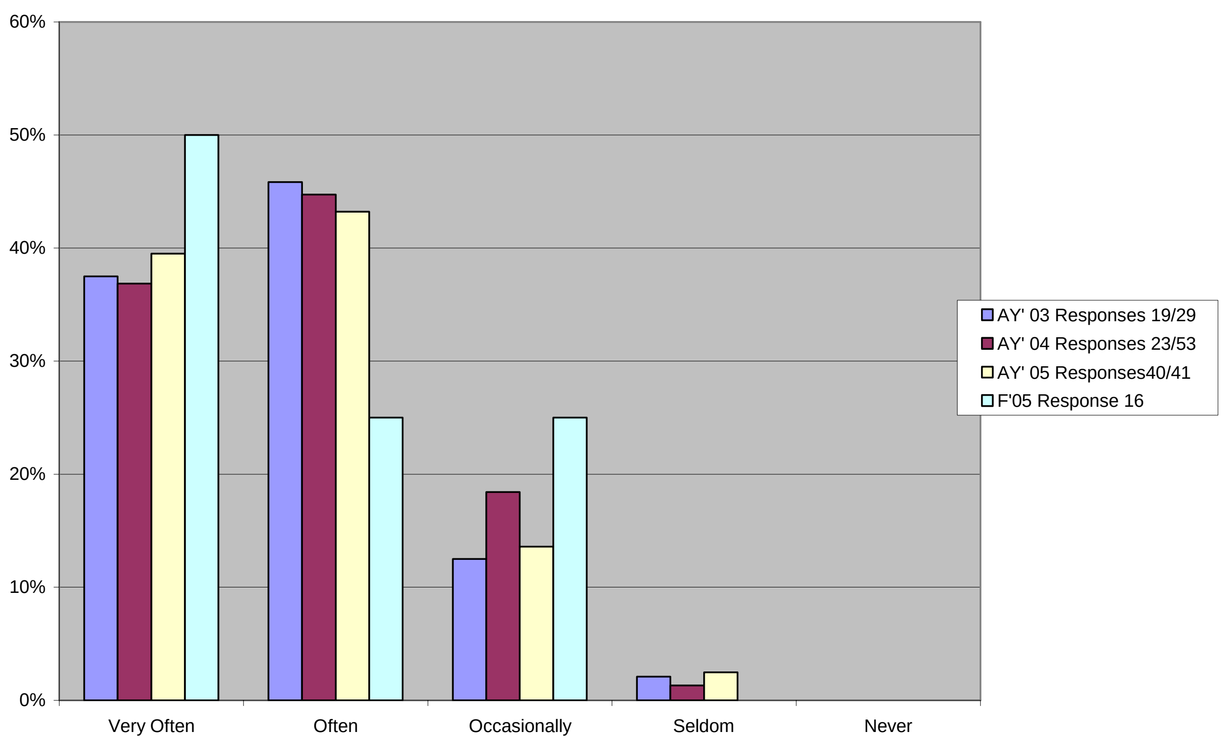
Part III Q. 3a Career Success - Work on Teams



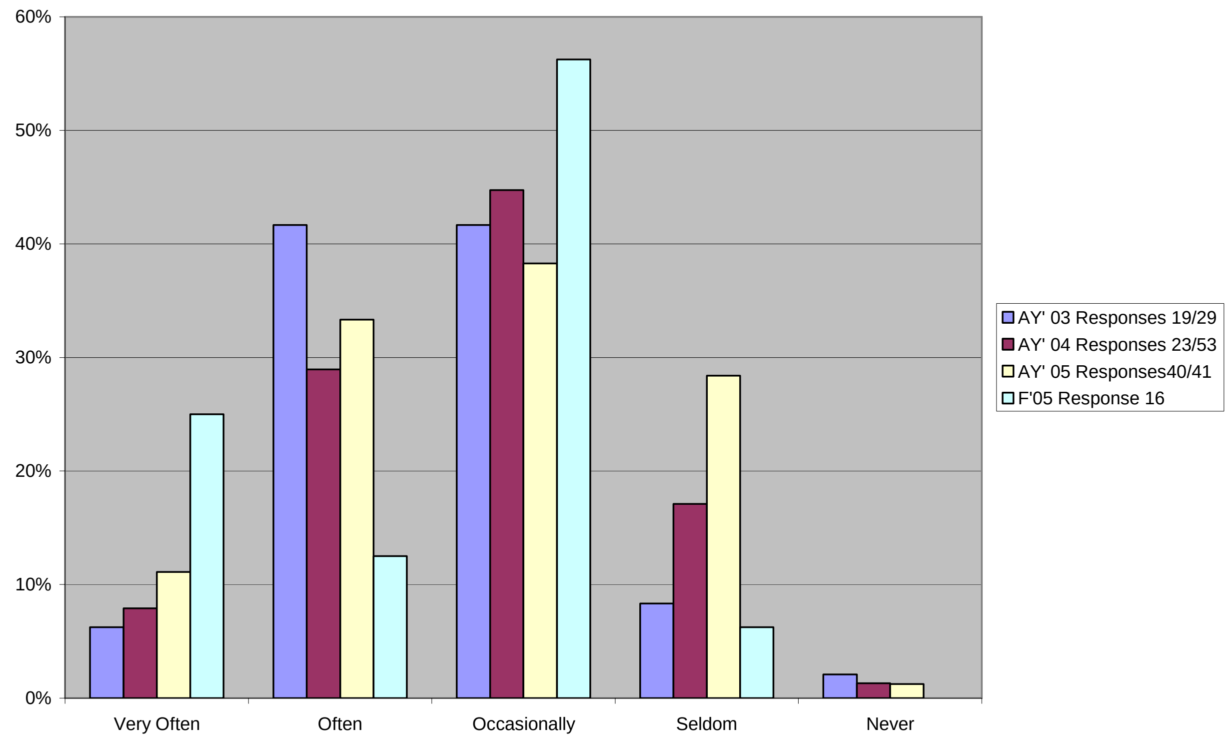
Part III Q. 3b Career Success Communicate in oral and/or written formats.



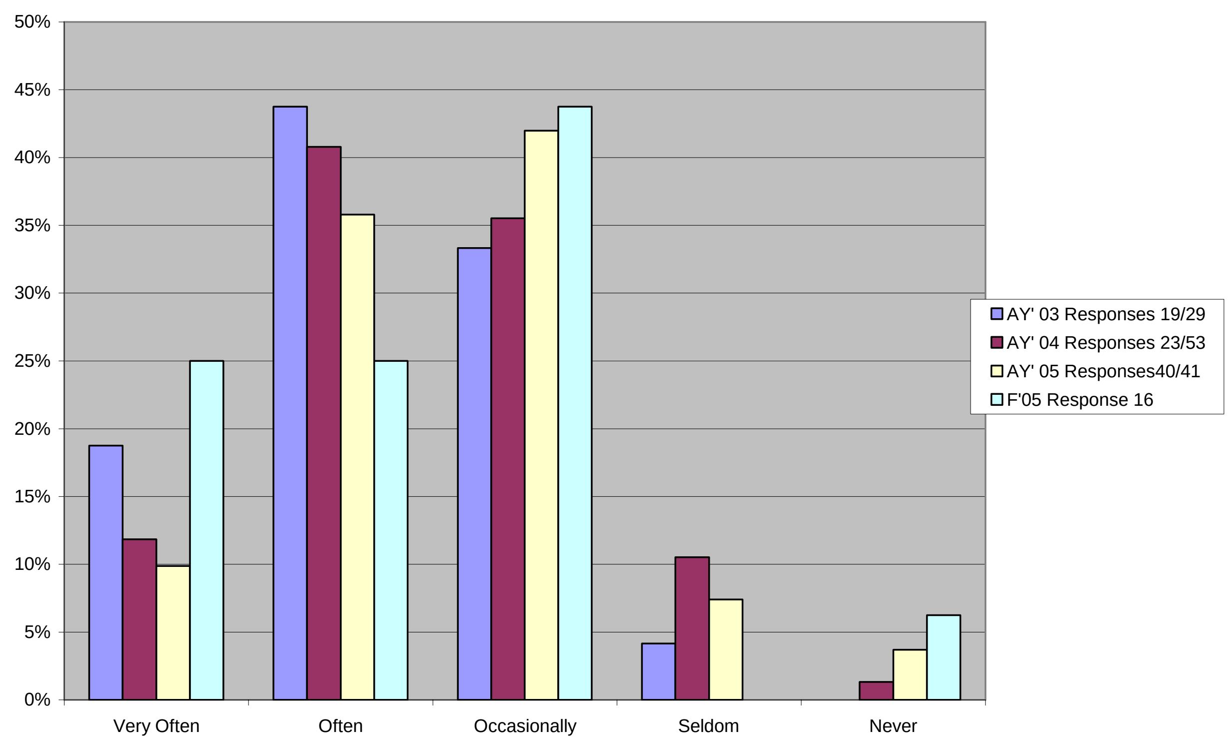
Part III Q. 3c Career Success - Engage in Self-Directed Learning.



Part III Q. 4a Social Awareness: Contemporary Issues



Part III Q.4b Social Awareness- Understand ethical and professional responsibilities.



Appendix I-E.5: Alumni Survey Report Spring 2005

Assessment Summary

Alumni Survey Spring 2005

Program Educational Objectives	Alumni Survey*
Attain the basic knowledge required to understand and analyze mechanical engineering systems.	4.60 ± 0.13
Apply engineering principles to create, analyze or improve processes, devices or systems to accomplish desired objectives.	4.55 ± 0.13
Develop engineering judgment through open-ended problems that require establishment of reasonable engineering assumptions and realistic constraints.	3.95 ± 0.21
Apply engineering knowledge to real-life design problems as well as to critically evaluate the solutions.	4.05 ± 0.22
Effectively work in multidisciplinary teams to solve engineering problems subject to technical and business constraints through critical thinking that crosses content boundaries.	3.65 ± 0.27
Develop an understanding of the societal context for practicing engineering, including ethical, environmental, legal, aesthetic considerations in design of engineering components and systems.	3.35 ± 0.15

*Scale based on preparation 1-None 2-Inadequate 3-Marginal 4-Good 5-Outstanding