Welcome to the Mechanical and Aerospace Engineering Department!

Congratulations on being admitted to the Department of Mechanical and Aerospace Engineering (MAE) in the Jacobs School of Engineering. We are sure you have questions about what to do next. We hope that this handbook will help you get familiar with our departments policies and expectations. If there are still questions or concerns that are not answered make sure to contact us.

MAE Undergraduate Academic Advising

The MAE advising staff assists students with their programs of study. The advising staff is available in EBU2, first floor for walk-in advising.

Walk-in Advising: Monday through Friday 9:00 AM—11:30 AM and 1:30 PM—3:30 PM

The MAE advising program runs parallel to the work of college advisors who assist students with the general-education requirements of each college. It is important that the scheduling of mathematics, physics, chemistry and engineering courses be done as suggested in the MAE curriculum table. If you have any questions about your major please refer to the MAE advisors.

Gerri Johnson- Phone: (858) 534-0114 Email: gljohnso@ucsd.edu
Christina Sandoval-Paquette- Phone (858) 822-2035 Email: cgsandov@ucsd.edu
Our primary educational objectives are:

To provide our students with a strong technical education that will enable them to have successful careers as engineers, technology leaders and innovators.

To prepare our students for rapid technological change with the core knowledge central to assuring that they are able to further develop their knowledge and skills across a range of disciplines throughout their professional careers and pursue advanced education.

To prepare our students to communicate effectively and to deal knowledgeably and ethically with the impact of technology in our society and on global issues.

PROGRAM OUTCOMES

(Abet accredited programs)

Aerospace and Mechanical Engineering:
- An ability to apply knowledge of mathematics, science, and engineering.
- An ability to design and conduct experiments, as well as being able to analyze and interpret data.
- An ability to design a system, component, or process to meet desired needs.
- An ability to function on multi-disciplinary teams.
- An ability to identify, formulate, and solve engineering problems.
- An understanding of professional and ethical responsibility.
- An ability to communicate effectively with written, oral, and visual means.
- The broad education necessary to understand the impact of engineering solutions in a global and societal context.
- A recognition of the need for and an ability to engage in life-long learning.
- A knowledge of contemporary issues.
- An ability to use modern engineering techniques, skills, and computing tools necessary for engineering practice.

Additionally:

Aerospace Engineering
- Knowledge of key topics in aeronautical engineering including aerodynamics, aerospace materials, structures, propulsion, flight mechanics, and stability and control.
- Knowledge of topics in astronautical engineering including attitude determination and control, space structures, orbital mechanics, and rocket propulsion.
- An ability to integrate knowledge of the fundamental topics in the design of an aerospace system.

Mechanical Engineering
- A familiarity with chemistry, calculus-based physics, and advanced mathematics.
- Familiarity with probability theory, statistics, and linear algebra.
- Ability to work professionally in mechanical systems areas including the design and realization of such systems.
- Ability to work professionally in thermal systems areas including the design and realization of such systems.
WHAT IS ABET?

ABET is the Accreditation Board for Engineering and Technology

All majors at USCD are accredited by the Western Association of Schools and Colleges (WASC). ABET is responsible for the specialized accreditation of educational programs in applied science, computing, engineering, and technology.

ABET accreditation is assurance that a college or university program meets the quality standards established by the profession for which it prepares its students. For example, an accredited engineering program must meet the quality standards set by the engineering profession. An accredited computer science program must meet the quality standards set by the computing profession.

The quality standards must meet to be ABET-accredited, which is set by the ABET professions themselves. This is made possible by the collaborative efforts of many different professional and technical societies. These societies and their members work together through ABET to develop the standards, and they provide the professionals who evaluate the programs to make sure they meet those standards.

Why Is ABET Accreditation Important?

- Accreditation helps students and their parents choose quality college programs.
- Accreditation enables employers to recruit graduates they know are well-prepared.
- Accreditation is used by registration, licensure, and certification boards to screen applicants.
- Accreditation gives colleges and universities a structured mechanism to assess, evaluate, and improve the quality of their programs.
DURING THE FIRST YEAR:

By the end of the first year, all students must complete at least the following eight required courses. These courses can be taken at UCSD or transferred in from a different university or community college.

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### Average GPA, MSAT and TSAT Scores of Students Admitted Directly to MAE Majors (2013):

<table>
<thead>
<tr>
<th></th>
<th>Fall 2013</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M.SAT</td>
<td>SAT</td>
<td>GPA</td>
<td>Transfer GPA (2012)</td>
</tr>
<tr>
<td>Aerospace</td>
<td>773</td>
<td>2046</td>
<td>4.22</td>
<td>3.76</td>
</tr>
<tr>
<td>Mechanical</td>
<td>734</td>
<td>2110</td>
<td>4.26</td>
<td>3.75</td>
</tr>
<tr>
<td>Environmental</td>
<td>690</td>
<td>1945</td>
<td>4.08</td>
<td>3.62</td>
</tr>
</tbody>
</table>

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### MAJOR ACADEMIC ADVISING

MAE Undergraduate Advising Staff.

The MAE advising staff assists students with their programs of study. The advising staff is available in EBU2, first floor for walk-in advising.

**Walk-in Advising: Monday through Friday 9:00 AM—11:30 AM and 1:30 PM—3:30 PM**

The MAE advising staff also assists students in preparing petitions to the Undergraduate Affairs Committee for any deviation from the standard programs of study. The MAE advising program runs parallel to the work of college advisors who assist students with the general-education requirements of each college. It is important that the scheduling of mathematics, physics, chemistry and engineering courses be done as suggested in the MAE curriculum table. If you have any questions about your major see an MAE advisor.

**Student Affairs Lobby.** The student lobby is a great resource for students. Here you’ll also find a complete MAE course offering list for the 2012-2013 academic year, copies of all MAE majors four year plans, along with a complete list of technical electives for each major, student petitions, etc. The MAE Student Affairs lobby is located in EBU II, first floor. We suggest you come prior to the Fall quarter, to familiarize yourself with the lobby and the EBU II building itself.
GENERAL EDUCATION/COLLEGE REQUIREMENTS

For graduation each student must satisfy general-education course requirements determined by the student’s college as well as the major requirements determined by the department. The six colleges at UCSD require widely different general-education courses and the number of such courses differs from one college to another. Each student should choose his or her college carefully, considering the special nature of the college and the breadth of general education.

Each MAE program allows for humanities and social science (HSS) courses so that students can fulfill their college requirements. In the ABET accredited programs, students must develop a program that includes a total of at least twenty-four units in the arts, humanities, and social sciences, not including subjects such as accounting, industrial management, finance, or personnel administration. It should be noted, however, that some colleges require more than the nine or ten HSS courses indicated in the curriculum tables. Accordingly, students in these colleges could take longer to graduate than the indicated four-year schedule. Students must consult with their college to determine which HSS courses to take.

Number of College General Education Courses in addition to those met within MAE Major Programs:

<table>
<thead>
<tr>
<th>College</th>
<th>Number of GE’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earl Warren College</td>
<td>9</td>
</tr>
<tr>
<td>Sixth College</td>
<td>9-13</td>
</tr>
<tr>
<td>Thurgood Marshall College</td>
<td>10</td>
</tr>
<tr>
<td>John Muir College</td>
<td>11-12</td>
</tr>
<tr>
<td>Eleanor Roosevelt College</td>
<td>13-14</td>
</tr>
<tr>
<td>Revelle College</td>
<td>13-17</td>
</tr>
</tbody>
</table>

MAE MAJOR PROGRAMS AND REQUIREMENTS

Specific course requirements for each major program are outlined in tables in this section of the handbook. In addition to the required technical courses specifically indicated, a suggested scheduling of humanities and social science courses (HSS) are distributed in the curricula for students to use to meet college general-education requirements. To graduate, students must maintain an overall GPA of at least 2.0, and the Department requires at least a C-grade in each course required for the major. A complete list of technical electives (TE) for each major is available in the MAE Student Affairs lobby (EBU II, first floor). In the accredited programs, TE courses are restricted to meet ABET standards. Students are encouraged to complete lower and upper-division courses as suggested in the curriculum tables in a timely fashion and in the sequences outlined. Deviation in scheduling of MAE upper-division courses is strongly discouraged.

Lower-division courses are offered more than once each year to permit students some flexibility in their program scheduling. However, many MAE upper-division courses are taught only once per year, and the courses are scheduled to be consistent with the curricula as shown in the tables. Students taking upper-division courses in a different order than that shown in the tables may experience conflicts as the schedules of different courses may overlap. A tentative schedule of course offerings is available from the department each spring for the following academic year. Prerequisite courses with a grade of D or F must be repeated before you can move on to the next course in the sequence. This includes the required math, physics and Chemistry courses. Prerequisites are strictly enforced by the department.
Impacted Majors

Due to high demand, some engineering majors at the Jacobs School have been designated as oversubscribed. They are:

1. Mechanical Engineering (Effective Fall 2009 for freshmen. Effective Fall 2011 for transfers)
2. Aerospace Engineering (Effective Fall 2009 for freshmen. Effective Fall 2011 for transfers)

Acceptance into an Impacted Engineering Major
Acceptance into an oversubscribed engineering major is based on academic excellence demonstrated in high school, community college or other four year institutions.

Freshmen
Admitted freshmen that have applied to an oversubscribed major will be further evaluated by the Office of Admissions and Relations with Schools for admission to the major. Acceptance will be granted to the maximum number of students in each of these impacted major programs. Students who are not admitted to the oversubscribed major are placed into the alternate major they selected on the UC Undergraduate Application, provided the alternate is not oversubscribed.

We highly recommend that freshman applicants list a non-oversubscribed open major as their alternate choice on the UC Undergraduate Application. If a student lists an oversubscribed major as both the first and alternate choices on the UC application, and is not admitted to the first choice major, the Office of Admissions and Relations with Schools will place the student in the Undeclared major. The Undeclared major is not affiliated with the Jacobs School. However, students admitted as undeclared may later seek admission to an open engineering major.

Transfers
Admitted transfer students who choose impacted engineering major programs as their first choice major on their UC application are strongly encouraged to complete the major preparation classes. Acceptance to impacted majors may be limited to the best transfer applicants, e.g., those who have been admitted with the most complete lower-division preparation and the highest college grade-point averages. For impacted majors, a competitive UCSD transferable cumulative GPA of 3.20 and 3.40 in the major-preparation courses is recommended. Since acceptance is restricted to these majors, transfer students are encouraged to apply to more than one major degree program.

We highly recommend that transfer applicants who list an impacted engineering major as their first major, choose a non-impacted engineering major or non-engineering major as their alternate choice. If a student lists impacted engineering majors as both the first and alternate choices on the UC application, and is not admitted to either of their engineering major choices, the Office of Admissions and Relations will place the student in the Undeclared major. The undeclared major is not affiliated with the Jacobs School. However, students admitted as Undeclared may later seek admission to an open engineering major.

It is strongly recommended that transfers complete the following preparation for all engineering majors.

- Calculus I—for Science and Engineering (Math 20A)
- Calculus II—for Science and Engineering (Math 20B)
- Calculus and Analytic Geometry (Math 20C)
- Differential Equations (Math 20D)
- Linear Algebra (Math 20F)
- Complete calculus-based physics series with lab experience (Physics 2A, B, and C)
- Chemistry 6A
- Highest level of introductory computer programming language course offerings at the community college
Transcripts and Course Equivalents

Your major department does not handle or receive or evaluate your transcripts. If you have questions about your transcription evaluations please contact the admission office.

Mail all official transcripts and documents to:
University of California, San Diego
Office of Admissions and Relations with Schools
Attn: Transcripts
9500 Gilman Dr., Dept 0021
La Jolla, CA 92093-0021

Some engineering courses may not transfer into MAE. You must come to MAE Student Affairs and complete a Student Petition form requesting to have the course count as the equivalent MAE course. You must provide documentation from the community college course in the form of a full syllabus (not just the course catalog description), homework and graded exams, and a textbook (suggested). Your complete petition will be reviewed by an MAE faculty member for equivalence.

ACADEMIC ENRICHMENT

A number of additional educational opportunities not formally required in the curriculum are available to undergraduates interested in exploring facets of engineering in more detail. These opportunities include participation in research, industrial internships, student societies, course instruction, and seminars.

Undergraduate Research and Independent Study (MAE 199)
Undergraduates may participate in engineering research at UCSD through Independent Study (MAE 199). MAE 199 courses offer qualified and motivated students the opportunity to work closely with faculty and graduate students and gain first-hand experience in conducting research. MAE students may take MAE 199, Independent Study for Undergraduates, under the guidance of an MAE faculty member. Typically, this course is taken as an elective on a P/NP basis.

Academic Internships: Special Study (MAE 197)
The UCSD Academic Internship Program coordinates work experiences for undergraduates with industry, government offices, and hospitals. Students work under the supervision of either a faculty member or an industrial supervisor. The position may or may not be salaried. Students may receive up to 12 units of academic credit by registering for MAE 197 Engineering Internship and completing a research paper or technical laboratory report on their internship work. The typical student time commitment to the internship is ten hours per week for every four units of academic credit. However, students may not receive upper division technical elective credit for such internships.

Opportunities Abroad
Engineering is already a global field offering jobs throughout the world. You can prepare yourself for these opportunities with an exciting study or internship experience abroad. Through the Programs Abroad Office, students may receive credit for international study through a variety of programs. For information on EAP and OAP programs, first contact the Programs Abroad Office (858-534-1123, pao@ucsd.edu, or http://infopath.ucsd.edu/icenter/pao/main.html) or visit the International Center on Library Walk.

Freshman Seminar Series
Informal seminars (MAE 87) are offered every quarter to new freshmen to provide them with the opportunity to explore an intellectual topic with a faculty member in a small seminar setting. Topics vary quarter by quarter.
**Teams In Engineering Service (TIES)**

Teams in Engineering Service are an innovative service-learning academic program putting UCSD undergraduates and their technical and creative skills to work for San Diego non-profit organizations. Multi-disciplinary teams of UCSD students design, build, and deploy projects that solve technology-based problems for community partners.

TIES projects can range from working with orthopedists and physical therapists to developing and building mechanical tools or prosthetics for the developmentally disabled and to working with agriculture to develop new irrigation solutions for local farming communities.

The benefits for student’s involvement in TIES are numerous, and include improved communication, organizational, and leadership skills, start-to-finish design experience, multi-disciplinary teamwork, experience in project and resource management, ethics training and responsibility, as well as customer and community awareness. Finally, TIES provides demonstrable and measurable outcomes of undergraduate engineering theoretical knowledge, technical skills, teamwork, communication, ethical responsibility and value for professional development. Mechanical and Environmental majors students are eligible to receive 4 units of technical elective.

*Note: The Aerospace major does not currently offer technical elective credit for either ENG100 or ENG100L.*

**Team Internship Program (TIP)**

Today’s employers are looking for engineers who have both technical skills and the ability to collaborate and function as a team. Summer Team Internships are part of the Jacobs School’s effort to enhance our students’ education through real-world engineering experiences in a team setting. Students work on-site with local, domestic, and international industry partners as a multi-disciplinary team of 2-5 students, focused on a clearly defined and significant project. TIP is a 10-12 week, full time, paid internship program during the summer. Undergraduate and graduate student of all levels in all engineering departments are eligible to apply. All application and resumes are screened by the TIP Office and candidates who best meet the criteria are forwarded to companies for review. TIP also offers resume guidance and professional development training to all applicants. This is designed to help students make the best impression at their interviews. TIP, in collaboration with the Corporate Affiliates Program (CAP), works with some of the top engineering companies. About 50% of TIP students are offered full time employment upon finishing their internship.

**Participating Companies**
AEROSPACE ENGINEERING

Aerospace engineering is a four-year curriculum that begins with fundamental engineering courses in mechanics, thermodynamics, materials, solid mechanics, fluid mechanics, and heat transfer. Additional courses are required in aerospace structures, aerodynamics, flight mechanics, propulsion, controls, and aerospace design. Graduates of this program normally enter the aerospace industry to develop aircraft and spacecraft, but also find employment in other areas that use similar technologies, such as mechanical and energy-related fields. Examples include automobile, naval, and sporting equipment manufacturing. This program received ABET accreditation in 2002.

Recommended Course Sequence of Required Courses for Fall 2013 Students:

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math 20A*</td>
<td>Math 20B*</td>
<td>Math 20C*</td>
</tr>
<tr>
<td>MAE 2-Intro to Aerospace</td>
<td>Phys 2A*</td>
<td>Phys 2B* and 2BL</td>
</tr>
<tr>
<td>Chem 6A</td>
<td>HSS</td>
<td>Structural Engineering (SE) 2</td>
</tr>
<tr>
<td>HSS (College Requirements)</td>
<td>HSS</td>
<td>HSS</td>
</tr>
<tr>
<td><strong>Year 2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math 20D</td>
<td>Math 20F*</td>
<td>Math 20E</td>
</tr>
<tr>
<td>Phys 2C and 2CL</td>
<td>MAE 8- Intro to MatLab</td>
<td>MAE 131A- Solid Mechanics</td>
</tr>
<tr>
<td>MAE 3- Graphics and Design</td>
<td>MAE 130A*- Statics</td>
<td>MAE 130B- Dynamics</td>
</tr>
<tr>
<td>HSS</td>
<td>HSS</td>
<td>HSS</td>
</tr>
<tr>
<td><strong>Year 3</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAE 105*- Mathematical Physics</td>
<td>MAE 101A*- Intro to Fluids</td>
<td>MAE 101B*- Advance Fluids</td>
</tr>
<tr>
<td>MAE 110A-Thermodynamics</td>
<td>MAE 143A*- Signals and Systems</td>
<td>MAE 143B- Linear Control</td>
</tr>
<tr>
<td>MAE 140- Linear Circuits</td>
<td>MAE 130C- Vibrations</td>
<td>MAE 170- Experimental Technique</td>
</tr>
<tr>
<td>MAE 107- Computational Methods</td>
<td>SE 160A*</td>
<td>SE 160B*</td>
</tr>
<tr>
<td><strong>Year 4</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAE 101C*- Heat Transfer</td>
<td>MAE 155A*- Aerospace Design</td>
<td>MAE 155B- Aeronautics Design</td>
</tr>
<tr>
<td>MAE 150*- Computer-Aid Design</td>
<td>MAE 175A- Engineering Lab</td>
<td>HSS</td>
</tr>
<tr>
<td>MAE 104*- Aerodynamics</td>
<td>MAE 142*- Dynamics and Controls</td>
<td>HSS</td>
</tr>
<tr>
<td>HSS</td>
<td>MAE 113*- Propulsion</td>
<td>TE</td>
</tr>
</tbody>
</table>

WHEN SCHEDULING CLASSES, THE MAE DEPARTMENT FOLLOWS THIS CURRICULUM GRID. IF YOU CHOOSE TO DEVIATE FROM IT, YOU WILL EXTEND YOUR TIME TO GRADUATION.

(continued on next page...)
AEROSPACE ENGINEERING:

Chem 6AH may be taken in place of Chem 6A

In fulfilling the Humanities and Social Science (HSS) requirements, students must take at least 24 units in the arts, humanities, and social sciences, not including subjects such as accounting, industrial management, finance, or personnel administration. Ten HSS courses are listed here; individual college requirements may be higher or lower.

Technical Elective (TE) courses must be upper-division or graduate courses in the engineering sciences, natural sciences or mathematics and must be selected with prior approval of the Department. See the MAE Student Affairs Office for a complete list of approved Technical Electives.

*COURSES MARKED WITH AN ASTERISK ARE PREREQUISITES TO COURSES LISTED IN THE IMMEDIATELY SUCCEEDING OR CONCURRENT QUARTER.

Photos courtesy of the MAE 2 course of 2008

First-year aerospace engineering students work in teams to design, build, and fly multi-disciplinary payload experiments on balloon satellites to near-space. Students gain real-world engineering experience developing and assembling sub-systems on space flight critical systems.
The Environmental Engineering program resembles the Chemical Engineering program for the first two years. In the third and fourth year, the programs diverge: an environmental engineering sequence is offered, as well as further specialization in fluid mechanics, and a wide choice of Technical Elective (TE) courses, both from within MAE and in other departments. The newly founded Environmental Engineering program within the Department of Mechanical and Aerospace Engineering (MAE) at UCSD is a modern interpretation of this rapidly changing field. Unlike the classical environmental engineering topics (e.g., water sanitation, brownfield remediation) many new environmental engineering and sustainability challenges require strong quantitative skills. Renewable energy technologies require skills in material science and physics, climate change research requires individuals trained in fluid mechanics and environmental transport and sustainable building design requires deep knowledge of heat and mass transfer in complex geometries.

**Proposed Course Sequence of Required Courses for Fall 2013 Students. All changes pending approval:**

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math 20A</td>
<td>Math 20B</td>
<td>Math 20C</td>
</tr>
<tr>
<td>Chem 6A</td>
<td>Phys 2A</td>
<td>Phys 2B and 2BL</td>
</tr>
<tr>
<td>HSS</td>
<td>Chem 6B</td>
<td>Chem 6C/6BL</td>
</tr>
<tr>
<td>HSS</td>
<td>HSS</td>
<td>HSS</td>
</tr>
<tr>
<td><strong>Year 2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math 20D</td>
<td>Math 20F</td>
<td>Math 20E</td>
</tr>
<tr>
<td>Phys 2C/2CL</td>
<td>ESYS 102- Ocean/Atmosphere</td>
<td>MAE 124- Environmental Engineering Challenges</td>
</tr>
<tr>
<td>MAE 3 Graphics and Design</td>
<td>MAE 8 Intro to MatLab</td>
<td>Chem 140A</td>
</tr>
<tr>
<td>HSS</td>
<td><strong>MAE 130A- Statics</strong></td>
<td>MAE 108 – Statistics and Probability for Engineering</td>
</tr>
<tr>
<td><strong>Year 3</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAE 105*- Mathematical Physics</td>
<td>MAE 101A*- Intro to Fluids</td>
<td>MAE 101B*- Advance Fluids</td>
</tr>
<tr>
<td>MAE 110A- Thermodynamics</td>
<td>MAE 119- Renewable Energy</td>
<td>MAE 170*- Experimental Technique</td>
</tr>
<tr>
<td>MAE 107- Computational Methods</td>
<td>HSS</td>
<td>TE</td>
</tr>
<tr>
<td>CENG 100- Modeling and Computations</td>
<td>HSS</td>
<td>HSS</td>
</tr>
<tr>
<td><strong>Year 4</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAE 101C*- Heat Transfer</td>
<td>MAE 126A*- Environmental Engineering Lab</td>
<td>MAE 126B- Environmental Engineering Lab</td>
</tr>
<tr>
<td>MAE 122- Environmental Transport</td>
<td>MAE 123- Groundwater Remediation</td>
<td><strong>MAE 121- Air Pollution Transport and Dispersion Modeling</strong></td>
</tr>
<tr>
<td>TE</td>
<td>TE</td>
<td>TE</td>
</tr>
<tr>
<td>HSS</td>
<td>HSS</td>
<td>HSS</td>
</tr>
</tbody>
</table>

When scheduling classes, the MAE department follows this curriculum grid. If you choose to deviate from it, you will extend your time to graduation.
ENVIRONMENTAL ENGINEERING

Chem 6AH, 6BH and 6CH may be taken in place of Chem 6A, 6B and 6C

In fulfilling the Humanities and Social Science (HSS) requirements, students must take at least 24 units in the arts, humanities, and social sciences, not including subjects such as accounting, industrial management, finance, or personnel administration. Eleven HSS courses are listed here; individual college requirements may be higher or lower.

Five Technical Elective (TE) courses are required to receive a degree in Environmental Engineering: at least 1 must be upper division courses selected from the MAE Department and at least 2 must be courses selected from outside the MAE Department. See the MAE Student Affairs Office for a complete list of approved Technical Electives.

**Proposed changes to the Environmental Engineering major are currently pending approval. The current curriculum has ESYS 101, where MAE 130A is showed, and a technical elective, where MAE 121 is shown.

*COURSES MARKED WITH AN ASTERISK ARE PREREQUISITES TO COURSES IN THE IMMEDIATELY SUCCEEDING OR CONCURRENT QUARTER.

This experiment consists of a plume produced by a source of salt water at the top of a tank of fresh water. The flow to the plume is controlled by a peristaltic pump, which pumps salt water from the beaker to the plume nozzle. The density of the plume is determined by a conductivity probe that measures the resistance of the solution that is, in turn, a function of the salt concentration. The probe measures the salinity of water drawn in through the tip by the second peristaltic pump. The location of the probe is controlled in the Labview VI.
MECHANICAL ENGINEERING

The Mechanical Engineering Program has a traditional ABET accredited four-year curriculum involving mechanics, vibrations, thermodynamics, fluid flow, heat transfer, materials, control theory and mechanical design. Graduates of this program find employment in the high-technology elector-mechanical industry as well as in the mechanical and aerospace industry.

Recommended Course Sequence of Required Courses for Fall 2010 Students:

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
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</thead>
<tbody>
<tr>
<td><strong>Year 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math 20A*</td>
<td>Math 20B*</td>
<td>Math 20C*</td>
</tr>
<tr>
<td>Chem. 6A*</td>
<td>Phys 2A*</td>
<td>Phys 2B* and 2BL</td>
</tr>
<tr>
<td>HSS</td>
<td>Chem 6B</td>
<td>MAE 3- Graphics and Design</td>
</tr>
<tr>
<td>HSS</td>
<td>HSS</td>
<td>HSS</td>
</tr>
<tr>
<td><strong>Year 2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math 20D</td>
<td>Math 20F*</td>
<td>Math 20E</td>
</tr>
<tr>
<td>Phys. 2C and 2CL</td>
<td>MAE 130A*- Statics</td>
<td>MAE 131A- Solid Mechanics</td>
</tr>
<tr>
<td>MAE 20- Materials Science</td>
<td>MAE 8- Intro to MatLab</td>
<td>MAE 130B- Dynamics</td>
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WHEN SCHEDULING CLASSES, THE MAE DEPARTMENT follows THIS CURRICULUM GRID. IF YOU CHOOSE TO DEVIATE FROM IT, YOU WILL EXTEND YOUR TIME TO GRADUATION.
MECHANICAL ENGINEERING:

Chem 6AH and 6BH may be taken in place of Chem 6A and 6B.

In fulfilling the Humanities and Social Science (HSS) requirements, students must take at least 24 units in the arts, humanities, and social sciences, not including subjects such as accounting, industrial management, finance, or personnel administration. Ten HSS courses are listed here; individual college requirements may be higher or lower.

Technical Elective (TE) courses must be upper-division or graduate courses in the engineering sciences, natural sciences or mathematics and must be selected with prior approval of the Department. See the MAE Student Affairs Office for a complete list of approved Technical Electives.

*COURSES MARKED WITH AN ASTERISK ARE PREREQUISITES TO COURSES LISTED IN THE IMMEDIATELY SUCCEEDING OR CONCURRENT QUARTER.*

Example of an MAE 3 Project

This course introduces the fundamentals of engineering graphics and the design. Emphasis is placed on applying engineering tools to design and fabrication of working machines. Course material will be centered around two projects:

- Model Clock Project (2.5 weeks): Students will use AutoCAD to design an escapement wheel and pendulum for a model clock, and make the model using shop tools.
- Robot Design Project (7.5 weeks): Teams of students will design and build a machine for a competition using DC motors, solenoids, and fabrication tools.
“What is an Impacted Major?”

Answer: The B.S. degrees in mechanical and aerospace engineering are impacted. Because of heavy student interest in these two majors, and the limited resources available to accommodate this demand, maintenance of a high-quality program makes it necessary to limit enrollments.

“What if I want to switch to an impacted major?”

Answer: Continuing students who wish to change into an impacted major (mechanical engineering and aerospace engineering) must submit an application to the department. Applications will be accepted twice a year. Please see the department web site maeweb.ucsd.edu for details. Continuing students who wish to be considered must submit an application to the MAE department on or before the target dates and must meet the following minimum requirements:

1. completed at least one year/three quarters in residence at UCSD
2. complete all lower-division requirements for the requested major
3. have a minimum 2.5 GPA

Applications will be ranked by their UCSD GPA on the date of the application. Students will be allowed into the major based on a ranking system, up to a maximum number.

“Which of the six UC San Diego colleges do engineering students choose?”

Answer: Each undergraduate college at UC San Diego is comprised of all types of majors, so there is no “particular” college for engineering students. The main difference is that each college has its own general education requirements to graduate, mission, philosophy, traditions, and housing/dining facilities.

“What courses should I take in my community college to prepare for transferring to MAE?”

Answer: It is strongly recommended that transfers complete the following preparation for all engineering majors.

- Calculus I—for Science and Engineering (Math. 20A)
- Calculus II—for Science and Engineering (Math. 20B)
- Calculus and Analytic Geometry (Math. 20C)
- Differential Equations (Math. 20D)
- Linear Algebra (Math. 20F)
- Complete calculus-based physics series with lab experience (Physics 2A, B, and C)
- Chemistry 6A
- Highest level of introductory computer programming language course offerings at the community college

“Can I double major?”

Answer: UC San Diego does allow students to double major. However, you cannot double major or major and minor in two engineering majors. For example, you can double major in Economics and Electrical Engineering but you cannot double major in Electrical Engineering and Mechanical Engineering.

“What companies recruit UC San Diego students?”

Answer: Various engineering companies actively recruit students from the Jacobs School of Engineering and a majority of these companies belong to our Corporate Affiliates Program (CAP). Below are just some of the companies affiliated with UCSD through CAP.
Course Descriptions

2011-2012

Please refer to The Schedule of Classes for the most up-to-date course information and prerequisites.

Lower-Division

MAE 02. Introduction to Aerospace Engineering (4)
An introduction to topics in aeronautical and astronautical engineering including aerodynamics, propulsion, flight mechanics, structures, materials, orbital mechanics, design, mission planning, and environments. General topics include historical background, career opportunities, engineering ethics, and professionalism. Must be taken for a letter grade. **Prerequisite:** none.

MAE 03. Introduction to Engineering Graphics and Design (4)
Introduction to design process through a hands-on design project performed in teams. Topics include problem identification, concept generation, project management, risk reduction. Engineering graphics and communication skills are introduced in the areas of: Computer-Aided Design (CAD), hand sketching, and technical communication. **Prerequisite:** grade of C– or better in Physics 2A or 4A (or concurrent enrollment). Priority enrollment given to engineering majors.

MAE 05. Quantitative Computer Skills (4)
Introductory course for non-engineering majors. Use of computers in solving problems; applications from life sciences, physical sciences, and engineering. Students run existing computer programs and complete some programming in BASIC. **Prerequisite:** none.

MAE 08. MATLAB Programming for Engineering Analysis (4)
Computer programming in MATLAB with elementary numerical analysis of engineering problems. Arithmetic and logical operations, arrays, graphical presentation of computations, symbolic mathematics, solutions of equations, and introduction to data structures. Priority enrollment given to engineering majors.

MAE 20. Elements of Materials Science (4)
The structure of materials: metals, ceramics, glasses, semiconductors, superconductors and polymers. Control of internal structure to produce desired properties. Mechanical, rheological, electrical, optical, superconducting and magnetic properties and classification. **Prerequisites:** Phys. 2A or 4A, Chem. 6A, Math. 21C or 20D (or concurrent registration).

MAE 87. Freshman Seminar (1)
The Freshman Seminar program is designed to provide new students with the opportunity to explore an intellectual topic with a faculty member in a small seminar setting. Freshman seminars are offered in all campus departments and undergraduate colleges. Topics vary from quarter to quarter. Enrollment is limited to fifteen to twenty students, with preference given to entering freshmen. **Prerequisite:** none.

MAE 92A. Design Competition—Design, Build, and Fly Aircraft (1)
(Cross-listed with SE 10A.) Student teams design, build, and fly unmanned aircraft for a national student competition. Students concentrate on vehicle system design including aerodynamics, structures, propulsion, and performance. Teams engineering, fabricate the aircraft, submit a design report, and prep aircraft for competition. **Prerequisites:** consent of instructor.

MAE 99R. Independent Study (1)
Independent study or research under direction of a member of the faculty. **Prerequisites:** student must be of first-year standing and a Regent's Scholar; approved Special Studies form.

Upper-Division

MAE 101A. Introductory Fluid Mechanics (4)
Fluid statics; fluid kinematics; integral and differential forms of the conservation laws for mass, momentum and energy; Bernoulli equation; potential flows; dimensional analysis and similitude. **Prerequisites:** admission to an engineering major and grades of C– or better in Phys. 2A, Math. 20D, 20E, or consent of instructor.

MAE 101B. Advanced Fluid Mechanics (4)
Laminar and turbulent flow. Pipe flow including friction factor. Boundary layers, separation, drag, and lift. Compressible flow including shock waves. Professional ethics will be discussed. **Prerequisites:** grade of C– or better in MAE 101A or CENG 101A or CENG 103A, and MAE 110A or CENG 102 or consent of instructor.

MAE 101C. Heat Transfer (4)
Extension of fluid mechanics in MAE 101A-B to viscous, heat-conducting flows. Application of the energy conservation equation to heat transfer in ducts and external boundary layers. Heat conduction and radiation transfer. Heat transfer coefficients in forced and free convection. Design applications. **Prerequisites:** grade of C– or better in MAE 101A or CENG 101A and MAE 101B, or consent of instructor.
MAE 102. Fluid Mechanics for Structural Engineers (4) (Cross-listed with SE 112.) Fluid statics, hydrostatic forces; integral and differential forms of conservation equations for mass, momentum, and energy; Bernoulli equation; dimensional analysis; viscous pipe flow; external flow, boundary layers; open channel flow. Prerequisites: grade of C– or better in Phys. 2A, Math. 20D, and Math. 20E or consent of instructor.

MAE 104. Aerodynamics (4) Basic relations describing flow field around wings and bodies at subsonic and supersonic speed. Thin-wing theory. Slender-body theory. Formulation of theories for evaluating forces and moments on airplane geometries. Application to the design of high-speed airplanes. Prerequisites: open to MC 25, MC 27, MC 28 and SE 27 only and grade of C– or better in MAE 101A-B, or consent of the instructor.

MAE 105. Introduction to Mathematical Physics (4) Fourier series, Sturm Liouville theory, elementary partial differential equations, integral transforms with applications to problems in vibration, wave motion, and heat conduction. Prerequisites: admission to engineering major or and grades of C– or better in Phys. 2A-B and Math. 20D or Math. 21D.

MAE 107. Computational Methods in Engineering (4) Introduction to scientific computing and algorithms; iterative methods, systems of linear equations with applications; nonlinear algebraic equations; function interpolation and differentiation and optimal procedures; data fitting and least-squares; numerical solution of ordinary differential equations. Prerequisites: engineering majors only and grades of C– or better in MAE 9 or MAE 10 and Math. 20F.

MAE 110A. Thermodynamics (4) Fundamentals of engineering thermodynamics: energy, work, heat, properties of pure substances, first and second laws for closed systems and control volumes, gas mixtures. Application to engineering systems, power and refrigeration cycles, combustion. Prerequisites: grades of C– or better in Phys. 2C and Chem 6A. Enrollment restricted to engineering majors only.


MAE 113. Fundamentals of Propulsion (4) Compressible flow, thermodynamics, and combustion relevant to aircraft and space vehicle propulsion. Analysis and design of components for gas turbines, including turbines, inlets, combustion chambers and nozzles. Fundamentals of rocket propulsion. Prerequisites: engineering majors MC 25, MC 27 and MC 28 only and grades of C– or better in MAE 110A or CENG 102 and MAE 101A-B or CENG 101A and 101C (or CENG 103A-B).

MAE 117A. Elementary Plasma Physics (4) (Cross-listed with Physics 151.) Particle motions, plasmas as fluids, waves, diffusion, equilibrium and stability, nonlinear effects, controlled fusion. Prerequisites: Math. 21D or consent of instructor. Phys. 100B-C or ECE 107 are recommended.

MAE 117B. Industrial Plasma Applications (4) Charged particle motion in DC and RF electro-magnetic; atomic processes in plasmas; ionization, excitation, dissociation, rate constants, electron energy balance electric breakdown of the gases; debye length, plasmas quasi-neutrality, sheath; DC, capacitive, inductive, and wave-heated discharges; etching, deposition, and implantation. Prerequisite: Math. 20D or 21D, or consent of instructor.

MAE 117L. Elements of Experimental Plasma Physics (4) Measurements of electron density and temperature with the langmuir probes, emission spectroscopy measurements of neutrals and ions in plasmas; electric breakdown of the gases; plasmas etching of materials. Prerequisites: none.

MAE 118. Introduction to Energy Systems (4) Overview of present day primary energy sources and availability; fossil fuel, renewable, and nuclear; heat engines; energy conservation, transportation, air pollution, and climate change. Students may not receive credit for both MAE 118 and MAE 118A. Prerequisites: MAE 101A or CENG 101A, or consent of instructor.

MAE 119. Introduction to Renewable Energy: Solar and Wind (4) Basic principles of solar radiation—diffuse and direct radiation; elementary solar energy engineering—solar thermal and solar photovoltaic; basic principles of wind dynamics—hydrodynamic laws, wind intermittency, Betz’s law; elementary wind energy engineering: solar and wind energy perspectives; operating the California power grid with 33 percent renewable energy sources. Students may not receive credit for both MAE 118B and MAE 119. Prerequisites: MAE 101A or CENG 101A, or consent of instructor.

MAE 120. Introduction to Nuclear Energy (4) Overview of basic fission and fusion processes. Elementary fission reactor physics and engineering; environmental and waste disposal issues. Survey of fusion technology issues and perspectives. May not receive credit for both MAE 118C and MAE 120. Prerequisites: MAE 101A or CENG 101A, or consent of instructor.

MAE 124. The Human Earth: An Introduction to Environmental Engineering and Policy (4) (Cross-listed with ESYS 103.) This course explores the impacts of human social, economic, and industrial activity on the environment. It highlights the central roles in ensuring sustainable development played by market forces, technological innovation and governmental regulation on local, national, and global scales. Prerequisites: grade of C– or better in Math. 20B or Math. 10A-C, or consent of instructor.

MAE 125A. Flow and Transport in the Environment (4) Study of river flow and hydraulic control; surface waves; applications to reservoirs and estuaries. Introduction to stratification and buoyancy; applications to atmospheric surface layer and the ocean mixed layer. Ideas behind turbulent dispersion. Turbulent and scaling laws. Gravity currents and katabatic flows. Prerequisites: engineering majors and students receiving a grade of C– or better in MAE 101A or CENG 103A or CENG 101A.
MAE 125B. Fluid-Solid Interactions in Environment Engineering (4)

MAE 125C. Case Studies In Environmental Engineering (4)
This course is project-oriented. Students will conduct research in small groups, give oral presentations and write reports. Topics reflect material in MAE 125A and MAE 125B. Possible topics: air pollution modeling, building ventilation, wetland preservation. **Prerequisites:** engineering majors and students receiving a grade of C– or better in MAE 125A-B.

MAE 126A. Environmental Engineering Laboratory I (4)
Design and analysis of experiments in environmental engineering. Experiments in wind tunnel, water tunnel, and other equipment. Use of instrumentation. Laboratory report writing; error analysis; engineering ethics. **Prerequisites:** grade of C– or better in MAE 101A or CENG 101A, MAE 125A.

MAE 126B. Environmental Engineering Laboratory II (4)
Design and analysis of original studies in environmental engineering. Students work on environmental projects and use computational and laboratory facilities. Students propose and design studies, collect and analyze data, and prepare a major report. **Prerequisite:** grade of C– or better in MAE 126A.

MAE 127. Statistical Methods for Environmental Sciences and Engineering (4)
Methods for evaluating environmental data including probability distributions, confidence intervals, functional fitting, spectral analysis, and programming methods for data analysis. **Prerequisite:** grade of C– or better in Math. 20C.

MAE 130A. Mechanics I: Statics (4)
(Cross-listed with SE 101A.) Statics of particles and rigid bodies in two and three dimensions. Free body diagrams. Internal forces. Static analysis of trusses, frames, and machines. Shear force and bending moment diagrams in beams. Equilibrium problems with friction. **Prerequisites:** Math. 20C and Phys. 2A with grades of C– or better. Students cannot also receive credit for SE 101A.

MAE 130B. Mechanics II: Dynamics (4)

MAE 130C. Mechanics III: Vibrations (4)
(Cross-listed with SE 101C.) Free and forced vibrations of undamped and damped single degree of freedom systems. Harmonically excited vibrations. Vibrations under general loading conditions. Vibrating systems with multiple degrees of freedom. Modal analysis with application to realistic engineering problems. Vibration of continuous systems. **Prerequisites:** grades of C– or better in Math. 20F and MAE 130B or SE 101B.

MAE 131A. Solid Mechanics I (4)
(Cross-listed with SE 110A) Students may not receive credit for SE 110A or MAE 131A and SE 110A/MAE 131A. Concepts of stress and strain. Hooke’s Law. Axial loading of bars. Torsion of circular shafts. Shearing and normal stresses in beam bending. Deflections in beams. Statically determinate and indeterminate problems. Combined loading. Principal stresses and design criteria. Buckling of columns. **Prerequisites:** grades of C– or better in Math. 20D, 20F, and MAE 130A or SE 101A.

MAE 131B. Fundamentals of Solid Mechanics II (4)
Continuum mechanics of solids and its application to the mechanical response of machine and structural elements. Stress and strain in indicial notation; field equations and constitutive relations. Linear elastic stress analysis in torsion, plane stress and plane strain; stress concentrations; fracture mechanics. Extremum principles and structural stability. Viscoelasticity, plasticity, and failure criteria. Theorems of plastic limit analysis. **Prerequisites:** grades of C– or better in MAE 131A or SE 110A and MAE 105.

MAE 131C. Solid Mechanics III (4)
Small deflection of plate bending. Solutions for rectangular and circular plates. Buckling of plates. Membrane and bending stresses in cylindrical shells. Pressure vessels. Energy methods and finite element analysis. **Prerequisite:** grade of C– or better in MAE 131A or SE 110A.

MAE 132. Intermediate Dynamics (4)
Kinematics and kinetics of 3-D rigid body motion. Angular momentum and its rate of change. Euler’s and general equations of motion. Rotation about a fixed axis and a fixed point. Gyroscopic motion. Dynamic reactions. Lagrange’s equations of motion with applications. **Prerequisite:** grade of C– or better in MAE 130B or SE 101B.

MAE 133. Finite Element Methods in Mechanical and Aerospace Engineering (4)
Development of stiffness and mass matrices based upon variational principles and application to static, dynamic, and stability design problems in structural and solid mechanics. Architecture of computer codes for linear and nonlinear finite element analysis and basic computer implementation. The use of general purpose finite element structural analysis computer codes. **Prerequisites:** grade of C– or better in MAE 131A or SE 110A.

MAE 135. Computational Mechanics (4)
Mathematical modeling in terms of systems of algebraic and differential equations. Overview of numerical methods. Problem statement, boundary, and initial conditions. Overview of commercial packages for solving the equations of Mathematical and Engineering Physics. Numerical solutions of selected examples drawn from real-life applications of fluid flow, solid mechanics, and heat transfer with emphasis on design. **Prerequisite:** consent of instructor.

MAE 140. Linear Circuits (4)
MAE 142. Dynamics and Control of Aerospace Vehicles (4)
The dynamics of vehicles in space or air are derived for analysis of the stability properties of spacecraft and aircraft. The theory of flight, lift, drag, dutch roll and phugoid modes of aircraft are discussed. Optimal state space control theory for the design of analog and digital controllers (autopilots). **Prerequisites:** admission to the engineering major and grades of C- or better in MAE 104 and MAE 143B or ECE 171A, or consent of instructor.

MAE 143A. Signals and Systems (4)
Dynamic modeling and vector differential equations. Concepts of state, input, output. Linearization around equilibria. Laplace transform, solutions to ODEs. Transfer functions and convolution representation of dynamic systems. Discrete signals, difference equations, z-transform. Continuous and discrete Fourier transform. **Prerequisites:** grades of C- or better in Math. 20D, 20E, and 20F and MAE 105, or consent of instructor.

MAE 143B. Linear Control (4)
Analysis and design of feedback systems in the frequency domain. Transfer functions. Time response specifications. PID controllers and Ziegler-Nichols tuning. Stability via Routh-Hurwitz test. Root locus method. Frequency response: Bode and Nyquist diagrams. Dynamic compensators, phase-lead and phase-lag. Actuator saturation and integrator wind-up. **Prerequisite:** grade of C- or better in MAE 143A or CENG 100, or consent of instructor.

MAE 143C. Digital Control Systems (4)
Discrete time systems: sampling, aliasing, stability, Z-transform, discrete time signals, state space models; state equations, canonical forms, observability, controllability. Pole placement design, observer design, output feedback, linear quadratic regulator design. Implementation: digital approximation, computational and numerical issues. **Prerequisite:** grade of C- or better in MAE 143B.

MAE 149. Sensor Networks (4)
(Cross-listed with ECE 156 and SIO 238) Characteristics of chemical, biological, seismic and other physical sensors; signal processing techniques supporting distributed detection of salient events; wireless communication and networking protocols supporting formation of robust sensor fabrics; current experience with low power, low-cost sensor deployments. **Prerequisites:** upper-division standing and consent of instructor, or graduate student in science or engineering.

MAE 150. Computer-Aided Design (4)
Computer-Aided Analysis and Design. Design methodology, tolerance analysis, Monte Carlo analysis, kinematics and computer-aided design of linkages, numerical calculations of moments of inertia, design of cams and cam dynamics; finite element analysis, design using Pro-E, Mechanica Motion and Mechanica Structures. **Prerequisites:** grade of C- or better in MAE 130A or SE 101A or BENG 110, MAE 107 or SE 121, and MAE 3, senior standing in engineering major, or consent of instructor.

MAE 152. Computer Graphics for Engineers and Scientists (4)
Computer graphics algorithms using C programming and Ironcad. Applications in engineering and science. Line-drawing algorithms. Area fill algorithms, color, CAD user interface, spline curves and surfaces, 2-D and 3-D transformations, wireframe and solid models. Hidden-surface elimination. **Prerequisites:** grade of C- or better in MAE 3 and MAE 9 or 10. Not offered every year.

MAE 155A. Aerospace Engineering Design I (4)
Fundamental principles of aerospace vehicle design including the conceptual, preliminary, and detailed design phases. Aeronautical or astronautical design project that integrates all appropriate engineering disciplines as well as issues associated with optimization, teamwork, manufacturability, reporting, and professionalism. **Prerequisites:** grade of C- or better in MAE 2, 104, 113, 130C, 142, 150, SE 2 and SE 160B or consent of instructor. Students may enroll concurrently with MAE 113, 142, and 150.

MAE 155B. Aerospace Engineering Design II (4)
Fundamental principles of aerospace vehicle design including the conceptual, preliminary, and detailed design phases. Aeronautical or astronautical design project that integrates all appropriate engineering disciplines as well as issues associated with optimization, teamwork, manufacturability, reporting, and professionalism. **Prerequisites:** grade of C- or better in MAE 113, 142, 150, 155A or consent of instructor.

MAE 156A. Fundamental Principles of Mechanical Design I (4)
Fundamental principles of mechanical design and the design process. Application of engineering science to the design and analysis of mechanical components. Initiation of team design projects that culminate in MAE 156B with a working prototype designed for a real engineering application. Professional ethics discussed. Course material fee may apply. **Prerequisites:** grades of C- or better in MAE 3, MAE 130C, MAE 131A, MAE 160, or MAE 131B, and MAE 170 or consent of instructor.

MAE 156B. Fundamental Principles of Mechanical Design II (4)
Fundamental principles of mechanical design and the design process. Culmination of a team design project initiated in MAE 156A which results in a working prototype designed for a real engineering application. **Prerequisite:** grade of C- or better in MAE 156A in the immediately preceding quarter; MAE 101C, MAE 150 or consent of instructor.

MAE 160. Mechanical Behavior of Materials (4)
Elasticity and anelasticity, dislocations and plasticity of crystals, creep, and strengthening mechanisms. Mechanical behavior of ceramics, composites, and polymers. Fracture: mechanical and microstructural. Fatigue. Laboratory demonstrations of selected topics. **Prerequisites:** grade of C- or better in MAE 20, MAE 130A (or SE 101A) and MAE 131A, or consent of instructor.

MAE 161. Electronic, Magnetic, and Photonic Materials (4)
Introduction to the worlds of electronic, magnetic/photonic materials, the unique properties of advance engineering materials in relation to processing, fabrication, and microstructure. Semiconductors, metals, alloys, ceramics, polymers, and composite materials and their practical applications. **Prerequisite:** consent of instructor. Not offered every year.

MAE 165. Fatigue and Failure Analysis of Engineering Components (4)
The engineering and scientific aspects of crack nucleation, slow crack growth, and unstable fracture in crystalline and amorphous solids. Microstructural effects on crack initiation, fatigue crack growth and fracture toughness. Methods of fatigue testing and fracture toughness testing. Fractography and microfractography. Design safe methodologies and failure prevention. Failure analysis of real engineering structures. **Prerequisite:** consent of instructor. Not offered every year.
MAE 166. Nanomaterials (4)
Basic principles of synthesis techniques, processing, microstructural control and unique physical properties of materials in nano-dimensions. Nanowires, quantum dots, thin films, electrical transport, optical behavior, mechanical behavior, and technical applications of nanomaterials. Prerequisite: consent of instructor. Not offered every year.

MAE 167. Wave Dynamics in Materials (4)
Pressure and shear waves in infinite solids. Reflection and diffraction. Rayleigh and Love waves in semi-infinite space. Impulse load on a half space. Waveguides and group velocity. Prerequisite: consent of instructor. Not offered every year.

MAE 168. MEME Materials, Fabrication, and Applications (4)
The principles of micro-electro-mechanical systems (MEMS) fabrication, materials involved, actuation principles utilized, and the fundamentals of MEMS operation in relation to stresses and deformation. Novel device applications, future trends, and nano-electro-mechanical (NEMS) systems. Prerequisite: consent of instructor. Not offered every year.

MAE 170. Experimental Techniques (4)
Principles and practice of measurement and control and the design and conduct of experiments. Technical report writing. Lectures relate to dimensional analysis, error analysis, signal-to-noise problems, filtering, data acquisition and data reduction, as well as background of experiments and statistical analysis. Experiments relate to the use of electronic devices and sensors. Prerequisite: Grade of C– or better in Phys. 2CL and admission to any engineering major.

MAE 171A. Mechanical Engineering Laboratory I (4)
Design and analysis of experiments in fluid mechanics, solid mechanics, and control engineering. Experiments in wind tunnel, water tunnel, vibration table and material testing machines, and refined electromechanical systems. Laboratory report writing. Error analysis; engineering ethics. Prerequisites: grade of C– or better in MAE 101C or CENG 101B, MAE 130C or SE 101C, MAE 160 or MAE 131B or SE 110B, MAE 140, MAE 143B or CENG 120, MAE 170, and senior standing in engineering major or consent of instructor.

MAE 171B. Mechanical Engineering Laboratory II (4)
Design and analysis of original experiments in mechanical engineering. Students research projects using experimental facilities in undergraduate laboratories: wind tunnel, water channel, vibration table, and testing machine and control systems. Students propose and design experiments, obtain data, complete engineering analysis and write a major report. Prerequisite: requires a grade of C– or better in MAE 171A.

MAE 175A. Aerospace Engineering Laboratory I (4)
Analysis of aerospace engineering systems using experimental facilities in undergraduate laboratories: wind tunnel, water channel, vibration table, and testing machine. Students operate facilities, obtain data, complete engineering analysis and write major reports. Prerequisites: grade of C– or better in MAE 101C or CENG 103C or CENG 101C; MAE 143B, and MAE 170.

MAE 180A. Spacecraft Guidance I (4)

MAE 181. Space Mission Analysis and Design (4)

MAE 192. Senior Seminar in Aerospace, Environmental or Mechanical Engineering (1)
The Senior Seminar Program is designed to allow senior undergraduates to meet with faculty members in a small group setting to explore an intellectual topic in aerospace, environmental or mechanical engineering (at the upper-division level). Topics will vary from quarter to quarter. Senior seminars may be taken for credit up to four times, with a change in topic and permission from the department. Enrollment is limited to twenty students, with preference given to seniors. Prerequisites: department stamp or consent of instructor.

MAE 195. Teaching (2-4)
Teaching and tutorial assistance in an MAE course under supervision of instructor. Not more than four units may be used to satisfy graduation requirements. P/NP grades only. Prerequisites: junior status and a B average in major and consent of department chair.

MAE 197. Engineering Internship (1-4)
Students work in local industry or hospitals under faculty supervision. Units may not be applied toward graduation requirements. Salaried or unsalaried. Number of units determined by enrollment frequency. First quarter up to four units. Subsequent quarters cannot exceed one unit. Prerequisites: consent of instructor and department stamp, 2.50 overall GPA minimum, at least ninety units.

MAE 198. Directed Group Study (1-4)
Directed group study on a topic or in a field not included in the regular department curriculum, by special arrangement with a faculty member. May be taken P/NP only. Prerequisite: consent of instructor.

MAE 199. Independent Study for Undergraduates (4)
Independent reading or research on a problem by special arrangement with a faculty member. P/NP grades only. Prerequisite: consent of instructor.
STUDENT AFFAIRS CONTACT LIST

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