JOHNS HOPKINS
UNIVERSITY

Mechanical Engineering
Department

Undergraduate Advising Manual

for Bachelor of Science Degrees in Mechanical Engineering and Engineering Mechanics

2011-2012

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Department of Mechanical Engineering

The Johns Hopkins University

Accredited Undergraduate Programs in

Mechanical Engineering and Engineering Mechanics

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1 INTRODUCTION

Welcome to the Johns Hopkins University's Department of Mechanical Engineering! In our time, we have seen once-diverse engineering fields merge and new technologies redefine industries. The pace of these developments will become even faster during the 21st century. To keep abreast of rapid technological innovation, engineers must be able to continually update and renew their knowledge throughout their careers.

The task of preparing students for this environment is facilitated by our focus on fundamentals and the low student-to-faculty ratio of the Department of Mechanical Engineering. Educating a small, select group of students has permitted the development of a number of distinctive educational features such as a "capstone" design course that closely simulates professional practice, student participation in faculty research, close faculty-student interaction, and effective advising. By means of flexible programs grounded in fundamentals, we enable our graduates to pursue the lifelong education needed to excel in a rapidly changing world.

1.1 Objectives

In fulfilling our mission of preparing our graduates for the future, we start with the recognition that, at the root of the ever-growing variety of technological innovations lie scientific, engineering, and professional principles that are both a foundation for the student's understanding and a compass throughout his or her career.

A primary objective of the Mechanical Engineering curriculum is to emphasize the importance of these fundamental principles and to help students understand them and master their application. Laboratory experience is invaluable for this purpose and we provide meaningful hands-on experience in modern instructional and research laboratories, so that students gain the skills of acquiring, analyzing, and interpreting data.

Fundamental principles are as vital today as when they were first discovered. This aspect is illustrated by showing them "in action" in the more advanced courses devoted to contemporary applications.

The demands of advanced technology, economy, and efficiency put an ever-increasing premium on the quantitative aspects of engineering. For this reason,

students must also be educated in the application of advanced mathematical and computational techniques in engineering analysis and design.

1.2 Programs

1.2.1 Academic Programs

The Department of Mechanical Engineering offers two distinct programs of study for undergraduates at Johns Hopkins: Mechanical Engineering and Engineering Mechanics.

The **Mechanical Engineering** program places an emphasis on mechanical and thermal-fluid systems analysis and design. Students develop a wide range of fundamental skills required of the mechanical engineering professional and choose upper-level technical electives for further in-depth study.

The **Engineering Mechanics** program is designed to provide students with a highly flexible but rigorous foundation in solid and fluid mechanics. Students choose an area of specialization in preparation for technical careers or graduate and professional school.

The objectives indicated before are common to the two programs. In addition, they share the following features:

Flexibility. While the Engineering Mechanics curriculum is, by design, very flexible, both curricula offer several technical electives and allow students to pursue special interests in engineering, physics, biology, mathematics, management, and humanities. Double-majors and a 5-year Master's degree are also possible.

Interdisciplinary approach. Both programs require courses in the basic sciences and mathematics and other engineering disciplines (including electrical, civil and materials). Each program also offers elective opportunities in diverse areas such as the physical and mathematical sciences, aerospace engineering, biomedical engineering, and environmental engineering. Students have the opportunity to interact with a multidisciplinary faculty both in the classroom and in research laboratories.

Preparation for professional practice. The modern engineer must be well versed in communication and teamwork skills. These are developed in a number of courses that involve laboratory exercises, report writing, and oral presentations. In addition to the two-semester freshman introductory and senior capstone design courses, the students' development in solving design problems is

cultivated and encouraged through design electives and special design projects assigned in many of the courses.

The requirements described in this guide are intended to ensure an excellent foundation in science, humanities and social sciences, engineering sciences and engineering design methods, as well as preparation in the specializations of Mechanical Engineering and Engineering Mechanics. Both programs are accredited by the Accreditation Board for Engineering and Technology (ABET). For further details, see www.abet.org.

1.2.2 Mechanical Engineering Program Objectives

Our primary objective is to educate an exceptional group of engineers who, after graduation, will be (1) successful and on track to become leaders among their peers in industry, government laboratories and other organizations, and (2) advanced students in the best graduate programs.

1.2.3 Mechanical Engineering Program Outcomes

Students graduating from the B.S. in Mechanical Engineering will have demonstrated the ability to

- Understand and apply the fundamentals of mathematics (through linear algebra and multivariate calculus), numerical methods, statistical analysis and physical sciences (physics and chemistry) necessary to attain competence in the mechanical engineering disciplines,
- Design, conduct, evaluate and report experiments including analysis and statistical interpretation of data,
- Identify, formulate and solve engineering problems in the areas of thermo-fluid and mechanical systems,
- Use basic concepts from the mechanical engineering sciences, modern engineering tools (machine-tools, laboratory instrumentation, and computer hardware and software), and related subjects to design mechanical engineering components and processes, taking into account constraints such as manufacturability, cost, safety, environmental and socio-political impacts,
- Enter professional practice and/or graduate school, with the recognition of the need for life-long learning and the ability to pursue it,
- Use effective communication, multidisciplinary teamwork, and possess awareness of professional and ethical responsibilities, and an appreciation of the societal, economic, and environmental impacts of engineering.

1.2.4 Engineering Mechanics Program Objectives

Our primary objective is to educate an exceptional group of science-oriented engineers who, after graduation, will be successful and on track to become leaders among their peers (1) in the best graduate programs in engineering, science, medical schools, or law schools, and (2) in industry, government laboratories and other organizations.

1.2.5 Engineering Mechanics Program Outcomes

Students graduating from the B.S. in Engineering Mechanics will have demonstrated the ability to

- Understand and apply the fundamentals of mathematics (through linear algebra and multivariate calculus), numerical methods, statistical analysis and physical sciences (physics and chemistry) necessary to attain competence in the mechanics or related disciplines such as applied physics, bioengineering or other scientific/engineering disciplines.
- Understand the interplay between engineering science and the design, evaluation and reporting of experiments including analysis and statistical interpretation of data.
- Identify, formulate and solve engineering problems in the mechanical sciences.
- Use basic concepts from the mechanical sciences, mathematics, the basic sciences and related subjects, as well as modern engineering tools, to design mechanical engineering components and processes, taking into account constraints such as manufacturability, cost, safety, environmental and socio-political impacts,
- Enter graduate school and/or professional practice with the tools needed for life-long learning and the recognition of its importance.
- Use effective communication, multidisciplinary teamwork, and possess awareness of professional and ethical responsibilities, and an appreciation of the societal, economic, and environmental impacts of engineering.

1.2.6 Research Programs

The research programs in the Department of Mechanical Engineering are broad and varied. Our faculty members working in

each research area are listed. Faculty members with secondary appointments are listed in a smaller font.

- *Micro/Nanoscale Science and Engineering:* Chirikjian, Knio, Herman, Hemker, Sharpe, Ramesh, Prosperetti, Wang; Weihs, Cammarata, Chen
- *Computational Engineering:* Meneveau, Mittal, Knio, Douglas, Chirikjian, Prosperetti, Sun; Chen
- *Mechanical Engineering in Biology and Medicine:* Ramesh, Douglas, Chirikjian, Whitcomb, Nguyen, Sun, Wang, Mittal; Taylor, Thakor
- *Energy and the Environment:* Herman, Meneveau, Katz, Prosperetti, Knio
- *Robotics and Human-Machine Interaction:* Chirikjian, Whitcomb, Cowan; Hager, Stoianovici, Taylor, Thakor
- *Aerospace and Marine Systems:* Katz, Hemker, Meneveau, Prosperetti, Ramesh, Herman, Knio, Chirikjian, Whitcomb, Mittal; Chen

1.2.7 Undergraduate Research Opportunities

The faculty welcomes undergraduate student participation in their research, which greatly enhances the educational experience beyond coursework. Opportunities are available during the academic semesters, intersession or the summer through independent study and research courses or through paid research positions.

Information on research in the department is located at http://www.me.jhu.edu/research.html.

Undergraduates at all levels are strongly encouraged to contact faculty members directly to participate in the Department's research programs.

1.2.8 "Responsible Conduct of Research Course" May Be Required

Many undergraduate graduate students participating in research will be required to take the "Responsible Conduct of Research" course.

- Students receiving payment for research or who are conducting research used to help complete degree requirements (such as in an Independent Research or Independent Study course) must first complete the online training course (360.624) before conducting research and receiving payment or credit.
- Students receiving payment from NIH Training Grants must take the in-person training course (360.625).

Information is available at http://eng.jhu.edu/wse/page/conduct-of-research-training. Successful completion of this course must be verified before a student's diploma is issued.

1.3 Advising

The Department's faculty coordinator for undergraduate advising is the "Director of Undergraduate Studies," Professor Rajat Mittal, whose office is in 126 Latrobe, telephone 410-516-4069, e-mail mittal@jhu.edu.

All undergraduate students must follow a program approved by their advisors, who are faculty members in the Department.

1.3.1 Visit Your Advisor Often

Each student should see his or her advisor to plan a course schedule, change courses, and discuss degree requirements. It is important to determine an outline of the total four years of courses as early as possible. Students can also discuss issues related to academics or academic performance at anytime.

Students must initiate a meeting with his or her advisor at least once – and preferably more – each semester.

A meeting approximately four weeks after classes begin provides a useful time to inform the advisor of potential difficulties in individual courses. Another meeting occurs in November during Advising Week, when decisions must be made on course registration for the following semester.

1.3.2 Advising Holds on Registration

Advising Holds are placed on your registration record, which your advisor must release before you can register for classes. Advising Week is the week before registration begins for the next semester. The Advising Hold is released only after you review your course plans with your advisor. Please arrange an appointment with your advisor during Advising Week.

1.4 Undergraduate Student Handbook

The JHU Undergraduate Student Handbook is a valuable resource for information on academic and administrative procedures, registration, grading, professional opportunities, and student life. Please refer to it often, as it will answer many questions about policies and procedures. The handbook is available online on the "Undergraduate Student Handbook" link in the Policies and Procedures tab of the Office of Academic Advising web page at http://www.advising.jhu.edu/.

1.5 "Advising Johns Hopkins Students" Handbook for Parents

The JHU Office of Academic Advising has created a companion book "Advising Johns Hopkins Students" for parents. Please encourage your parent(s) or guardian(s) to refer to this book as it provides helpful information about suggestions to prepare for each of the four years of the student experience and beyond.

2 GENERAL REGULATIONS

2.1 Course Grading – Letter Grades vs. S/U grades

The Department of Mechanical Engineering requires that all courses taken after the first semester of the freshman year and counted toward the 126 credits required for Mechanical Engineering, or the 127 credits required for Engineering Mechanics, be taken for a letter grade. (That is, they may not be taken with the Satisfactory/ Unsatisfactory option.)

The University regulations are located on the web at the Office of Academic Advising web page: http://www.advising.jhu.edu/.

2.1.1 S/U and Pass/Fail Grades Don't Count after the Freshman Fall Semester

Whereas the University allows one S/U course each semester outside the student's major, with the exception of grades in the first semester of the freshman year, the Department does not allow any S/U courses, including Intersession courses, to count toward the requirements for graduation.

2.1.2 Grades Below C-

The Department of Mechanical Engineering requires that grades of C- or better be obtained in all required Engineering, Mathematics and Science and related required elective courses of those areas. Grades of D, D+, or F will not be accepted for the degree.

No more than ten D+, D, or D- credits may be counted toward graduation requirements in the Humanities and Social Sciences course designations.

2.2 WSE Course-Level Guidelines

In an effort to promote consistent course labeling, the course numbering guidelines found below are used throughout the University and the Whiting School of Engineering:

- 100: introductory/freshman-level coursework

- 200: sophomore-level coursework
- 300: junior-level coursework
- 400: senior-level coursework; typically permitted to apply to graduate degrees (at the discretion of the student's department)
- 500: undergraduate independent study, undergraduate research, and senior thesis coursework
- 600: graduate coursework; typically graded with letter grades
- 700: advanced graduate and topics courses; often offered P/F
- 800: graduate seminars, graduate independent study, graduate research and dissertation research coursework; nearly always offered P/F

2.3 Courses taken at other Universities

According to University regulations, no more than 12 credits completed prior to matriculation or in summer sessions at other accredited colleges or universities will be accepted.

Transfer students are not subject to this restriction. They must obtain credit for courses they wish to transfer during their first year at Hopkins. University regulations also require a minimum of two years' residence for a Hopkins degree.

2.4 Course Waivers – No Credits Earned

As a result of mathematics placement testing or prior course experience in high school, some students may be allowed to begin their course sequences at a higher level than in the initially prescribed curriculum. For example, some students may initiate the math sequence at Calculus II instead of the traditional Calculus I start.

No academic credit is given for waivers. A waiver merely shifts the beginning level of course work. Students must earn the prescribed number of credits for each portion of their degree program, and are expected to work with their advisors to select appropriate classes.

2.5 Advanced Placement

Johns Hopkins University grants credit for many Advanced Placement (AP) examinations. Official records of advanced placement examinations should be submitted to the Office of Academic Advising, 103 Shaffer Hall. AP scores will be entered on academic records upon receipt.

- **CALCULUS:** A score of 4 or 5 on the Calculus AB exam, or a score of 3 on the Calculus BC exam exempts a student from taking Calculus I (110.108). A score of 4 or 5 on Calculus BC exempts Calculus I and II (110.108, 110.109).

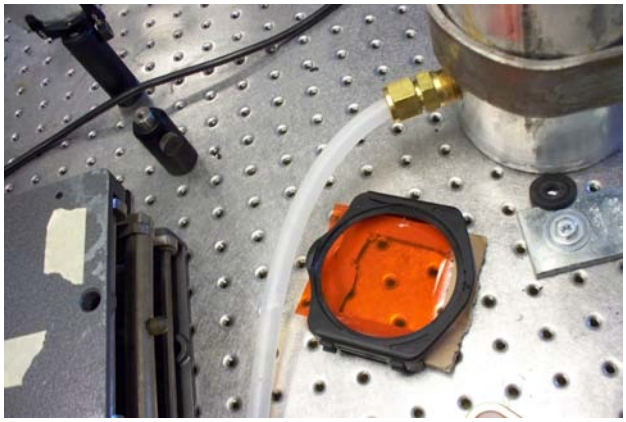
- **CHEMISTRY:** A score of 4 or 5 on the AP Chemistry exam exempts a student from taking the Intro Chemistry I and II sequence (030.101, 030.102) or Introduction to Materials Chemistry (510.101).
- **MACROECONOMICS:** A score of 4 or 5 on the Macroeconomics exams would replace Macroeconomics (180.101), which can be used to count toward the Humanities and Social Sciences requirements.
- **MICROECONOMICS:** A score of 4 or 5 on the Macroeconomics exams would replace Microeconomics (180.102), which can be used to count toward the Humanities and Social Sciences requirements.
- **PHYSICS:** A score of 4 or 5 on Physics C (mechanics) exempts a student from 530.103/.104 Intro to Mechanics I / II or 171.101 Physics I. A score of four or five on Physics C (electricity and magnetism) exempts a student from 171.102 Physics II. No AP credit is awarded for Physics B.

LABS MUST BE TAKEN, EVEN WITH AP PHYSICS CREDIT!

While the University does not require the labs, departments can, and Mechanical Engineering does. All Mechanical Engineering or Engineering Mechanics students must take either the 530.105/.106 Mechanical Engineering Freshman Lab I and II or 173.111 General Physics Laboratory I as appropriate to the freshman introductory course track one is taking.

Also, the 173.112 General Physics Laboratory II course or approved equivalent is required for all Mechanical Engineering and Engineering Mechanics students.

Note: if a student takes the course of which the AP credits normally would replace, the AP credits will be lost. This is important to consider with the physics courses where taking either 530.103 or 530.104 or both will eliminate the AP Physics C credits.



For additional information about AP credits, please consult the JHU Undergraduate Student Handbook online.

2.6 Independent Research and Independent Study

Students may wish to explore topics only partially covered or not covered at all in coursework, and others may wish to expand their learning on a course topic.

Independent Research is a course under the direct supervision of a faculty member in which a student identifies and proposes research work.

Independent Study is the result of creating a course of study that is focused on topics not covered in current courses or is an expansion of one topic in which further study is desired.

- Up to three credits can be earned in any one semester, summer, or intersession, though only up to a total of three credits of independent work can be counted toward the B.S. Mechanical Engineering degree as an elective.
- Each credit should reflect 40 hours of work, which is unpaid.
- No distribution credits are attached to independent work, though your advisor can designate a distribution through a Course Exception Waiver form at http://www.me.jhu.edu/Course_Exception_Waiver_Form.pdf.

The Mechanical Engineering department strongly recommends that a student have a cumulative GPA of at least 3.0 to request approval to conduct independent research or independent study.

Pre-Approval is Required

Before embarking on a project, students must obtain pre-approval from their academic advisors by presenting a completed "Undergraduate Research, Independent Study, Internship, and Departmental Thesis" form available at the Registrar or from the Academic Program Administrator. Research performed without this pre-approval will not be recognized and accredited.

2.7 Student Classification and First Semester Grades

The Whiting School of Engineering stipulates that students entering JHU from high school will be classified as "freshmen," regardless of the number of credits earned through Advanced Placement or other pre-college programs.

First-semester grades for all students entering JHU will be "covered." Grades of "Satisfactory" or "Unsatisfactory" will be displayed on transcripts for all first semester classes, even though letter grades are assigned by instructors.

3 DOUBLE MAJORS AND MINORS

Both Mechanical Engineering and Engineering Mechanics majors may elect to double major or to complete a minor from any department in the School of Engineering or the School of Arts and Sciences that offers one. The flexibility of the Engineering Mechanics curriculum makes it possible to double major in Biomedical Engineering, Materials Science and Engineering, Physics, and Applied Mathematics and Statistics among other fields.

Double Majors

Students wishing to pursue a double major must contact the Whiting School's Academic Advising office. Students must ensure that course requirements for both majors are met, and must visit faculty advisors from each major to obtain approval of the planned program.

Major / Minors

Students wishing to pursue a minor should confer with the department through which the minor is offered to ascertain the exact requirements. Lists of departments offering minors appear on the following pages:

- Arts and Sciences: http://www.advising.jhu.edu/majorsminors.php
- Engineering: http://eng.jhu.edu/wse/page/degree-programs

Robotics Minor

The field of Robotics integrates sensing, information processing, and movement to accomplish specific tasks in the physical world. As such, it encompasses several topics, including mechanics and dynamics, kinematics, sensing, signal processing, control systems, planning, and artificial intelligence. Applications of these concepts appear in many areas including medicine, manufacturing, space exploration, disaster recovery, ordinance disposal, deep-sea navigation, home care, and home automation.

The faculty of the Laboratory for Computational Sensing and Robotics (LCSR), in collaboration with the academic departments and centers of the Whiting School of Engineering, now offers a **Robotics Minor** in order to provide a structure in which undergraduate students at Johns Hopkins University can advance their knowledge in robotics while receiving recognition on their transcript for this pursuit.

Information is available at https://lcsr.jhu.edu/Robotics_Minor.

Entrepreneurship and Management minor

The minor in Entrepreneurship and Management from the Center for Leadership Education focuses on business and management from a multidisciplinary viewpoint. It is designed to provide students with the knowledge and skills to become leaders in technology companies.

Students may opt to take these courses separately from their major course requirements, but most can be incorporated into the course requirements so that only as little as four extra courses would be required to complete the student's primary major plus the Entrepreneurship and Management minor.

It is important to work with your academic advisor to plan your course work plan so you can complete all courses, as you will take them over multiple years.

The table below illustrates how a student can complete the Mechanical Engineering or Engineering Mechanics major plus the Entrepreneurship and Management minor. Note that these are updated requirements effective the Fall 2010 semester.

This course…	…counts toward both this E&M minor requirement…	…and this Mechanical Engineering or Engineering Mechanics requirement.
550.310 or 560.348 Probability and Statistics	Statistics Option #2	Statistics
660.105 Introduction to Business	E&M Fundamentals #1	One allowed "S" course from a Whiting School department
660.203 Financial Accounting	E&M Fundamentals #2	Extra Course #1
660.250 Principles of Marketing	E&M Fundamentals #3	Extra Course #2
660.461 Engineering Business and Management	Upper Level Elective #1	Core Engineering Course
CLE upper-level elective	Upper Level Elective #2	Extra Course #3
CLE upper-level elective	Upper Level Elective #3	Extra Course #4

Table 1 – Entrepreneurship and Management minor course comparison

Contact Academic Program Administrator Kristen Kelley at kkelley@jhu.edu for further information, or view their website at http://web.jhu.edu/leadership.

4 FREQUENCY OF COURSE ELECTIVE OFFERINGS

Some courses are offered exclusively in specific semesters, and sometimes in alternating years. Required core engineering courses are offered every year. Below is the standard timeframe of elective course offerings. These offerings are subject to change without notice. Please confirm these offerings with your advisor or the Academic Program Administrator when planning your course schedule.

COURSE	INTERVAL	NEXT EXPECTED
530.405 Mechanics of Solids and Structures	variable	Spring 2013
530.410 Biomechanics of the Cell	variable	To be determined
530.418 Aerospace Structures and Materials	variable	Fall 2013
530.420 Robot Sensors and Actuators	variable	Fall 2012
530.421 Mechatronics	variable	Spring 2013
530.424 Dynamics of Robots and Spacecraft	Even Years	To be determined
530.425 Mechanics of Flight	variable	Fall 2013
530.432 Jet and Rocket Propulsion	variable	Spring 2014
530.426 Biofluid Mechanics	Spring / Even Years	Spring 2014

COURSE	INTERVAL	NEXT EXPECTED
530.435 Refrigeration and HVAC	Fall / Even Years	To be determined
530.440 Computational Mechanical of Biological Macromolecules	variable	Fall 2012
530.445 Introduction to Biomechanics	variable	Fall 2012
530.446 Experimental Biomechanics	variable	Fall 2012
530.448 Biosolid Mechanics	Spring	To be determined
530.449 Compressible Flow	Fall / Odd Years	Fall 2013
580.451 Cell and Tissue Engineering Laboratory	variable	Fall 2012
530.457 Introduction to Acoustics	variable	To be determined
530.467 Thermal Design Issues for Aerospace Systems	variable	Fall 2012
530.470 Space Vehicle Dynamics and Control	variable	To be determined
530.495 Microfabrication Laboratory	Fall	Fall 2012
530.496 Micro/Nanoscience and Biotechnology	Fall / Even Years	To be determined

Table 2 – Elective Course Frequencies

5 HUMANITIES AND SOCIAL SCIENCE REQUIREMENTS

The Humanities and Social Sciences play an important role in an individual's education. The Whiting School of Engineering requires a minimum of six courses (each of at least three credits, 18 credits) in the Humanities or Social Sciences (catalog code H or S) areas.

Some Mechanical Engineering majors and all Engineering Mechanics majors will follow these minimum requirements, and require one writing course and two courses at the 300 level or above. Please read further for important information for Mechanical Engineering majors.

New for Mechanical Engineering majors – see Section 6.4

In Section 6.4, a change in the Core Engineering requirements for Mechanical Engineering majors - in which an additional three-credit course is being added - affects the H&S credits requirements.

Students through the Class of 2014 have the option of following the new Core Engineering requirements or continuing with the former requirements option in place before Fall 2010. Students of the Class of 2015 and later must follow the new Core Engineering requirements.

New Option: 18 H&S Credits – Economics is no longer required

Those following the new Mechanical Engineering requirements will have to earn the extra three credits in the Core Engineering requirements and only 18 H&S credits. An economics course will no longer be required.

Former Option: 21 H&S Credits – three credits in Economics still required

Those who use the former Mechanical Engineering requirements will not have to take the extra Core Engineering course, but will still have to earn 21 H&S credits. One course must be an economics course: 180.101 Macroeconomics, 180.102 Microeconomics, or 570.334 Engineering Microeconomics.

Engineering Mechanics majors: 18 H&S Credits – Economics no longer required

Effective Fall 2010, Engineering Mechanics majors will no longer be required to take an economics course as one of the H&S credit courses.

5.1 Foreign Language Credit

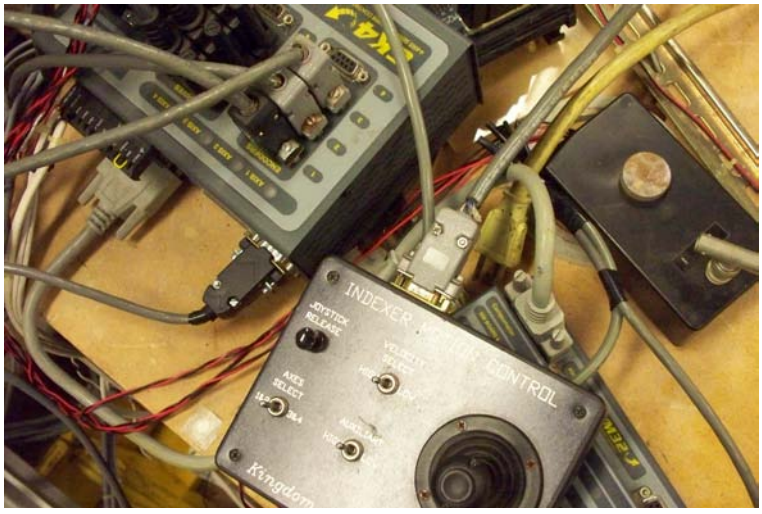
Students taking elements of a foreign language (xxx.101) are granted an H area designator for both semesters only if the second semester course (xxx.102) is successfully completed.

For example, a student successfully completing 090.101 and 090.102 *Elementary German* would receive eight H credits. *Note that while four H credits would be given for 090.102 if taken alone, no H credits are given for 090.101 "elements" if taken alone.*

5.2 Writing Requirement

Whiting School of Engineering students must take two courses (6 credits) that carry the writing intensive (W) designation. Since competence in written communication is essential for an engineering graduate, Mechanical Engineering and Engineering Mechanics majors must take at least two courses that specifically develop writing skills.

530.403/.404 Engineering Design Project I/II is counted as one of the two courses. Students must take an additional course to complete the writing requirement. Although this course must also be designated as a writing intensive course (designation code "W"), this designation alone is not sufficient to guarantee the desirable level of intensity in writing instruction in the Mechanical Engineering department.



Two choices that satisfy this requirement are: 060.113 or 060.114 Expository Writing – (either one; both cannot be counted for H/S credit) and

220.105 Introduction to Fiction and Poetry Writing (220.106 may also be counted for H/S credit). Students wishing to use any other course to satisfy this writing requirement must have written permission from their advisor by using the Course Exception Wavier Form.

Students who take 661.110 Professional Communication for Science, Business, and Industry will not be able to use it to satisfy this requirement, as it does not carry the appropriate designation.

5.2.1 A Note about Intro to Fiction and Poetry Writing

Note that the instructors of 220.105 Intro to Fiction and Poetry Writing emphasize the importance that students attend the very first class sessions as the course's assignments are highly front-loaded. In other words, most of the courses' assignments are assigned and due early in the semester, with continued discussion and lecture throughout the semester. It is recommended that students not add this course during the "add/drop" period, especially after the second class session.

5.3 Distribution and Depth Requirements

Although not directly related to the major field of study, the Humanities and Social Science portion of the program is also of great importance in broadening the student's education and in stimulating the development of an inquisitive and critical mind. In order to best attain these objectives, the free electives in Humanities and Social Science courses must be chosen to obtain sufficient depth. Departmental regulations require that at least six H/S credits (two courses) be taken at the 300 level or higher.

With the approval of the student's advisor, intermediate level language courses may be taken to satisfy this depth requirement. Note that the Whiting School and the Department allow the first two semesters of any elementary course in a foreign language to count toward the fulfillment of the H/S requirement, as stated in Section 5.1, as long as both semesters are successfully completed.

Mechanical Engineering majors may count <u>one</u> course that is taught in the Whiting School with an H and/or S designation towards this requirement. The accounting courses, 660.203 and 660.204, may not count towards this requirement. The philosophy behind these limitations is that H&S courses should be taught or supervised by full-time faculty in the Krieger School.

Bachelor of Science Degree in the Mechanical Engineering major

6 MECHANICAL ENGINEERING CURRICULUM

6.1 Our Mission

The mission of the B.S. in Mechanical Engineering degree program is to provide a rigorous educational experience that prepares a select group of students for leadership positions in the profession and a lifetime of learning. The faculty is committed to maintaining a modern and flexible curriculum which, building on a foundation of basic sciences and mathematics, develops a solid education in the mechanical engineering sciences. The aim of the Mechanical Engineering program is to build competence in the analysis, design and development of thermal, fluid, and mechanical systems; to promote a broad knowledge of the contemporary social and economic context, and to develop the communication skills necessary to excel.

6.2 Introduction

The program provides fundamental courses in thermal and mechanical systems. Both laboratory instruction and the senior design project allow all students hands-on experience. Each student's program of study is planned in consultation with his or her faculty advisor. Students are encouraged to develop depth in one or two areas chosen from:

- Aerospace Engineering concentration
- Biomechanical Engineering concentration
- Robotics
- Mechanics and Design
- Thermofluids and Thermofluid Systems

The choice of depth and concentration is typically decided in the junior year after consultation with the faculty advisor. If you are ready to choose a concentration prior to your junior year, please discuss your intentions with your advisor.

6.3 Educational Objectives

Our primary objective is to educate an exceptional group of engineers who, after graduation, will be (1) successful and on track to become leaders among their peers in industry, government laboratories and other organizations, and (2) advanced students in the best graduate programs.

6.4 NEW – 530.414 Computer Aided Design – now a Required Engineering course

Effective Fall 2010, the course 530.414 Computer Aided Design will be a Required Engineering requirement. This results in 51 credits for Required Engineering courses. To make room for the requirement change, only 18 H&S course credits will required, instead of the previous 21. An economics course will no longer be required.

Current students can use new or former requirements

All students through the Class of 2014 will have the option to continue with either the former requirements…

- 21 H&S credits, including either 180.101 Macroeconomics, 180.102 Microeconomics, or 570.334 Engineering Microeconomics
- Take 530.414 Computer Aided Design as an elective, if desired.

…or follow the new requirements:

- 18 H&S credits, with an economics course as an option among H&S courses
- Take 530.414 Computer Aided Design as a required core engineering course.

The new requirements are mandatory for the Class of 2015 and later.

6.5 Mechanical Engineering Curriculum

The Mechanical Engineering curriculum is structured as follows:

Mathematics (19 credits; grades of D+, D, or D- not accepted)

- 110.108 Calculus I
- 110.109 Calculus II
- 110.202 Calculus III (or 110.211 Honors Multivariable Calculus)
- 550.291 Linear Algebra/Differential Equations (or 110.201 Linear Algebra and 110.302 Differential Equations)
- Statistics Elective at the 300 level or above (e.g. 560.348 Probability and Statistics in Civil Engineering or 550.310 Probability and Statistics)

Science (12 credits; grades of D+, D, or D- not accepted)

- 530.103/104 Introduction to Mechanics I/II
- 171.102 Physics II
- 173.112 Physics Lab II (required for all students, even with AP credit)
- 510.101 Introduction to Materials Chemistry or 030.101 Chemistry I

Humanities and Social Sciences (18 or 21 credits)

- See Humanities and Social Sciences, Section 5

Required Engineering Courses (48 or 51 credits; grades of D+, D, or D- not accepted)

- 530.101/102 Freshman Experiences in Mechanical Engineering I/II
- 530.105/106 Mechanical Engineering Freshman Laboratory I/II
- 530.201 Statics and Mechanics of Materials
- 560.202 Dynamics
- 530.215 Mechanics Based Design
- 530.231 (and 530.232 lab, beginning Fall 2011) Mechanical Engineering Thermodynamics
- 530.241 Electronics and Instrumentation […or 520.213 Circuits followed by 520.345 Electrical and Computer Engineering Laboratory (which can be used as a Technical Elective)]
- 530.327 (and 530.329 lab, beginning Fall 2011) Introduction to Fluid Mechanics
- 530.334 (and 530.335 lab, beginning Spring 2012) Heat Transfer
- 530.343 Design and Analysis of Dynamic Systems [plus 530.344 Dynamic Systems Laboratory only for students taking a course substituting 530.343]
- 530.352 Materials Selection
- 530.414 Computer Aided Design *(for those following new requirements)*
- 530.454 Manufacturing Engineering
- 660.461 Engineering Business and Management [or 660.105 Introduction to Business **and** 660.341 Business Process and Quality Management.]

Capstone Design (8 credits)

- 530.403 and 530.404 Engineering Design Project I and II

Mechanical Engineering Electives (9 credits)

- Three courses (300-level or higher) in mechanical engineering (530.xxx)

Technical Electives (9 credits)

- Three (E), (Q), or (N) courses at or above the 300-level, chosen from any combination of courses in engineering, basic sciences, or mathematics chosen in consultation with the student's advisor. These courses are intended to complement the Mechanical Engineering Electives.
    - One of the technical electives may be any computer language course of any level, recognizing the importance of such technology in today's society.
    - 030.205 Organic Chemistry will count as a Technical Elective for those taking the Biomechanics Concentration. See Section 6.4.3.

A program of no fewer than **126 credits** must be completed to be eligible for the bachelor's degree. All undergraduate students must follow a program approved by a faculty member in the department who is selected as the student's advisor.

Course Frequency

Listed in Section 4 of this manual are courses offered and the frequency of those offerings in the Mechanical Engineering department. It is important to plan all four years of your coursework as early as possible, keeping in mind the frequency of courses offered so you can enroll in all courses required for your degree.

6.5.1 Choosing Mechanical Engineering Electives

Students are encouraged to develop depth in one or two areas within mechanical engineering. Some examples of courses that could form the basis of concentrations are provided below. Note that many of the elective courses below are taught in alternate years. Check with your advisor or the Academic Program Administrator for the schedule. (Electives are in *italics*):

Mechanics and Design

- 530.215 Mechanics-Based Design
- 530.352 Materials Selection
- *530.405 Mechanics of Solids and Structures*
- 530.414 Computer-Aided Design *(elective for those following old requirements)*
- *530.416 Advanced Mechanical Design*
- *530.418 Aerospace Structures and Materials*
- *530.730 Finite Element Methods*

Thermo-fluids and Thermo-fluid Systems

- 530.327/329 Introduction to Fluid Mechanics
- *530.328 Fluid Mechanics II*
- 530.334/335 Heat Transfer
- *530.425 Mechanics of Flight*
- *530.426 Biofluid Mechanics*
- *530.432 Jet and Rocket Propulsion*
- *530.435 Refrigeration and Heating, Ventilation and Air Conditioning*
- *530.457 Introduction to Acoustics*
- *530.467 Thermal Design Issues for Aerospace Systems*

Robotics

- 530/560.202 Dynamics
- 530.343 Design and Analysis of Dynamic Systems
- 530.414 Computer-Aided Design *(elective for those following old requirements)*
- *530.420 Robot Actuators and Sensors*
- *530.421 Mechatronics*
- *530.424 Dynamics of Robots and Spacecraft*

6.5.2 Aerospace Engineering Concentration

A student may specialize in Aerospace Engineering once a solid background in the fundamentals of Mechanical Engineering has been developed through the basic ME

courses. This Concentration requires knowledge and background in several fields including advanced dynamics, flight mechanics, propulsion, aerospace materials and structures, signal processing, control systems, astrophysics and space systems. Students pursuing the Aerospace Engineering Concentration are required to take **at least five** of the following courses (which can be counted toward the Mechanical Engineering elective and Technical Elective requirements in the general Mechanical Engineering program):

- 530.328 Fluid Mechanics II
- 530.418 Aerospace Structures and Materials
- 530.424 Dynamics of Robots and Spacecraft
- 530.425 Mechanics of Flight
- 530.432 Jet and Rocket Propulsion
- 530.467 Thermal Design Issues for Aerospace Systems
- 530.470 Space Vehicle Dynamics and Control
- 171.321 Introduction to Space Science and Technology
- 270.318 Remote Sensing of the Environment
- 535.442 Control Systems for ME Applications
- 615.444 Space Systems I
- 615.445 Space Systems II

Any five of the courses listed above are required. A sixth course amongst this list, though not required is highly recommended.

Other courses relevant to (but do not count toward) the Aerospace Concentration include:

- 171.118 Stars and the Universe
- 520.214 Signals and Systems
- 520.401 Basic Communications
- 525.445 Modern Navigation Systems

For information on these courses and the frequency of course offerings, please consult the Registrar's course listings at http://www.jhu.edu/~registr/schedule.html or the courses' department websites:

- 171.xxx Physics and Astronomy, http://pha.jhu.edu/acad/ugrad/ugradcourses.html
- 520.xxx Electrical and Computer Engineering, http://www.ece-jhu.org/index.php/undergraduate
- Engineering and Applied Science Program for Professionals (525.xxx, 535.xxx, 615.xxx): http://ep.jhu.edu/schedule.

6.5.2.1 Internships in Aerospace Engineering

Students in the Aerospace Engineering Concentration are encouraged to participate in internships in organizations involved with aerospace engineering. Opportunities within the university include the Applied Physics Laboratory (Satellites), the Center for Astrophysical Sciences (CAS) and the Space Telescope Science Institute (Hubble Space Telescope). In

addition, local companies and institutions, such as Northrop Grumman (which is formally affiliated with the Mechanical Engineering department as an Industrial Partner), NASA Goddard, Lockheed Martin, Orbital Sciences and other private corporations offer excellent opportunities for internships.

See Section 9 for further information on internships, scholarships, jobs, and careers.

6.5.3 Mechanical Engineering Biomechanics Concentration

A student may specialize in Biomechanics once a solid background in the fundamentals of Mechanical Engineering has been developed through the basic ME courses. Students pursuing the Biomechanics Concentration within Mechanical Engineering are required to take **at least four** of the following courses. Two among the four should be chosen from the biomechanics-oriented courses, indicated by an asterisk (*).

- 530.410 Biomechanics of the Cell*
- 530.426 Biofluid Mechanics*
- 540.426 Biomacromolecules at the Nanoscale (Chemical and Biomolecular Engineering)
- 530.440 Computational Biomechanics of Biological Macromolecules*
- 530.445 Introduction to Biomechanics*
- 530.448 Biosolid Mechanics*
- 580.455 Introduction to Orthopaedic Biomechanics (Biomedical Engineering)*
- 540.459 Bioengineering in Regenerative Medicine
- 530.672 Biosensing and BioMEMS*
- 580.221 Molecules and Cells (Prerequisite: 030.101 and 030.104 Introductory Chemistry and Lab) (Biomedical Engineering)
- 580.421 through .423 Systems Bioengineering I with lab: Cells and Membranes, Cardiovascular Systems (Prerequisite: 580.221 Molecules and Cells)
- 510.431 Biocompatibility of Materials
- 580.440 Cellular and Tissue Engineering
- 530/580.452 Cellular and Tissue Engineering Laboratory
- 580.456 Introduction to Rehabilitation Engineering
- 530.495 Microfabrication Lab

NOTE: Some biomechanics courses may require 030.205 Organic Chemistry as a prerequisite. Please check the courses for prerequisite requirements. "Orgo" will count as a Technical Elective when taken to allow enrollment in the appropriate Biomechanics Concentration courses. Note that 030.205 has several prerequisites: 030.101/.102 Intro to Chemistry and 030.105/.106 Chemistry labs. Please plan course work accordingly.

6.6 Sample Mechanical Engineering Programs

Sample *Mechanical Engineering* Program for students beginning with Calculus I

Total Credits for a B.S. Degree in Mechanical Engineering - 126

* - Students are encouraged to take 110.302 Differential Equations (4) and 110.201 Linear Algebra (4) instead of the combined 550.291 L.A./D.E. course (4) if they can work the additional four credits into their schedule. An advantage of taking the courses separately is that 110.302 Differential Equations can be counted as a Technical Elective.

** - Students must take either
A) 660.461 Engineering Business and Management or
B) 660.105 Introduction to Business and Management and 660.341 Business Process and Quality Management.

▲ - 530.343 Design and Analysis of Dynamic Systems requires concurrent enrollment in or prior completion of 560.202 Dynamics with a minimum C- grade.

⚐ - If taking traditional 48-credit Required Engineering track: 21 credits in Humanities and Social Sciences with one writing course, one course in economics. If taking the new 51-credit Required Engineering track that includes 530.414 CAD: 18 H&S credits are necessary with one writing course (and economics is optional). For both tracks: two H/S courses, 300-level or above are required.

FRESHMAN YEAR			
110.108 Calculus I	4	110.109 Calculus II	4
530.101 Freshman Exp in ME I	2	530.102 Freshman Exp in ME II	2
530.103 Intro to Mechanics I	2	530.104 Intro to Mechanics II	2
530.105 MechE Freshman Lab I	1	530.106 MechE Freshman Lab II	1
510.101 Intro to Materials Chemistry	3	H/S (2) Elective (Economics ⚐)	3
H/S (1) Elective	3	H/S (3) Elective	3
Total credits	**15**	**Total credits**	**15**
SOPHOMORE YEAR			
110.202 Calculus III	4	550.291 L.A./D.E. *	4
530.201 Statics and Mechanics	3+1	560.202 Dynamics	3+1
530.231 Thermodynamics	3+1	530.215 Mechanics Based Design	3+1
171.102 General Physics II	4	530.241 Electronics and Instrumentation	3+1
173.112 General Physics II Lab	1		
Total credits	**17**	**Total credits**	**16**
JUNIOR YEAR			
530.327 Intro. Fluid Mechanics	3+1	530.334 Heat Transfer	3+1
530.352 Materials Selection	3+1	530.343 D. & A. Dynamic Systems ▲	3+1
H/S (4) Writing Elective	3	M. E. Elective (1)	3
Statistics elective	3	Technical Elective (1)	3
H/S (5) Elective or 530.414 CAD ⚐	3	xxx.3xx or .4xx H/S (5 or 6) Elective	3
Total credits	**17**	**Total credits**	**17**
SENIOR YEAR			
530.403 Eng. Design Project I	4	530.404 Eng. Design Project II	4
530.454 Manufacturing Engineering	3	M. E. Elective (2)	3
Eng. Business and Mgmt. options**	3	M. E. Elective (3)	3
Technical Elective (2)	3	Technical Elective (3)	3
xxx.3xx or .4xx H/S (6 or 7) Elective	3		
Total credits	**16**	**Total credits**	**13**

Sample *Mechanical Engineering* Program for students beginning with Calculus II

Total Credits for a B.S. Degree in Mechanical Engineering – 126

* - Students are encouraged to take 110.302 Differential Equations (4) and 110.201 Linear Algebra (4) instead of the combined 550.291 L.A./D.E. course (4) if they can work the additional four credits into their schedule. An advantage of taking the courses separately is that 110.302 Differential Equations can be counted as a Technical Elective, as long as it is not being counted as one of the courses helping to meet the required 19 math credits.

** - Students must take either
A) 660.461 Engineering Business and Management or
B) 660.105 Introduction to Business and Management and 660.341 Business Process and Quality Management.

▲ - 530.343 Design and Analysis of Dynamic Systems requires concurrent enrollment in or prior completion of 560.202 Dynamics with a minimum C- grade.

⚐ - If taking the new track with Core Engineering requirement that includes 530.414 CAD: 18 H&S credits are necessary (with economics as an option). If taking old track: 21 credits in Humanities and Social Sciences with one writing course, one course in economics. NOTE for both tracks: two courses at the 300 level or above are required.

FRESHMAN YEAR			
110.109 Calculus II	4	110.202 Calculus III	4
530.101 Freshman Exp in ME I	2	530.102 Freshman Exp in ME II	2
530.103 Intro to Mechanics I	2	530.104 Intro to Mechanics II	2
530.105 MechE Freshman Lab I	1	530.106 MechE Freshman Lab II	1
510.101 Intro to Materials Chemistry	3	H/S (2) Elective (Economics ⚐)	3
H/S (1) Elective	3	H/S (3) Elective	3
Total credits	**15**	**Total credits**	**15**
SOPHOMORE YEAR			
530.201 Statics and Mechanics	3+1	550.291 L.A./D.E. *	4
530.231/232 Thermodynamics	3+1	560.202 Dynamics	3+1
H/S (4) Writing Elective	3	530.215 Mechanics Based Design	3+1
171.102 General Physics II	4	530.241 Electronics and Instrumentation	3+1
173.112 General Physics II Lab	1		
Total credits	**16**	**Total credits**	**16**
JUNIOR YEAR			
530.327/329 Intro. Fluid Mechanics	3+1	530.334/335 Heat Transfer	3+1
530.352 Materials Selection	3+1	530.343 D. & A. Dynamic Systems ▲	3+1
xxx.3xx or .4xx H/S (5) Elective	3	M. E. Elective (1)	3
H/S (6) Elective or 530.414 CAD ⚐	3	Technical Elective (1)	3
Statistics elective	3	Mathematics elective	4
Total credits	**17**	**Total credits**	**18**
SENIOR YEAR			
530.403 Eng. Design Project I	4	530.404 Eng. Design Project II	4
530.454 Manufacturing Engineering	3	M. E. Elective (2)	3
Eng. Business and Mgmt. options**	3	M. E. Elective (3)	3
Technical Elective (2)	3	Technical Elective (3)	3
xxx.3xx or .4xx H/S (7) Elective	3		
Total credits	**16**	**Total credits**	**13**

6.7 Mechanical Engineering - Checkout Sheet – Old Requirements

Student:	**Advisor:**				
Basic Science: 12 Credits.	**Credits**	**Grade or AP**	**Credits Earned**	**Credit Type**	**Semester**
530.103 Introduction to Mechanics I	2			N	
530.104 Introduction to Mechanics II	2			N	
171.102 General Physics 2	4			N	
171.112 General Physics Lab 2	1			N	
510.101 Intro to Materials Chemistry	3			N	
	12				
Mathematics*: 19 Credits.	**Credits**	**Grade or AP**	**Credits Earned**	**Credit Type**	**Semester**
110.108 Calculus 1	4			Q	
110.109 Calculus 2	4			Q	
110.202 Calculus 3	4			Q	
550.291 Linear Algebra/Differential Equations	4			Q	
___.3__ Statistics elective	3			Q	
	19				
H & S Electives*: 21 Credits, two at 300-level or above. One Economics, one Writing Intensive.	**Credits**	**Grade or AP**	**Credits Earned**	**Credit Type**	**Semester**
181.10_ _____economics	3				
(Writing)	3				
	3				
	3				
	3				
___.3__	3				
___.3__	3				
	21				
Required Engineering: 48 Credits.	**Credits**	**Grade**	**Credits Earned**	**Credit Type**	**Semester**
530.101 Freshman Experiences in MechE I	2			E	
530.102 Freshman Experiences in MechE II	2			E	
530.105 MechE Freshman Lab I	1			E	
530.106 MechE Freshman Lab II	1			E	
530.201 Statics and Mechanics of Materials	4			E	
560.202 Dynamics	4			E	
530.215 Mechanics Based Design	4			E	
530.231/232 Thermodynamics	4			E	
530.241 Electronics and Instrumentation	3			E	
530.327/329 Introduction to Fluid Mechanics	4			E	
530.352 Materials Selection	4			E	
530.334/335 Heat Transfer	4			E	
530.343 Design and Analysis of Dynamic Sys.	4			E	
530.454 Manufacturing Engineering	3			E	
660.461 Engineering Business and Management	3			E	
	48			***See next page***	

Mechanical Engineering - Checkout Sheet – Old Requirements (p. 2)

Mechanical Engineering Electives*. 9 Credits, all at 300-level or above.	Credits	Grade	Credits Earned	Credit Type	Semester
	3				
	3				
	3				
	9				

Technical Electives*: 9 Credits, any E, Q, or N courses, 300 level or above (One programming course can be <300 level).	Credits	Grade	Credits Earned	Credit Type	Semester
	3				
	3				
	3				
	9				

Others*: Courses for a Minor Requirement, Etc.	Credits	Grade	Credits Earned	Credit Type	Semester

Capstone Design Project: 8 Credits.	Credits	Grade	Credits Earned	Credit Type	Semester
530.403 Engineering Design Project 1	4			E	
530.404 Engineering Design Project 2	4			E	
	8				

Total: Should be 126 or above.	126		

I certify that this information is correct and verified from University records.

Academic Program Administrator _____ Date _____

I certify that the student has met the requirements for the Bachelor of Science degree in Mechanical Engineering.

Academic Advisor _____ Date _____

Chair, Department of Mechanical Engineering _____ Date _____

6.8 Mechanical Engineering - Checkout Sheet – New Requirements

Student:	**Advisor:**				
Basic Science: 12 Credits.	**Credits**	**Grade or AP**	**Credits Earned**	**Credit Type**	**Semester**
530.103 Introduction to Mechanics I	2			N	
530.104 Introduction to Mechanics II	2			N	
171.102 General Physics 2	4			N	
171.112 General Physics Lab 2	1			N	
510.101 Intro to Materials Chemistry	3			N	
	12				
Mathematics*: 19 Credits.	**Credits**	**Grade or AP**	**Credits Earned**	**Credit Type**	**Semester**
110.108 Calculus 1	4			Q	
110.109 Calculus 2	4			Q	
110.202 Calculus 3	4			Q	
550.291 Linear Algebra/Differential Equations	4			Q	
___.3__ Statistics elective	3			Q	
	19				
H & S Electives*: 18 Credits, two at 300-level or above. One Writing Intensive.	**Credits**	**Grade or AP**	**Credits Earned**	**Credit Type**	**Semester**
(Writing)	3				
	3				
	3				
	3				
___.3__	3				
___.3__	3				
	18				
Required Engineering: 51 Credits.	**Credits**	**Grade**	**Credits Earned**	**Credit Type**	**Semester**
530.101 Freshman Experiences in MechE I	2			E	
530.102 Freshman Experiences in MechE II	2			E	
530.105 MechE Freshman Lab I	1			E	
530.106 MechE Freshman Lab II	1			E	
530.201 Statics and Mechanics of Materials	4			E	
560.202 Dynamics	4			E	
530.215 Mechanics Based Design	4			E	
530.231/232 Thermodynamics	4			E	
530.241 Electronics and Instrumentation	3			E	
530.327/329 Introduction to Fluid Mechanics	4			E	
530.352 Materials Selection	4			E	
530.334/335 Heat Transfer	4			E	
530.343 Design and Analysis of Dynamic Sys.	4			E	
530.414 Computer Aided Design	3			E	
530.454 Manufacturing Engineering	3			E	
660.461 Engineering Business and Management	3			E	
	51			***See next page***	

Mechanical Engineering - Checkout Sheet – New Requirements (p. 2)

Mechanical Engineering Electives*. 9 Credits, all at 300-level or above.	Credits	Grade	Credits Earned	Credit Type	Semester
	3				
	3				
	3				
	9				

Technical Electives*: 9 Credits, any E, Q, or N courses, 300 level or above (One programming course can be <300 level).	Credits	Grade	Credits Earned	Credit Type	Semester
	3				
	3				
	3				
	9				

Others*: Courses for a Minor Requirement, Etc.	Credits	Grade	Credits Earned	Credit Type	Semester

Capstone Design Project: 8 Credits.	Credits	Grade	Credits Earned	Credit Type	Semester
530.403 Engineering Design Project 1	4			E	
530.404 Engineering Design Project 2	4			E	
	8				

Total: Should be 126 or above.	126		

I certify that this information is correct and verified from University records.

Academic Program Administrator _____ Date _____

I certify that the student has met the requirements for the Bachelor of Science degree in Mechanical Engineering.

Academic Advisor _____ Date _____

Chair, Department of Mechanical Engineering _____ Date _____

Bachelor of Science Degree in the Engineering Mechanics major

7 ENGINEERING MECHANICS CURRICULUM

7.1 Our Mission

The mission of the B.S. in Engineering Mechanics degree program is to provide a rigorous educational experience that prepares a select group of students for leadership positions in the profession and a lifetime of learning. The faculty is committed to maintaining a modern and flexible curriculum which, building on a foundation of basic sciences and mathematics, develops a solid education in the mechanical engineering sciences. The aim of the Engineering Mechanics program is to build competence in the analysis, design and modeling of fluid and mechanical systems, to promote a broad knowledge of the contemporary social and economic context, and to develop the communication skills necessary to excel.

7.2 Introduction

The Engineering Mechanics program concentrates on the scientific fundamentals of the behavior of solids and fluids. The program is designed to be highly flexible while providing the student with a broad scientific and technical background in the mechanical sciences.

The curriculum is intended to enable graduates to explore fundamental questions in many fields of engineering. Emphasis is placed on the basic sciences (mathematics, physics, and chemistry) and on the analysis, modeling, and design aspects of solid and fluid engineering systems. Although specific core courses are required, the student is encouraged and guided by his or her advisor to select an individual program of study, within ABET guidelines, according to the student's particular goals. This program of study may range from a general study of mechanics or engineering science to more specialized programs in a variety of areas, such as robotics, fluid dynamics, environmental engineering, mechanics of solids, experimental mechanics, dynamical systems, mechanics of materials, or biomechanics.

This flexibility makes the program ideal for double-majors and for those wishing to tailor a strong foundation for graduate work in a wide range of disciplines. All mathematics elective and technical elective courses must be at the .300 level or higher, unless approved by your faculty advisor.

7.3 Engineering Mechanics Educational Objectives

Our primary objective is to educate an exceptional group of science-oriented engineers who, after graduation, will be successful and on track to become leaders among their peers (1) in the best graduate programs in engineering, science, medical schools, or law schools, and (2) in industry, government laboratories and other organizations.

7.3.1 Engineering Mechanics Biomechanics Concentration

Engineering Mechanics (EM) is a highly flexible program, which is ideal for students who want to specialize in any area of mechanics, including biomechanics. The essence of mechanics is the interplay between forces and motion.

In biology, mechanics is important at the macroscopic, cellular, and subcellular levels. At the macroscopic length scale biomechanics of both soft and hard tissues plays an important role in computer-integrated surgical systems and technologies (e.g., medical robotics). At the cellular level, issues such as cell motility and chemotaxis can be modeled as mechanical phenomena. At the subcellular level, conformational transitions in biological macromolecules can be modeled using molecular dynamics simulation (which is nothing more than computational Newtonian mechanics), statistical mechanics, or using coarse-grained techniques that rely on principles from the mechanics of materials. In addition, much of structural biology can be viewed from the perspective of kinematics (e.g., finding spatial relationships in data from the Protein Data Bank).

Each student who pursues the Biomechanics concentration within the EM major will, in consultation with his or her EM advisor, choose a set of six elective bio-oriented courses that best matches the student's interests. Many electives from other departments are acceptable. The electives for the EM major are structured as follows:

Engineering Science Electives (12 credits)

- One course in solid mechanics
- One course in fluid mechanics
- One course in mechanics of either solids or fluids
- One course in either materials or dynamics

Engineering Mechanics Electives (6 credits)

- Two additional courses in the same area of mechanics (i.e., fluids, solids, or dynamics)

Technical Electives (18 credits)

- Chosen from 300 level courses in engineering and the sciences in consultation with the student's faculty advisor.

Example bio-oriented courses which can be applied to the above three categories include (but are not limited to):

- 020.346 Immunobiology
- 020.363 Developmental Biology
- 020.380 Eukaryotic Molecular Biology
- 250.353 Computational Biology
- 530.426 Biofluid Mechanics
- 530.440 Computational Mechanics of Biological Macromolecules
- 530.445 Introductory Biomechanics
- 530.448 Biosolid Mechanics
- 580.456 Introduction to Rehabilitation Engineering
- 530.495 Microfabrication Laboratory
- 540.409 Modeling Dynamics and Control for Chemical and Biological Systems
- 530.671 Statistical Mechanics in Biological Systems

This is not a complete list of possible courses that can be taken, and not all of these courses must be taken. Rather, students who wish to pursue the Biomechanics concentration will take at least six courses such as those listed above. These six should be concentrated either at the cellular/subcellular length scale or in macroscopic biomechanics. Note that given the flexibility of the Engineering Mechanics program, it would be possible for students to satisfy both of these kinds of concentrations simultaneously if they apply all 12 of their elective courses towards this end.

7.4 Engineering Mechanics Course Requirements

The specific requirements for the engineering mechanics program are either "Mathematics with a focus on ***applications***" or "Mathematics with a focus on ***fundamentals***."

*Mathematics with a focus on **applications**: (23 credits; grades of D+, D, or D- not accepted)*

- 110.108 Calculus I
- 110.109 Calculus II
- 110.202 Calculus III (or 110.211 Honors Multivariable Calculus)
- 550.291 Linear Algebra/Differential Equations (or 110.212 Honors Multivariable Calculus, or 110.201 Linear Algebra and 110.302 Differential Equations, the latter which can count as a technical elective)
- Another Mathematics Elective
- Statistics Elective at the 300 level or above (e.g. 560.348 Probability and Statistics in Civil Engineering or 550.310 Probability and Statistics)

*Mathematics with a focus on **fundamentals**: (23 credits; grades of D+, D, or D- not accepted)*

- 110.108 Calculus I
- 110.109 Calculus II
- 110.211-212 Honors Multivariable Calculus and Linear Algebra
- 110.302 Differential Equations with Applications
- Statistics Elective at the 300 level or above (e.g. 560.348 Probability and Statistics in Civil Engineering or 550.310 Probability and Statistics)

Basic Science (16 credits; grades of D+, D, or D- not accepted)

- A Physics course suite that covers mechanics: *either* 171.101 Physics I and 173.111 Physics Lab I *or* 530.103/104 Introduction to Mechanics I/II
- 171.102 Physics II and 173.112 Physics Lab II
- 510.101 Introduction to Materials Chemistry (or 030.101 Chemistry I)
- Another basic science elective

Humanities: (18 credits)

- See Humanities, Section 5

Required Engineering Courses (minimum of 26 credits; grades of D+, D, or D- not accepted)

INTRODUCTORY COURSE: The Mechanical Engineering Department's Freshman Experiences course suite: 530.101/102 Freshman Experiences in Mechanical Engineering and 530. 105/106 Mechanical Engineering Freshman Laboratory I/II, is a strongly recommended choice for introductory engineering but other options are accepted.

If choosing other options, students must take:

- An introductory computing course
  - 500.200 Computing for Engineers and Scientists
  - 510.202 Computation and Programming for Materials Scientists and Engineers
  - 560.220 Civil Engineering Analysis
  - 580.200 Intro to Scientific Computing

- 600.107 Intro to Java (other courses are preferred, but this will be accepted with the advisor's approval such as when scheduling conflicts prevent a student from taking preferred programming courses.)

- An introductory freshman engineering course (♣ =strongly recommended, ♠=recommended)
  - 500.101 What is Engineering?♣
  - 510.101 Introduction to Materials Chemistry♠ (if not taken to complete the Basic Science requirement)
  - 520.137 Introduction to Electrical and Computer Engineering
  - 570.108 Introduction to Environmental Engineering
  - 580.202 Biomedical Engineering in the Real World (Biomedical Engineering double majors only)

OTHER REQUIRED ENGINEERING COURSES:

- 530.201 Statics and Mechanics of Materials
- 560.202 Dynamics
- 530.215 Mechanics Based Design or 530.405 Mechanics of Solids and Structures
- 530.231/.232 Mechanical Engineering Thermodynamics Lecture and Lab
- 530.327/.329 Introduction to Fluid Mechanics Lecture and Lab

Capstone Design (8 credits)

- 530.403 and 530.404 Senior Design Project I and II

Engineering Science Electives (12 credits; grades of D+, D, or D- not accepted)

- One course in each of these disciplines:
  - mechanics of solids
  - mechanics of fluids
- An additional course in mechanics of either solids or fluids
- One course in either materials or dynamics

Engineering Mechanics Electives (6 credits; grades of D+, D, or D- not accepted)

- Two additional elective courses in the same area of engineering mechanics (solid mechanics, fluid mechanics or dynamics)

Technical Electives (minimum of 18 credits; grades of D+, D, or D- not accepted)

A minimum of five (E), (Q), or (N) courses at or above the 300 level totaling at least 18 credits, chosen from any combination of courses in engineering, basic sciences, or mathematics chosen in consultation with the student's advisor are required. Appropriate choices from the social sciences and philosophy may also be used to fulfill this requirement (for example, 180.305 Game Theory, or 150.420 Logic), if approved by the student's advisor. Because of the importance

of computer languages in modern technical society, students may take one of any computer language course at any level.

Course Frequency

In Section 4 of this manual is the frequency of course offerings in the Mechanical Engineering department. It is important to plan all four years of your coursework as early as possible, keeping in mind the frequency of offerings so you can enroll in all courses required for your degree requirements.

7.5 Engineering Mechanics Elective Courses

Solid mechanics courses may be chosen from courses such as:

- 530.215 Mechanics Based Design*
- 530.405 Mechanics of Solids and Structures*
- 530.414 Computer-Aided Design
- 530.416 Advanced Mechanical Design
- 530.730 Finite Element Methods
- 560.320 Steel Structures
- 560.330 Foundation Design

Fluid mechanics courses may be chosen from courses such as:

- 530.328 Fluid Mechanics II
- 530.425 Mechanics of Flight
- 530.426 Biofluid Mechanics
- 570.301 Environmental Engineering I: Fundamentals

Dynamics courses may be chosen from courses such as:

- 530.343 Design and Analysis of Dynamic Systems
- 530.424 Dynamics of Robots and Spacecraft
- 530.420 Robot Sensors and Actuators
- 550.391 Dynamical Systems

Materials courses may be chosen from courses such as:

- 580.440 Cellular and Tissue Engineering
- 510.311 Structure of Materials
- 510.312 Thermodynamics of Materials
- 510.313 Mechanical Properties of Materials
- 510.314 Electronic Properties of Materials
- 510.315 Physical Chemistry of Materials

* If not used to satisfy the Required Engineering Courses.

- 510.426 Biomolecular Materials
- 510.431 Biocompatibility of Materials

A program of no fewer than 127 credits must be completed to be eligible for the bachelor's degree. All undergraduate students must follow a program approved by a faculty member in the department who is selected as the student's advisor.

7.6 Sample Engineering Mechanics Programs

Sample *Engineering Mechanics* Program for students beginning with Calculus I taking the Mechanical Engineering Freshman Experiences course suite.

Total Credits for a B.S. Degree in Engineering Mechanics – 127

* - Students are encouraged to take 110.302 Differential Equations (4) and 110.201 Linear Algebra (4) instead of the combined 550.291 L.A./D.E. course (4) if the additional four credits can fit into the schedule. An advantage of taking the courses separately is that 110.302 Differential Equations can count as a Technical Elective.

★ - Alternate introductory course sequence: 500.101 What is Engineering (3) or other acceptable freshman introductory course, 500.200 Computing for Engineers (3) or 560.220 Civil Engineering Analysis (3) or 510.202 Computation and Programming for Materials Scientists and Engineers, plus 171.101 Physics I (4), and 173.111 Physics I Lab (1)

The Engineering Mechanics program requires six full courses (18 credits) in Humanities and Social Sciences, and requires one writing course, and two courses at the 300 level or above. As of Fall 2010, economics is no longer required.

FRESHMAN YEAR			
110.108 Calculus I	4	110.109 Calculus II	4
530.101 Freshman Experiences★	2	530.102 Freshman Experiences★	2
530.103 Intro to Mechanics I ★	2	530.104 Intro to Mechanics I ★	2
530.105 Freshman Lab ★	1	530.106 Freshman Lab ★	1
H/S Elective (1)	3	H/S Elective (2)	3
510.101 Intro to Materials Chemistry	3	Basic Science Elective	4
Total credits	**15**	**Total credits**	**16**
SOPHOMORE YEAR			
110.202 or .211 Calculus options	4	550.291 LA/DE *	4
530.201 Statics and Mechanics	3+1	560.202 Dynamics	3+1
530.231/232 Mech. Eng. Thermodynamics	3+1	530.215 or .405 Mechanics course	4
171.102 General Physics II	4	Technical Elective (1)	4
173.112 General Physics II Lab.	1		
Total credits	**17**	**Total credits**	**16**
JUNIOR YEAR			
530.327/329 Intro. Fluid Mechanics	3+1	E. S. Elective (fluids)	3
E. S. Elective (solids)	3	E. S. Elective (solids or fluids)	3
Technical Elective (2)	3	Technical Elective (3)	3
Statistics Elective	3	Mathematics Elective	4
H/S Elective (3)	3	H/S Elective (4)	3
Total credits	**16**	**Total credits**	**16**
SENIOR YEAR			
530.403 Senior Design Project I	4	530.404 Senior Design Project II	4
E. M. Elective (solids, fluids, dynamics)	3	Technical Elective (4)	4
E. S. Elective (materials/dynamics)	3	Technical Elective (5)	4
E. M. Elective (solids, fluids, dynamics)	3	xxx.3xx or .4xx H/S Elective (6)	3
xxx.3xx or .4xx H/S Elective (5)	3		
Total credits	**16**	**Total credits**	**15**

Sample *Engineering Mechanics* Program for students beginning with Calculus II taking the Mechanical Engineering Freshman course suite.

Total Credits for a B.S. Degree in Engineering Mechanics – 127

* - Students are encouraged to take 110.302 Differential Equations (4) and 110.201 Linear Algebra (4) instead of the combined 550.291 L.A./D.E. course (4) if the additional four credits can fit into the schedule. An advantage of taking the courses separately is that 110.302 Differential Equations can count as a Technical Elective, as long as it is not being counted as one of the courses helping to meet the required 23 math credits.

★ - Alternate introductory course sequence: 500.101 What is Engineering (3) or other acceptable freshman introductory course, 500.200 Computing for Engineers (3) or 560.220 Civil Engineering Analysis (3) or 510.202 Computation and Programming for Materials Scientists and Engineers, plus 171.101 Physics I (4), and 173.111 Physics I Lab (1)

The Engineering Mechanics program requires six full courses (18 credits) in Humanities and Social Sciences, and requires one writing course, and two courses at the 300 level or above. As of Fall 2010, economics is no longer required.

FRESHMAN YEAR			
110.109 Calculus II	4	110.202 or .211 Calculus options	4
530.101 Freshman Experiences★	2	530.102 Freshman Experiences★	2
530.103 Intro to Mechanics I ★	2	530.104 Intro to Mechanics I ★	2
530.105 Freshman Lab ★	1	530.106 Freshman Lab ★	1
H/S Elective (1)	3	H/S Elective (2)	3
510.101 Intro to Materials Chemistry	3	Basic Science Elective	4
Total credits	**15**	**Total credits**	**16**
SOPHOMORE YEAR			
550.291 LA/DE *	4	Statistics Elective	3
530.201 Statics & Mechanics	3+1	560.202 Dynamics	3+1
530.231/232 MechE Thermodynamics	3+1	530.215 or .405 Mechanics course	4
171.102 General Physics II	4	Technical Elective (1)	4
173.112 General Physics II Lab.	1	Technical Elective (2)	3
Total credits	**17**	**Total credits**	**18**
JUNIOR YEAR			
530.327/329 Intro. Fluid Mechanics	3+1	E. S. Elective (fluids)	3
E. S. Elective (solids)	3	E. S. Elective (solids/fluids)	3
Mathematics Elective (1)	4	Technical Elective (3)	3
Mathematics Elective (2)	4	H/S Elective (4)	3
H/S Elective (3)	3	E. M. Elective (solids, fluids, dynamics)	3
Total credits	**18**	**Total credits**	**15**
SENIOR YEAR			
530.403 Eng. Design Project I	4	530.404 Eng. Design Project II	4
Technical Elective (4)	4	E. M. Elective (solids, fluids, dynamics)	3
E. S. Elective (materials/dynamics)	3	Technical Elective (5)	4
xxx.3xx or .4xx H/S Elective (5)	3	xxx.3xx or .4xx H/S Elective (6)	3
Total credits	**14**	**Total credits**	**14**

7.7 Engineering Mechanics - Degree Requirements Checkout Sheet

Student: **Advisor:**

Basic Science: 16 Credits.	**Credits**	**Semester**	**Grade or AP**	**Credits Earned**	**Credit Type**	**Towards Minor?**
530.103 Intro to Mech I or 171.101 Physics I	2 / 4					
530.104 Intro to Mech II or 173.111 Phy Lab	2 / 1					
171.102 General Physics 2	4					
171.112 General Physics Lab 2	1					
510.101 Intro to Materials Chemistry	3					
___.___ Basic Science elective	3					
	16					

Mathematics: 23 Credits.	**Credits**	**Semester**	**Grade or AP**	**Credits Earned**	**Credit Type**	**Towards Minor?**
110.108 Calculus 1	4					
110.109 Calculus 2	4					
110.202 or 110.211 Calculus options	4					
550.291 or 110.212 or 110.201+.302 LA/DE	4					
___.___ Mathematics elective	4					
___.3__ Statistics elective	3					
	23					

H & S Electives*: 18 Credits, two at 300-level or above. One Writing Intensive.	**Credits**	**Semester**	**Grade or AP**	**Credits Earned**	**Credit Type**	**Towards Minor?**
(Writing)	3					
	3					
	3					
	3					
___.3__	3					
___.3__	3					
	18					

Required Engineering: 26 Credits.	**Credits**	**Semester**	**Grade**	**Credits Earned**	**Credit Type**	**Towards Minor?**
___.___ Intro to Engineering option	3 or 4					
___.___ Intro to Computing option	3					
530.201 Statics and Mechanics of Materials	4					
560.202 Dynamics	4					
530.231/232 Thermodynamics	4					
530.215 Mechanics Based Design or 530.405 Mechanics of Solids and Structures	3 or 4					
530.327/329 Introduction to Fluid Mechanics	4					
	26					

Engineering Science and Mechanics Electives: 18 Credits, all 300 level or above.	**Credits**	**Semester**	**Grade**	**Credits Earned**	**Credit Type**	**Towards Minor?**
___.___ ES Solids	3				E	
___.___ ES Fluids	3				E	
___.___ ES Dynamics/Materials	3				E	
___.___ ES Solids/Fluids	3				E	
___.___ EM Elective 1	3				E	
___.___ EM Elective 2	3				E	
	18				***(please turn over)***	

Engineering Mechanics - Degree Requirements Checkout Sheet, p. 2

Technical Electives: 18 Credits any E, Q, or N courses, 300 level or above (One programming course can be <300 level).	Credits	Semester	Grade	Credits Earned	Credit Type	Towards Minor?
___.___						
___.___						
___.___						
___.___						
___.___						
___.___						
	18					

Others: Courses for a Minor Requirement, Etc.	Credits	Semester	Grade	Credits Earned	Credit Type	Towards Minor?
___.___						
___.___						
___.___						
___.___						
___.___						

Capstone Design Project: 8 Credits.	Credits	Semester	Grade	Credits Earned	Credit Type	Towards Minor?
530.403 Engineering Design Project 1	4				E	
530.404 Engineering Design Project 2	4				E	
	8					
Total: Should be 127 or above.	127					

** Note: In some cases there will not be five technical electives courses. A student might take all 3-credit courses in which case one would need six courses to earn 18 credits. Or if a student takes certain 400-level math classes or engineering graduate courses, these could be 4.5 credits for each class, in which case only four courses would give the 18 credits.

I certify that this information is correct and verified from University records.

Academic Program Administrator _____ Date _____

I certify that the student has met the requirements for the Bachelor of Science degree in Mechanical Engineering.

Academic Advisor _____ Date _____

Chair, Department of Mechanical Engineering _____ Date _____

8 Study Abroad

The University offers opportunities to study abroad through the Office of Study Abroad in Levering Hall through one-semester exchange and other study programs. Pre-approved programs are available for Mechanical Engineering students at various universities that fit our curriculum, typically in the first semester of the junior year. Other programs can be crafted for other universities and semesters, as long as students begin planning early.

When considering a study abroad program, requirements like knowledge of the local language must be taken into account. Further information is available from the Study Abroad website at http://web.jhu.edu/study_abroad/index.html.

8.1 Comillas Pontifical University - Madrid

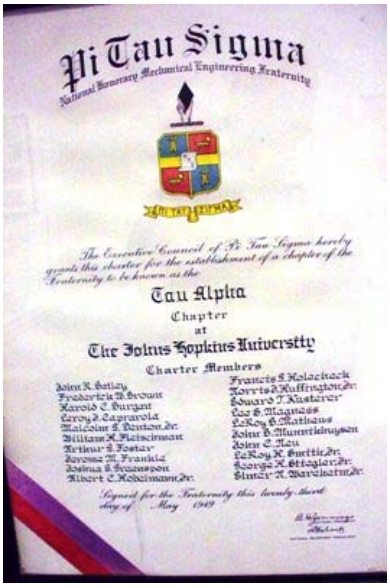
The Comillas Pontifical University in Madrid, Spain offers an international engineering program in their ICAI School of Engineering. The program offers two full-load semesters of engineering courses, along with additional courses in Spanish language, and European and Spanish culture. Courses may be taken in English and Spanish.

Johns Hopkins University has an academic collaboration agreement with Comillas and strongly encourages students to consider participation in this program. View their site at http://www.upcomillas.es for additional information.

9 Honors

There are two methods to recognize our most outstanding students:

- Membership in Pi Tau Sigma
- Honors upon graduation


Pi Tau Sigma
National Honorary Mechanical Engineering Fraternity
Tau Alpha
Chapter
at
The Johns Hopkins University
Charter Members

9.1 Pi Tau Sigma

Juniors and seniors who demonstrate high academic and service achievement can be inducted into the Tau Alpha Chapter of Pi Tau Sigma, the national honorary mechanical engineering fraternity. Members, who are inducted twice yearly, are invited to participate in service-oriented events that benefit the entire Mechanical Engineering community. Information is available at http://www.me.jhu.edu/pts.html.

9.2 Departmental Honors and University Honors

Upon graduation, all students earning a cumulative grade point average of 3.50 or higher are granted Departmental Honors and University Honors. Honorees are recognized at Commencement as well as on their transcripts and permanent University records.

10 The Concurrent Five-Year Bachelor's / Master's Program

The Mechanical Engineering department offers a concurrent five-year Bachelor's / Master's (BS/MSE) program for Mechanical Engineering and Engineering Mechanics majors.

This is an excellent program for individuals who would like to earn Master's Degrees quickly. The degree will generally increase a student's chances for higher quality employment than would a Bachelor's Degree.

10.1 Eligibility and Application Process

This program is available *only* to Mechanical Engineering or Engineering Mechanics majors at the Johns Hopkins University.

Applications to the BS/MSE program must be submitted during the junior year.

There are two application deadlines during the course of the year:

- January 5 – applicants will be notified of decisions around January 20
- June 15 – applicants will be notified of decisions around July 5

To apply for admission, the student must submit a college transcript and a formal graduate application. In addition, the student will need to present a statement of purpose that describes their career plans and rationale for advanced study at JHU. Three letters of recommendation are required for the application; two of the letters should be from Mechanical Engineering faculty.

These items can be delivered to the Academic Program Administrator. Upon acceptance into the program, students will be asked to develop an outline of his or her proposed academic program with his or her advisor.

10.2 Whiting School 50% Tuition Fellowship

The Whiting School of Engineering will provide a 50% tuition fellowship to all Johns Hopkins alumni who have completed eight semesters and completed a bachelor's degree. Mechanical Engineering BS/MSE students will be eligible for this fellowship beginning their ninth semester.

10.3 ***Requirements***

The requirements for an M.S.E. in Mechanical Engineering are as follows:

Satisfactory completion of eight one-semester advanced courses approved by your advisor, as follows:

- No more than two courses may be chosen from the part-time EP program.
- No more than four courses may be at the intermediate/advanced undergraduate (xxx.300 – xxx.499) level. Computer Science (CS) uses the 400-level designation (600.4xx) for courses at the beginning graduate level, and therefore a maximum of two 400-level CS courses may be used to fulfill the graduate-level course requirements for ME PhD and MS students, and those two courses will not count against the four-course limit for intermediate/advanced-undergraduate courses. This may result in listing up to six courses at the 400 level, though the 400-level CS courses are actually graduate-level courses.
- At least two courses should be in applied mathematics, numerical analysis, or computational methods. (This requirement can be waived in writing by your advisor, if sufficient prior preparation in these areas can be demonstrated).
- These courses *cannot* include Independent Study, Graduate Research, MSE Graduate Student Research, or Special Studies.

Plus either:

- Two additional one-semester graduate courses (xxx.600–xxx.799) approved by your advisor, only one of which can be 530.600 MSE Graduate Student Research, *or*
- An M.S.E. Thesis acceptable to your advisor and one other reader. According to the Graduate Board's Procedures for Administration of Approved Policies for the Award of Advanced Degrees, "Thesis readers are selected and appointed by the chair or appropriate faculty of the sponsoring department or committee. Any duly appointed member of a department or committee holding the rank of assistant professor or higher (excluding lecturers) is eligible for selection as a referee without prior approval. The Graduate Board Office must approve readers from outside the University, or from any non-Ph.D. sponsoring department, laboratory or institute within the University."

Additional information is available at
http://www.grad.jhu.edu/academics/gradboard/policies/index.php.

10.4 *Bachelor's / Master's Double Counting of Courses*

Students either in a bachelor's/master's program or seeking a master's degree in the Whiting School, after having earned a Whiting School or Krieger School of Arts and Sciences bachelor's degree may double-count two courses (400-level or higher) to both programs with the permission of the master's faculty advisor.

Students may not double-count courses applied to a bachelor's degree earned at a different institution.

For coursework not applied to a bachelor's degree, any graduate-level coursework (as defined by the Whiting School graduate program) not applied to the undergraduate degree may be applied to the graduate degree, regardless of when that course was taken (i.e., before or after the undergraduate degree has been conferred) with the permission of the master's faculty advisor. Information is available at http://eng.jhu.edu/wse/page/graduate-double-counting/.

11 Master of Science in Engineering Management

The Whiting School of Engineering offers a Master of Science degree in Engineering Management (MSEM). This program bridges the gap between technology and business by equipping students with the technical expertise and leadership skills they need to advance their career in the fast-paced world of technology.

11.1 *Program Requirements*

Just ten courses are required to complete this advanced degree:

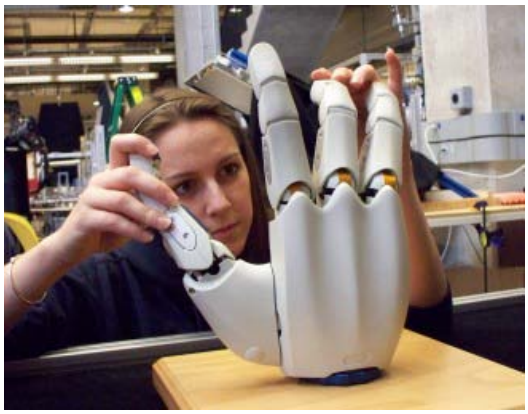
- Five advanced courses to fulfill the management concentration, including one capstone course that integrates and applies knowledge gained throughout the program.
- Five advanced courses in a declared technical area of engineering or applied science.

11.2 *Technical Specializations*

There are twelve available technical areas of specialization:

- Biomaterials
- Communications Science
- Computer Science

- Fluid Mechanics
- Materials Science and Engineering
- Mechanical Engineering
- Mechanics and Materials
- Nano-Biotechnology
- Nanomaterials and Nanotechnology
- Probability and Statistics
- Smart Product and Device Design
- Environmental Systems Analysis, Economics and Public Policy



Consult the MSEM website at http://engineering.jhu.edu/msem/index.html for additional course and application information.

11.3 Whiting School 50% Tuition Fellowship

The Whiting School of Engineering will provide a 50% tuition fellowship to all Johns Hopkins alumni who have completed eight semesters and completed a bachelor's degree. Most Mechanical Engineering and Engineering Mechanics alumni will be eligible for this fellowship.

12 Internships, Scholarships, Jobs, and Careers

The Johns Hopkins University and the Whiting School of Engineering offer significant resources to help you find internships during the summer months, assistance in the process of searching for jobs before and after graduation, and help in determining your career path and identifying opportunities. The department often receives information on opportunities and will forward them to you as they are received.

You are strongly encouraged to take advantage of these resources, as successful career and opportunity planning begins with you.

12.1 Internships, Research Positions, and Jobs

Information regarding research positions and how to find them, internships, study abroad, career planning, scholarships, grants, and fellowships are linked to the Whiting School of Engineering "Opportunities" site at http://eng.jhu.edu/wse/page/student-opportunities.

12.2 Scholarships

Information on scholarships is available from the Office of Academic Advising at the website http://www.jhu.edu/~advising/scholarships/index.html.

12.3 *Careers and Career Planning*

The Career Center, located on the third floor of Garland Hall offers practical advice on determining a career path, resume preparation, interviewing, appropriate dress, and on-campus recruiting by companies. Their website is http://www.jhu.edu/~careers.

You can set up a Career Center account to receive information on the latest career recruiting events and surf their site for the other services offered. The Career Center also welcomes you to make an appointment to visit or drop by at available drop-in hours to discuss your questions and get help with your career planning decisions.

13 Mechanical Engineering Undergraduate Student Council (MUSC)

MUSC is a student-run organization that focuses on improvements to the department as it applies to the undergraduate students. It is comprised of nine members: two students from each of the four class levels and an appointed faculty member to act as liaison. Professor Rajat Mittal, whose office is in Latrobe 126, is the faculty liaison. He can be reached at 410-516-4069 or mittal@jhu.edu. The MUSC website is located at http://www.me.jhu.edu/musc.html.

13.1 *MUSC Services and Activities*

Projects include planning recreational activities for the department, suggesting improvements and additions to the curriculum, requesting updates in department resources, and so on. Every year, the student representatives generally choose one major issue that they believe requires immediate attention. For example, recent years' issues led to the creation of a new intersession CAD course, requiring a CAD course for the degree, and annual updates to this manual.

Any student who believes that any aspect of the department needs to be updated, changed, or improved is strongly encouraged to speak to the class representatives. Freshman appointments for class representatives are made in the Fall by the department's faculty advisors. To be considered for one of these appointments please speak to your advisor.

14 Student Groups

There are many opportunities to participate in student professional engineering clubs, team projects, and competitions. Among these organizations are events, along with their websites are:

- ASME, the American Society of Mechanical Engineers: and http://www.asme.org
- AIAA, the American Institute of Aeronautics and Astronautics: http://www.aiaa.org
- Baja SAE: http://www.jhu.edu/baja
- Design, Build, Fly: https://sites.google.com/site/jhudbf/
- National Society of Black Engineers: http://web1.johnshopkins.edu/homes
- SWE, the Society of Women Engineers: http://www.jhu.edu/~swe
- Tau Beta Pi: http://www.jhu.edu/~tbp

Campus-wide student groups, clubs, athletics, and activities are posted at http://webapps.jhu.edu/jhuniverse/admissions/student_activities_organizations.

15 Office of Student Disability Services

The Office of Student Disability Services (SDS) assists full-time undergraduate and graduate students in the Krieger School of Arts and Sciences and the Whiting School of Engineering with disability concerns, in compliance with the provisions of the Americans with Disabilities Act of 1990 (ADA) and Section 504 of the Rehabilitation Act of 1973.

SDS assists the University community in understanding the effects of disabilities and in eliminating the physical, technical, attitudinal and programmatic barriers that limit the range of opportunities for students with disabilities, as well as provides individuals with reasonable accommodations. The SDS maintains and protects the confidentiality of individual records as required by law.

For additional information and to access the services of the SDS office, please see their website at http://web.jhu.edu/disabilities/index.html, or contact them at 410-516-4720 or studentdisabilityservices@jhu.edu. You may also visit their office in 385 Garland Hall.

16 Laboratory Safety

Lab Safety is the responsibility of all who use, maintain, or visit the labs within the ME department. Laboratory researchers are responsible for working with the principal investigator to become familiar with the appropriate hazard information and safety policies before performing any work.

The JHU Department of Health, Safety and Environment maintains a website to ensure updated information on policies, issues, and concerns are available to all. Visit http://www.hopkinsmedicine.org/hse to view directives concerning Safety Responsibilities and Policies, Environmental Monitoring, Fire Safety, Chemical Safety, Laboratory Safety, and Radiation Safety.

Please also visit the Whiting School's Lab Safety page at http://eng.jhu.edu/wse/page/wse-laboratory-safety for important information.

For each lab, a Principal Investigator (PI) is assigned. That person is responsible for the safe operation of the lab, training on all chemicals in the work area, the training of the persons on the equipment within the lab, and is a ready source to answer any questions on a specific lab with regards to its operation and all safety aspects. The PI's for each lab are listed on the entrance door to each lab. Laboratory Administrator Niel Leon can also be contacted at 410-516-6752 for help.

17 Latrobe Hall Machine Shop

The Latrobe Hall Machine Shop is located in Latrobe Hall, Room 3. An orientation regarding shop safety, shop rules, and equipment operations is available.

This orientation is required to be allowed to work in the Machine Shop, and no one is authorized to work in the shop without the machinist's permission. Please contact Machinist Rich Middlestadt at 410-516-7710 or rmiddle4@jhu.edu to arrange your orientation.

18 Mechanical Engineering Computer CAD Lab (Latrobe 113)

18.1 Services/Equipment

Located in Wyman G-06, the Senior Design Lab are several desktop computers, which are available for use seven days a week, 24 hours a day to any person with access to the space and login information. To gain access to the computers, each user must be assigned login information to the server. Contact Niel Leon at 410-516-6752 or nleon@jhu.edu for access.

18.2 *Technical Information*

The computers are primarily for use in conjunction with the Senior Design class, and as such, are oriented in software towards that goal. PRO-E, ANSYS, and FEMLAB are but a few of the programs available on the computers. Other software is available for installation on an as needed basis.

18.3 *Procedures for Reserving Time/Space*

The computers are available on a first come, first served basis, however, priority is given to those students involved with Senior Design. As long as a computer is available, anyone with access may use them. Once all computers are in use, then those not involved in Senior Design will be asked to make room for those who are. Conflicts will be resolved by the lab administrator.

18.4 *Safety Procedures*

There are no special safety procedures involved with computer use. All those using the computers are asked to keep the lab administrator informed of any problems that arise. Please keep all work areas neat.

19 Laser Engraving and Cutting System

19.1 *Services and Equipment*

Located in Krieger Hall room K-16, the Universal Laser Systems model X2-660 Laser engraving and cutting system is available for use by all persons assigned within the ME department who have been properly trained in its operation. A detailed operations manual is available online at http://www.me.jhu.edu/LaserCutter.pdf.

19.2 *Technical Information*

The CO2 class 1 laser with Red Diode Pointer (class 111a) is contained with a 32″x18″ work area. The Windows 2000/XP operating system on the computer driver makes the system user friendly. The system is air assisted and the air assist must be applied as described in the orientation class in order for the system to operate properly. A point of use filter with acrylic window is available to check the system for traces of water prior to laser operation. MSE cards are available for materials used with the system. A log is kept to indicate usage of the laser system. A small hourly rate is charged to the appropriate PI budget code for each use of the system.

19.3 *Procedures for Reserving Time and Space*

An orientation class of about three hours in duration is required before access is granted to the machine. Training is done on a scheduled basis on a need basis. Schedule training

through the lab administrator at 410-516-6752. Once training is complete, the equipment is available on a seven-day / 24-hour first come – first serve basis. Conflicts in scheduling will be resolved by the lab administrator. Each user is responsible for signing in on the log with an appropriate budget code, cleaning up the area after use, reporting any problems immediately to the lab administrator, and for safely operating the equipment. Failure in any of these areas will result in the loss of the privilege of using the equipment.

20 NOTICE OF NONDISCRIMINATORY POLICY

The Johns Hopkins University admits students of any race, color, sex, religion, national or ethnic origin, handicap or veteran status to all of the rights, privileges, programs, benefits and activities generally accorded or made available to students at the University. It does not discriminate on the basis of race, color, sex, religion, sexual orientation, national or ethnic origin, handicap or veteran status in any program or activity, including the administration of its educational policies, admission policies, scholarship and loan programs, and athletic and other University-administered programs. Accordingly, the University does not take into consideration personal factors that are irrelevant to the program involved.

Questions regarding access to programs following Title VI, Title IX, and Section 504 should be referred to the Affirmative Action Officer, 205 Garland Hall, 410-516-8075.

21 Directory of Faculty, Staff, and Other Contacts

*21.1 **Faculty***

Name	Telephone	E-mail	Office
Professor Greg Chirikjian	410-516-7127	gregc@jhu.edu	116 Hackerman
Associate Professor Noah Cowan	410-516-5301	ncowan@jhu.edu	126 Hackerman
Assistant Professor Jaafar El-Awady	410-516-6683	jelawady@jhu.edu	124 Latrobe
Assistant Professor Dennice Gayme	410-516-5784	dennice@jhu.edu	229 Latrobe
Professor Kevin Hemker, Chair	410-516-6451	hemker@jhu.edu	223-C Latrobe
Professor Cila Herman	410-516-4467	cherman@jhu.edu	102 Latrobe
Professor Joe Katz	410-516-5470	katz@jhu.edu	219 Latrobe
Professor Omar Knio	410-516-7736	knio@jhu.edu	103 Latrobe
Senior Lecturer Steve Marra	410-516-5396	marra@jhu.edu	123 Latrobe
Professor Charles Meneveau	410-516-7802	meneveau@jhu.edu	127 Latrobe
Professor Rajat Mittal, Vice Chair	410-516-4069	mittal@jhu.edu	126 Latrobe
Assistant Professor Vicky Nguyen	410-516-4538	vicky.nguyen@jhu.edu	125 Latrobe
Professor Andrea Prosperetti	410-516-8534	prosperetti@jhu.edu	119 Latrobe
Professor K. T. Ramesh	410-516-7735	ramesh@jhu.edu	122 Latrobe
Senior Lecturer Nathan Scott	410-516-5646	nscott@jhu.edu	G-06 Wyman
Associate Professor Sean Sun	410-516-4003	ssun@jhu.edu	105 Latrobe
Associate Professor Jeff Wang	410-516-7086	thwang@jhu.edu	108 Latrobe
Professor Louis Whitcomb	410-516-6724	llw@jhu.edu	115 Hackerman

21.2 Administrative Staff

Name	Telephone	E-mail	Office
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