

**MECHANICAL ENGINEERING
AND
MATERIALS SCIENCE
UNDERGRADUATE INFORMATION**

2005-2006

**WILLIAM MARSH RICE UNIVERSITY
HOUSTON, TEXAS**

Rice University seeks to attract to its faculty, staff, and student body qualified persons of diverse backgrounds. In accordance with this policy, Rice does not discriminate in admission, educational programs, or employment against any individual on the basis of sex, sexual orientation, race, color, religion, age, national or ethnic origin, or handicap.

(Revised 01/06)

INTRODUCTION

The following undergraduate degree programs are available in the Department of Mechanical Engineering and Materials Science:

1. Bachelor of Science in Mechanical Engineering (ABET accredited)
2. Bachelor of Science in Materials Science and Engineering
3. Bachelor of Arts with a major in Mechanical Engineering
4. Bachelor of Arts with a major in Materials Science

The formal requirements for these degrees are described in this document. The degree programs emphasize fundamental instruction in several engineering-science subjects to insure that the student will be prepared to work effectively in a variety of new and undeveloped fields as well as in the well-established areas of engineering. The curricula outlines illustrate typical programs. However, considerable variation by substitution or by the use of elective courses is possible, and other special programs tailored for an individual student may be formulated and approved. Students who complete the four-year program receive either the Bachelor of Arts degree or the accredited Bachelor of Science degree, depending upon the course of study followed.

Some students may feel that their interests would be best served by majoring in more than one field. By proper selection of elective courses, multi-majors are possible and encouraged. Both the Bachelor of Arts and the Bachelor of Science, in either Mechanical Engineering or Materials Science, are especially suited for a double-major program. Students in one of the Bachelor of Science programs who complete the major requirements of a second Bachelor of Science program can have an entry to that effect entered on their transcripts.

It is common for our undergraduates to enter the program with several hours of advanced placement credit. Such students have the opportunity to also obtain a Master of Mechanical Engineering degree. In the latter part of their program they can apply to the Graduate School and begin taking selected courses for graduate credit while completing the undergraduate requirements. While obtaining a BS degree is a significant step, a masters degree is viewed by many as the first "professional level" degree in mechanical engineering.

In addition to the curricular information, this document also lists the departmental faculty. For the same information electronically, go to <http://www.mems.rice.edu/undergraduate/program.html>.

MECHANICAL ENGINEERING

Mechanical engineers generally deal with the relations among forces, work or energy, and power in designing systems to improve the human environment. They may work to extract oil from deep within the earth or to send a spacecraft to the moon. The products of their efforts may be automobiles or jet aircraft, nuclear power plants or air conditioning systems, large industrial machinery or household can openers. They are involved in programs to better utilize natural resources of energy and materials as well as to lessen the impact of technology on the environment.

Mechanical engineers, while strongly oriented towards science, are not scientists. Science is a search for knowledge. The science of mathematics extends abstract knowledge. The science of physics extends organized knowledge of the physical world. In each of these, consideration can be limited to a carefully isolated aspect of reality. The mechanical engineer must deal with reality in all its aspects. He or she must not only be competent to use the most classical and the most modern parts of science, but also must be able to devise and make a product which will be used by people. Moreover, the engineer must assume professional responsibility insofar as the safety and well-being of society are affected by those products.

A program in Mechanical Engineering will be a most stimulating and rewarding undergraduate experience for the great majority of students entering this field. Such a program is established by an educational environment created by men and women in contact with the world of people and industry. Engineering education is being called upon to produce graduates well versed in rapidly advancing science and who can lead industry and the public into the new world which engineering will make possible. Engineers will often discover in science, through their own research and invention or through the findings of scientists, those things which can be put to human use. In any engineering achievement, a new or better product is the objective; and all means available to the intellect of man will be employed to reach that objective. Science and its application remain a part, but only a part, of any great engineering advance. The first moon landing could have been devised and carried out only by mechanical engineers with great resources in science. In order to make the first spacecraft, science had to be combined with the engineer's drive toward creation of a predetermined object. Young people who can respond to this kind of challenge are needed now, and they will be needed as never before in the years ahead.

The Rice Mechanical Engineering program is also designed to prepare the student to succeed in graduate school. Many of our graduates continue on for advanced study in areas such as business, engineering, law, and medicine.

THE BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING DEGREE

PREAMBLE

The Accreditation Board for Engineering and Technology (ABET) has put in place accreditation criteria that require in part a publicized program development plan that defines the Goals and Objectives of each degree program. They are intended to assure that the degree program is producing qualified engineers and that assessment procedures are in place for actively improving the degree program on a continuing basis. Thus, intended educational outcomes from each objective are also established along with the means for assessing the outcomes so it can be demonstrated that the program is achieving those Goals.

GOALS

After consultation with program constituencies, the Faculty of the Department of Mechanical Engineering and Materials Science has established the following goals for the students completing its BS degree program in Mechanical Engineering.

1. The graduate will be well prepared to successfully practice as an engineering professional. In addition to being in demand by leading companies, as a result of their engineering training, this goal means that the graduate recognizes the importance of becoming a licensed professional engineer. Such registration is important, and is required by law if they are to: a) own their own engineering firm, b) teach engineering, c) hold a position in industry that is responsible for "sealing" the engineering design certification for products produced by a company for use by the public. Seniors are strongly encouraged to take the Texas Fundamentals of Engineering Exam that is offered on campus each April. It is the first step in becoming licensed.
2. The graduate will be well prepared to synthesize various technical fields so as to produce engineering designs and to effectively communicate aspects of those designs to others. This goal recognizes that written, oral, and graphical communications and presentations are important in producing safe and effective designs, and for working in groups. Those processes are increasingly common in design projects.
3. The graduate will be well prepared to successfully obtain a graduate degree at a top rated school. This goal reflects the consensus that while obtaining a BS degree is an important and significant step formal education beyond the BS degree is important to all our students. Many professional societies support the view that a graduate degree represents the first professional degree.

OBJECTIVES

Students receiving the Bachelor of Science in Mechanical Engineering degree will have an ability to rationally formulate and solve mechanical engineering problems. This includes the ability to:

1. Apply knowledge of mathematics, science, and computing through the use of analytic techniques, experiments, computer simulations, and other modern engineering tools.
2. Design and conduct physical experiments, analyze, and interpret data.
3. Develop and assess design criteria forming the basis for a safe and effective final design or product.
4. Design a system, component, or process to meet desired needs.
5. Function on multi-disciplinary teams.
6. Communicate engineering and related concepts effectively in written, graphical, and oral form.

In addition they will have:

7. An understanding of professional and ethical responsibility.
8. A broad-based education that extends beyond math, science, and engineering and prepares the student with knowledge of contemporary global and societal issues that affect engineering practice and the impact that engineering has on these issues.
9. A recognition of the need for and an ability to engage in life-long learning.
10. An education that prepares them for successful graduate study in a masters degree or a doctoral program.

Finally, the seniors should take and pass both sections of the Fundamentals of Engineering Exam.

MATERIALS SCIENCE AND ENGINEERING

Materials science is a modern-day engineering program concerned with the production, fabrication, and properties of materials used by society. These include metals and their alloys, semiconductors, ceramics, glasses, polymers, and composites of various materials.

All matter is made up of atoms of the elements found in the earth's crust. These atoms are combined in different ways in each of the various classes of materials. This results in materials exhibiting different electronic, atomic, molecular, and crystalline structures. A material's internal structure often consists of various chemical phases and crystalline regions of different orientation in space, both of which are connected by interface boundaries of atomic dimensions. The internal structure of a material can be further altered, for example, through heat treatment and/or deformation (as the turn-of-the-century metallurgist would say, "heat it and beat it"). It is precisely the internal structure of a material which determines the solid's response to external mechanical (will it fracture?), electrical (will it conduct electricity?), or chemical (will it corrode?) forces. The materials scientist primarily involves himself or herself with producing the correct class of materials and subsequently altering the internal structure within the means available so that the component will perform satisfactorily in the application for which it is intended.

Four factors have been instrumental in bringing together this study of these different classes of materials in one curriculum:

1. Thousands of new commercial compositions of metallic alloys, semiconductors, glasses, plastics, ceramics, and composites have appeared during the past few decades. This rapid growth demanded the education of broadly based materials scientists to develop and select the materials required by today's technology. Consequently, people working in various areas of the materials field began to think and work together in an interdisciplinary manner.
2. Similar underlying mathematical, physical, and chemical concepts are now realized to form the basis for studying materials.
3. The basic ingredient of many high-technology developments is the semiconductor. This material, as well as other electronic materials, has to be produced and processed to form the transistors, microcircuits, and computer memory devices of the communication and information industries. It requires a fundamental knowledge of materials science.
4. The demand for products incorporating the best characteristics of different materials has led to the development of composites. A composite, for example graphite-epoxy, is a piece of matter in which two or more classes of materials are mechanically melded into a single structural or electrical component with the most desirable properties.

The materials scientist is not an applied mathematician, physicist, or chemist -- but, rather, a combination of all three. The materials scientist is interested in applying the basics of these three areas so that he or she may ultimately design, produce, fabricate, and utilize the materials necessary for the engineering requirements of today and tomorrow.

Industrial companies, such as those involved with the production and/or manufacture of metals, electronic parts, ceramics, glasses, polymers, or with materials fabrication, employ professional materials scientists. So do utility companies, consulting firms, governmental agencies, research institutes, educational institutions, and even publishing firms. For the potential engineer or scientist who asks, "Why does this material behave this way?" the broad-based study of materials science attempts to teach him or her how to answer this question.

In the next decade, the United States will commence to experience materials shortages beyond those of crude oil. Shortages in chromium and cobalt, for example, are anticipated. Industries need well-trained materials engineers to design, devise, and fabricate new materials to do the job previously accomplished with alloys or composites made-up of materials wherein no shortage in supply existed. This job market will undoubtedly be very demanding. The phenomenal rise of the electronics industry has created a demand for engineers with a strong background in the processing of and the properties of electronic materials, such as semiconductors.

The curriculum provides the student with the requisite skills and educational background to contribute to the solution of many materials problems, allow him or her to work in a fascinating field, and make it possible to become a leader in one of the most challenging technologies of today.

**DEPARTMENT OF
MECHANICAL ENGINEERING AND MATERIALS SCIENCE**

FACULTY

FACULTY MEMBERS	GENERAL AREA OF SPECIALTY	OFFICE	PHONE
J. E. Akin	Computational Mechanics - CAD	221 MEB	348-4879
E. V. Barrera	Materials Science	203 MEB	348-6242
Y. Bayazitoglu	Heat Transfer	237 MEB	348-6291
F. R. Brotzen (emeritus)	Materials Science	235 MEB	348-3563
M. M. Carroll	Continuum Mechanics	226 MEB	348-6142
A. J. Chapman (emeritus)	Heat Transfer - Thermodynamics	232 MEB	348-4908
	Fluid Mechanics		
F. Ghorbel	Control Systems – Robotics – Biomedical Systems	205 MEB	348-3738
B. C. Houchens	Fluids - Thermal Science	230 MEB	348-3546
C. M. Landis	Solid Mechanics	224 MEB	348-3609
J. Lou	Materials – Nanotechnology	223 MEB	348-3573
R. B. McLellan	Materials - Metallurgy	236 MEB	348-4993
A. J. Meade	Fluids - Thermal Science	238 MEB	348-5880
A. Miele (emeritus)	Astronautics	230 Ryon	348-4907
M. O'Malley	Systems Dynamics and Control - Mechatronics	234 MEB	348-3545
P. D. Spanos	Mechanics	231 MEB	348-4909
T. E. Tezduyar	Computational Fluid Dynamics and Finite Element Method	228 MEB	348-6051
C. C. Wang (emeritus)	Mechanics and Applied Mathematics	222 MEB	348-5259
B. I. Yakobson	Computational Materials Science	201 MEB	348-3572

Faculty with Joint Appointments in Mechanical Engineering and Materials Science

A. Barron	Department of Chemistry	410C BH	348-5610
S. Nagarajaiah	Department of Civil and Env. Engineering	216 Ryon	348-6207
R. Nordgren (emeritus)	Department of Civil and Env. Engineering	214 Ryon	348-5292
J. M. Tour	Department of Chemistry	255 BH	348-6246

DEPARTMENT OFFICE: 101 MECHANICAL ENGINEERING BUILDING - MS 321
 713-348-4906
 713-348-3582
 Fax: 713-348-5423
 Email: mems@rice.edu

Undergraduate Program in Mechanical Engineering (2005-2006)

This is a new curriculum beginning in the Fall 2001. Current students have the options of choosing the catalog they entered Rice with or the catalog they will graduate with.

The BSME degree requirements list (131 hours):

1. Basic Mathematics and Science (26 hours)
 - CHEM 121 Chemistry (4)
 - MATH 101 Single Variable Calculus I (3)
 - MATH 102 Single Variable Calculus II (3)
 - MATH 211 Ordinary Differential Equations and Linear Algebra (3)
 - MATH 212 Multivariable Calculus (3)
 - MSCI 301 Materials Science (3)
 - PHYS 101 Mechanics (3)
 - PHYS 102 Electricity and Magnetism (4)
2. Computational and Applied Mathematics (12 hours)
 - COMP 110 Computation in Science and Engineering (3)*
 - CAAM 210 Engineering Computation (3)
 - CAAM 335 Matrix Analysis (3)
 - CAAM 336 Differential Equations in Science and Engineering (3)
3. Senior Design (7 hours)
 - MECH 407 Mechanical Design Project I (3)
 - MECH 408 Mechanical Design Project II (4)
4. Labs (3 hours)
 - MECH 331 Mechanics Lab (1)
 - MECH 332 Thermo/Fluids Lab (1)
 - MECH 431 Senior Lab (1)
5. Other Courses (32 hours)
 - MECH 200 Classical Thermodynamics (3)
 - MECH 211 Engineering Mechanics (3)
 - MECH 311 Mechanics-Deformable Solids (3)
 - MECH 340 Industrial Process Lab (1)
 - MECH 343 Modeling of Dynamic Systems (4)
 - MECH 371 Fluid Mechanics I (3)
 - MECH 401 Machine Design (3)
 - MECH 412 Vibrations (3) *Prerequisite (s): MECH 343
 - MECH 420 Feedback Control of Dynamic Systems (3)
 - MECH 481 Heat Transfer (3)
 - Limited Elective (3)**
6. Specialization Area Cluster Courses (12 hours)
7. Distribution Electives (24 hours)
8. Free Electives (15 hours)

*Transition: Students who entered in the mechanical engineering program before 2001 may substitute another course for COMP 110 with approval of the chair of the mechanical engineering Curricular Advising Committee.

**Any 300 level or higher MATH, CAAM, STAT, or MECH course.

Specialization Area Options:

The Specialization Area can be one of the following five clusters. Students must take at least two of the following Required Cluster courses for their selected cluster, and two from the list of the Suggested Cluster Elective courses. There is also a General Mechanical Engineering cluster. The cluster advisors will update elective courses as needed and maintain lists of electives in the department. The Required Cluster courses are:

1. **Biomechanics**
BIOE 372 Intro. Biomechanics, MECH 380 Tissue Mechanics
2. **Computational Engineering**
MECH 417 Finite Element Analysis, MECH 454 Computational Fluid Mechanics
3. **Fluid Mechanics and Thermal Science**
MECH 372 Fluid Mechanics II, MECH 471 App. of Thermodynamics
4. **Solid Mechanics and Materials**
MECH 400 Adv Mechanics of Materials, MSCI 402 Mech. Properties of Materials
5. **System Dynamics and Control**
MECH 498 Intro to Robotics, MECH 411 Dyn & Cont of Mech Sys, MECH 488 Design of Mechatronic Sys (choose 2)
6. **General Mechanical Engineering**
Any four required courses listed above may be taken to define a general cluster

The student also has the option of selecting the "General cluster" which requires the student to select four courses from the ten required courses for the above five specialization area options.

Cluster	Advisor
1	Dr. Akin
2	Dr. Tezduyar
3	Dr. Bayazitoglu
4	Dr. Landis
5	Dr. O'Malley
Petitions	Chair of Curriculum Committee

Computer Programming Languages

Beginning in the Fall of 2003 the MEMS department (and others) changed the requirements for learning computer programming languages. In the past students were required to learn the C and/or f95 languages as freshmen. However, the languages were generally not again utilized until the senior year. At that time the actual language needed depends on the student's selected specialization area.

Students are now required to take CAAM 210 as freshmen where programming concepts are presented via the Matlab environment and no specific high level computer language is required. Most engineers need to know at least two computer languages (typically C and f95 in ME) but we no longer require or provide "for credit" courses on specific languages.

Most computer languages have very similar features and the specific language utilized in junior or senior level courses can usually be quickly mastered if you have utilized the Matlab environment. Students are encouraged to become familiar with C, C++, Fortran 95, and Visual Basic (VB) as the four most commonly used programming tools in engineering. Controls courses tend to utilize the C language while computational mechanics courses tend to use f95. Visual Basic is powerful for reports and spreadsheets prepared on personal computers. The concepts of object-oriented programming methods of C++, f95, and VB are becoming increasingly useful in engineering. In summary, MEMS students are to utilize the CAAM 210 course as a programming concepts foundation and are expected to pick up other high level programming languages as needed.

MECHANICAL ENGINEERING
BSME
 BASIC CURRICULUM

FRESHMEN YEAR

Fall		SPRING	
MATH 101 Calculus I	3	MATH 102 Calculus II	3
CHEM 121 Chemistry	4	PHYS 102 Elec. & Magnetism	4
COMP 110 Comp. In Sci. & Engineering	3	CAAM 210 Eng. Computation	3
PHYS 101 Mechanics	3	Electives	6
Electives	3	HPER 102	0
HPER 101	0	Total	16 hrs
Total	16 hrs		

SOPHOMORE YEAR

Fall		Spring	
MATH 211 Diff. Eqns	3	MATH 212 Multivariable Calculus	3
MECH 211 Mechanics	3	MECH 200 Thermodynamics	3
MSCI 301 Materials Sci.	3	MECH 311 Mechanics of Solids	3
MECH 340 Mfg. Processes	1	MECH 331 Mechanics Lab.	1
Electives	6	Electives	6
Total	16 hrs	Total	16 hrs.

JUNIOR YEAR

Fall		Spring	
CAAM 335 Appl. Math. I	3	CAAM 336 Appl. Math. II	3
MECH 371 Fluid Mechanics I	3	MECH 401 Machine Design	3
MECH 343 Model Dyn. Sys.	4	MECH 481 Heat Transfer	3
CLUSTER COURSE #1	3	MECH 332 Thermo/Fluids Lab	1
Electives	3	CLUSTER COURSE #2	3
Total	16 hrs	MECH 420 Feedback Control	3
		Total	16 hrs

SENIOR YEAR

Fall		Spring	
MECH 407 Sr. Design	4	MECH 408 Sr. Design	3
MECH 431 Senior Lab.	1	MECH 412 Vibrations	3
CLUSTER COURSE #3	3	CLUSTER COURSE #4	3
Limited Elective*	3	Electives	9
Electives	6	Total	18 hrs
Total	17 hrs		

Summary:

Total 131 hrs.
 24 hrs University distribution electives
 15 hrs free electives
 80 hrs of required courses
 12 hrs cluster requirements and electives

Notes: It is expected that CHEM 121 will be replaced by a new course in chemistry for engineers. Students that advance place out of MATH 101 should consider taking COMP 110 in the fall semester.

*Any 300 level or higher MATH, CAAM, STAT, or MECH course.

MECHANICAL ENGINEERING
BSME
BIOMECHANICS CLUSTER

FRESHMEN YEAR

Fall		Spring	
MATH 101 Calculus I	3	MATH 102 Calculus II	3
CHEM 121 Chemistry	4	PHYS 102 Elec. & Magnetism	4
COMP 110 Comp. in Sci. & Engineering	3	CAAM 210 Eng. Computation	3
PHYS 101 Mechanics	3	Electives	6
Electives	3	HPER 102	0
HPER 101	0	Total	16 hrs
Total	16 hrs		

SOPHOMORE YEAR

Fall		Spring	
MATH 211 Diff. Eqns	3	MATH 212 Multivariable Calculus	3
MECH 211 Mechanics	3	MECH 200 Thermodynamics	3
MSCI 301 Materials Sci.	3	MECH 311 Mechanics of Solids	3
MECH 340 Mfg. Processes	1	MECH 331 Mechanics Lab.	1
Electives	6	Electives	6
Total	16 hrs	Total	16 hrs.

JUNIOR YEAR

Fall		Spring	
CAAM 335 Appl. Math. I	3	CAAM 336 Appl. Math. II	3
MECH 371 Fluid Mechanics I	3	MECH 481 Heat Transfer	3
MECH 343 Model Dyn. Sys.	4	MECH 332 Thermo/Fluids Lab	1
Electives	3	MECH 401 Machine Design	3
BIOE 372 INTRO. BIOMECHANICS	3	MECH 380 TISSUE MECH	3
Total	16 hrs	MECH 420 Feedback Control	3
		Total	16 hrs

SENIOR YEAR

Fall		Spring	
MECH 407 Sr. Design	4	MECH 408 Sr. Design	3
MECH 431 Senior Lab.	1	MECH 412 Vibrations	3
CLUSTER ELECTIVE # 3	3	CLUSTER ELECTIVE #4	3
Limited Elective*	3	Electives	9
Electives	6	Total	18 hrs
Total	17 hrs		

Summary:

Total 131 hrs.

24 hrs University distribution electives

15 hrs free electives

80 hrs of required courses

12 hrs cluster requirements and electives

***Any 300 level or higher MATH, CAAM, STAT, or MECH course.**

Biomechanical Suggested (S) Cluster Electives:

MECH 400 Adv Mech Matl

ELEC 481 Comp. Neurosci.

ELEC 482 Physiological Systems

MECH 417 Intro to FEA

MECH 454 Computational Fluid Mechanics

MECH 471 Applied Thermo.

MECH 483 Bio. Instr. Meas.

MECH 485 Biomechanics

MSCI 402 Mech Prop.

MECHANICAL ENGINEERING
BSME
COMPUTATIONAL ENGINEERING CLUSTER

FRESHMEN YEAR

Fall		Spring	
MATH 101 Calculus I	3	MATH 102 Calculus II	3
CHEM 121 Chemistry	4	PHYS 102 Elec. & Magnetism	4
COMP 110 Comp. in Sci. & Engineering	3	CAAM 210 Eng. Computation	3
PHYS 101 Mechanics	3	Electives	6
Electives	3	HPER 102	0
HPER 101	0	Total	16 hrs
Total	16 hrs		

SOPHOMORE YEAR

Fall		Spring	
MATH 211 Diff. Eqns	3	MATH 212 Multivariable Calculus	3
MECH 211 Mechanics	3	MECH 200 Thermodynamics	3
MSCI 301 Materials Sci.	3	MECH 311 Mechanics of Solids	3
MECH 340 Mfg. Processes	1	MECH 331 Mechanics Lab.	1
Electives	6	Electives	6
Total	16 hrs	Total	16 hrs.

JUNIOR YEAR

Fall		Spring	
CAAM 335 Appl. Math. I	3	CAAM 336 Appl. Math. II	3
MECH 371 Fluid Mechanics I	3	MECH 481 Heat Transfer	3
MECH 343 Model Dyn. Sys.	4	MECH 332 Thermo/Fluids Lab	1
CLUSTER ELECTIVE #1	3	MECH 401 Machine Design	3
Electives	3	MECH 417 INTRO FEA	3
Total	16 hrs	MECH 420 Feedback Control	3
		Total	16 hrs

SENIOR YEAR

Fall		Spring	
MECH 407 Sr. Design	4	MECH 408 Sr. Design	3
MECH 431 Senior Lab.	1	MECH 412 Vibrations	3
MECH 454 COMP FLUID MECH	3	CLUSTER ELECTIVE #4	3
Limited Elective*	3	Electives	9
Electives	6	Total	18 hrs
Total	17 hrs		

Summary:

Total 131 hrs.
 24 hrs University distribution electives
 15 hrs free electives
 80 hrs of required courses
 12 hrs cluster requirements and electives

*Any 300 level or higher MATH, CAAM, STAT, or MECH course.

Computational Engineering Cluster Electives:

CAAM 353 Comp. Num.Anal.
 CAAM 453 Numerical Analysis I
 CAAM 454 Numerical Analysis II

CEVE 305 Structural Ana. II
 MECH 372 Fluids II
 MECH 403 Comp. Aided Des.
 MECH 471 App. Thermo

MECHANICAL ENGINEERING
BSME
FLUID MECHANICS AND THERMAL SCIENCE CLUSTER

FRESHMEN YEAR

Fall		SPRING	
MATH 101 Calculus I	3	MATH 102 Calculus II	3
CHEM 121 Chemistry	4	PHYS 102 Elec. & Magnetism	4
COMP 110 Comp. in Sci. & Engineering	3	CAAM 210 Eng. Computation	3
PHYS 101 Mechanics	3	Electives	6
Electives	3	HPER 102	0
HPER 101	0	Total	16 hrs
Total	16 hrs		

SOPHOMORE YEAR

Fall		Spring	
MATH 211 Diff. Eqns	3	MATH 212 Multivariable Calculus	3
MECH 211 Mechanics	3	MECH 200 Thermodynamics	3
MSCI 301 Materials Sci.	3	MECH 311 Mechanics of Solids	3
MECH 340 Mfg. Processes	1	MECH 331 Mechanics Lab.	1
Electives	6	Electives	6
Total	16 hrs	Total	16 hrs.

JUNIOR YEAR

Fall		Spring	
CAAM 335 Appl. Math. I	3	CAAM 336 Appl. Math. II	3
MECH 371 Fluid Mechanics I	3	MECH 481 Heat Transfer	3
MECH 343 Model Dyn. Sys.	4	MECH 332 Thermo/Fluids Lab	1
MECH 471 APP. THERMO	3	MECH 401 Machine Design	3
Electives	3	MECH 420 Feedback Control	3
Total	16 hrs	MECH 372 FLUIDS II	3
		Total	16 hrs

SENIOR YEAR

Fall		Spring	
MECH 407 Sr. Design	4	MECH 408 Sr. Design	3
MECH 431 Senior Lab.	1	MECH 412 Vibrations	3
CLUSTER ELECTIVE #3	3	CLUSTER ELECTIVE #4	3
Limited Elective*	3	Electives	9
Electives	6	Total	18 hrs
Total	17 hrs		

Summary:

Total 131 hrs.

24 hrs University distribution electives

15 hrs free electives

80 hrs of required courses

12 hrs cluster requirements and electives

***Any 300 level or higher MATH, CAAM, STAT, or MECH course.**

Fluid Mechanics and Thermal Science Cluster Electives:

CEVE 412 Hydrology

MECH 403 Comp. Aided Des.

MECH 417 Intro. Finite Elements

MECH 454 Computational Fluid Mechanics

MECH 476 Fluid Machinery

MECH 482 Inter. Heat Transfer

MECH 591 Gas Dynamics

MECH 594 Intro Aerodynamics

MSCI 401 Thermo. Materials

MECHANICAL ENGINEERING
BSME
SOLID MECHANICS AND MATERIALS CLUSTER

FRESHMEN YEAR

Fall		SPRING	
MATH 101 Calculus I	3	MATH 102 Calculus II	3
CHEM 121 Chemistry	4	PHYS 102 Elec. & Magnetism	4
COMP 110 Comp. in Sci. & Engineering	3	CAAM 210 Eng. Computation	3
PHYS 101 Mechanics	3	Electives	6
Electives	3	HPER 102	0
HPER 101	0	Total	16 hrs
Total	16 hrs		

SOPHOMORE YEAR

Fall		Spring	
MATH 211 Diff. Eqns	3	MATH 212 Multivariable Calculus	3
MECH 211 Mechanics	3	MECH 200 Thermodynamics	3
MSCI 301 Materials Sci.	3	MECH 311 Mechanics of Solids	3
MECH 340 Mfg. Processes	1	MECH 331 Mechanics Lab.	1
Electives	6	Electives	6
Total	16 hrs	Total	16 hrs.

JUNIOR YEAR

Fall		Spring	
CAAM 335 Appl. Math. I	3	CAAM 336 Appl. Math. II	3
MECH 371 Fluid Mechanics I	3	MECH 481 Heat Transfer	3
MECH 343 Model Dyn. Sys.	4	MECH 332 Thermo/Fluids Lab	1
MSCI 402 MECH. PROP. OF MATERIALS	3	MECH 401 Machine Design	3
Electives	3	MECH 400 ADV MECH OF MATL	3
Total	16 hrs	MECH 420 Feedback Control	3
		Total	16 hrs

SENIOR YEAR

Fall		Spring	
MECH 407 Sr. Design	4	MECH 408 Sr. Design	3
MECH 431 Senior Lab.	1	MECH 412 Vibrations	3
CLUSTER ELECTIVE #2	3	CLUSTER ELECTIVE #4	3
Limited Elective*	3	Electives	9
Electives	6	Total	18 hrs
Total	17 hrs		

Summary:

Total 131 hrs.
 24 hrs University distribution electives
 15 hrs free electives
 80 hrs of required courses
 12 hrs cluster requirements and electives

***Any 300 level or higher MATH, CAAM, STAT, or MECH course.**

Solid Mechanics and Materials Cluster Electives

BIOE 372 Intro. Biomech	MSCI 417 Thermo Mat.
CEVE 304 Structural Ana. I	MSCI 404 Mat. Design
CEVE 305 Structural Ana. II	MSCI 411 Metallography
CEVE 470 Soil Mech	MSCI 415 Ceramics and Glass
MECH 417 Intro. FEA	

MECHANICAL ENGINEERING
BSME
SYSTEM DYNAMICS AND CONTROL CLUSTER

FRESHMEN YEAR

Fall		SPRING	
MATH 101 Calculus I	3	MATH 102 Calculus II	3
CHEM 121 Chemistry	4	PHYS 102 Elec. & Magnetism	4
COMP 110 Comp. in Sci. & Engineering	3	CAAM 210 Eng. Computation	3
PHYS 101 Mechanics	3	Electives	6
Electives	3	HPER 102	0
HPER 101	0	Total	16 hrs
Total	16 hrs		

SOPHOMORE YEAR

Fall		Spring	
MATH 211 Diff. Eqns	3	MATH 212 Multivariable Calculus	3
MECH 211 Mechanics	3	MECH 200 Thermodynamics	3
MSCI 301 Materials Sci.	3	MECH 311 Mechanics of Solids	3
MECH 340 Mfg. Processes	1	MECH 331 Mechanics Lab.	1
Electives	6	Electives	6
Total	16 hrs	Total	16 hrs.

JUNIOR YEAR

Fall		Spring	
CAAM 335 Appl. Math. I	3	CAAM 336 Appl. Math. II	3
MECH 371 Fluid Mechanics I	3	MECH 481 Heat Transfer	3
MECH 343 Model Dyn. Sys.	4	MECH 332 Thermo/Fluids Lab	1
Electives	3	MECH 401 Machine Design	3
CLUSTER COURSE #1	3	MECH 420 Feedback Control	3
Total	16 hrs	CLUSTER COURSE #2	3
		Total	16 hrs

SENIOR YEAR

Fall		Spring	
MECH 407 Sr. Design	4	MECH 408 Sr. Design	3
MECH 431 Senior Lab.	1	MECH 412 Vibrations	3
CLUSTER COURSE #3	3	CLUSTER COURSE #4	3
Limited Elective**	3	Electives	9
Electives	6	Total	18 hrs
Total	17 hrs		

Summary:

Total 131 hrs.

24 hrs University distribution electives

15 hrs free electives

80 hrs of required courses

12 hrs cluster requirements and electives

****Any 300 level or higher MATH, CAAM, STAT, or MECH course.**

System and Control Cluster:

You must take at least 2 of the following courses:

MECH 498 Introduction to Robotics

MECH 488 Design of Mechatronic Systems

MECH 411 Dyn and Control of Mechanical Systems

And the remainder of your courses from this list:

ELEC 481 Comp. Neurosci.

ELEC 482 Physiological Systems

MECH 403 Comp. Aided Des

MECH 435 Electromechanical Dev and Sys

Required (R) and Suggested (S) Cluster Courses

1. Biomechanics
2. Computational Engineering
3. Fluids and Thermal Sciences
4. Solids and Materials Science
5. System Dynamics and Control

Course	Title	1	2	3	4	5
BIOE						
372	Intro Biomech.	R	-	-	S	-
CAAM						
353	Comp. Num. Anal.	-	S	-	-	-
453	Num. Analysis I	-	S	-	-	-
454	Num. Analysis II	-	S	-	-	-
CEVE						
304	Structural Ana. I	-	-	-	S	-
305	Structural Ana. II	-	S	-	S	-
470	Soil Mech.	-	-	-	S	-
COMP						
210	Engineering Comp.	-	-	-	-	-
212	Intermediate Prog.	-	-	-	-	-
ELEC						
243	Circuits	-	-	-	-	R/ S
481	Comp. Neurosci.	S	-	-	-	S
482	Physiological Sys.	S	-	-	-	S
ENGI						
201	Intro. Design	-	-	-	-	-
303	Engr. Econ	-	-	-	-	-
ENVI						
412	Hydrology	-	-	-	S	-
MECH						
372	Fluids, II	-	S	R	-	-
380	Tissue Mech.	R	-	-	-	-
400	Adv Mech Matl	S	-	-	R	-
403	Comp. Aided Des.	-	S	S	-	S
411	Anal. Dyn.	-	-	-	-	R
417	Intro. Finite Elements	S	R	S	S	-
435	Electromech.	-	-	-	-	S
454	Comp Fluid Mechanics	S	R	S	-	-
471	App. Thermo	S	S	R	-	-
476	Fluid Machinery	-	-	S	-	-
482	Inter. Heat Trans.	-	-	S	-	-
483	Bio Instr. Meas.	S	-	-	-	-
485	Biomechanics	S	-	-	-	-
488	Design Mechatronic Sys	-	-	-	-	R
498	Robotics	-	-	-	-	R
591	Gas Dynamics	-	-	S	-	-
594	Intro Aerodynamics	-	-	S	-	-
MSCI						
401	Thermo. Materials	-	-	S	S	-
402	Mech. Prop. Materials	S	-	-	R	-
404	Mat. Design	-	-	-	S	-
411	Metallography	-	-	-	S	-
415	Ceramics and Glass	-	-	-	S	-

Bachelor of Arts (BA) in MECHANICAL ENGINEERING

Non-Accredited

(2005-2006)

FRESHMAN YEAR: Same as BS
(23 Major hrs + 9 elective hrs = 32 hrs)

SOPHOMORE YEAR: Same as BS,
except MECH 340 and MECH 331 are not required.
(18 Major + 15 electives hrs = 33hrs)

JUNIOR and SENIOR YEARS:
CAAM 335 Matrix Analysis (3 hrs)
CAAM 336 Differential Equations in Science and Engineering (3 hrs)
MECH 343 Modeling of Dynamic Systems (4 hrs)
MECH 371 Fluid Mechanics I (3 hrs)
MECH 401 Machine Design (3 hrs)
MECH 412 Vibrations (3 hrs)
MECH 420 Feedback Control of Dynamic Systems (3 hrs)
MECH 481 Heat Transfer (3 hrs)
Electives (31 hrs)
(25 Major + 30 electives hrs = 55 hrs)

Summary:

Total 120 hrs.

24 hrs. University distribution electives
30 hrs Free Electives
66 hrs of required Major courses

UNDERGRADUATE PROGRAM IN MECHANICAL ENGINEERING
(For students graduating under catalogs from 2000 or earlier)

The following is the recommended sequence of courses for obtaining the undergraduate degree in Mechanical Engineering. There is some flexibility in the order in which some of the courses may be taken, but the student should first consult a faculty advisor before making an alteration.

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING
(89 major hours + 45 elective hours = 134 hours required)

FRESHMAN YEAR (21 major hrs + 12 elective hrs = 33 hrs):

Fall	hrs	Spring	hrs
MATH 101 (Calculus I)	3	MATH 102 (Calculus II)	3
CHEM 121 (Genl. Chemistry)	4	CHEM 122 (Genl. Chemistry)	4
PHYS 101 (Mechanics)	3	PHYS 102 (Elec. & Magnetism)	4
Electives [Note 5]	6	Electives [Note 5]	6
HPER 101		HPER 102	
	16		17

SOPHOMORE YEAR (24 major hrs + 9 elective hrs = 33 hrs):

Fall	hrs	Spring	hrs
MATH 211 (Diff. Eqns.)	3	MATH 212 (Multivariable Calculus)	3
MECH 211 (Mechanics)	3	MECH 200 (Thermodynamics)	3
MSCI 301 (Materials Sci.)	3	CAAM 210 (Computer)[Note 5]	3
MSCI 304 (Materials Engi.)	1	MECH 311 or CEVE 300(Mech. of Solids I)	3
MECH 340 (Mfg.Processes)[Note 2]	1	MECH 331 (Mechanics Lab)	1
Electives [Note 5]	6	Electives	3
	17		16

JUNIOR YEAR (27 major hrs + 9 elective hrs = 36 hrs):

Fall	hrs	Spring	hrs
CAAM 335 (Appl. Math I)	3	CAAM 336 (Appl. Math II)	3
MECH 371 (Fluid Mech. I)	3	MECH 372 (Fluid. Mech. II)	3
MECH 471 (Applied Thermo.)	3	MECH 481 (Heat Transfer)	4
Electives	9	MECH 332 (Thermo/Fluids Lab)	1
	18	ELEC 243 (Circuits)	4
		Electives	3
			18

SENIOR YEAR (20 major hrs + 12 elective hrs = 32 hrs)

Fall	hrs	Spring	hrs
MECH 401 (Mechanical Design)	3	MECH 404 (Sr. Design Project)[Note 3]	4
MECH 403 (Comp. Aided Design)	3	MECH 412 (Vibrations)	3
MECH 411 (Dynamics)	3	Electives	9
Approved Design Elective [Note 3]	3		
MECH 431 (Senior Lab)	1		
Elective	3		
	16		16

See **SPECIAL NOTES** for Undergraduate Degree in Mechanical Engineering

Undergraduate Program in Mechanical Engineering - cont.

**Bachelor of Arts in Mechanical Engineering
(Non-Accredited)
(For students graduating under catalogs from 2000 or earlier)**

63 major hrs + 60 electives = 123 hours required

FRESHMAN YEAR (21 Major hrs + 12 elective hrs = 33 hrs)
(Same as B.S.)

SOPHOMORE YEAR (21 Major hrs + 9 elective hrs = 30 hrs)
(Same as B. S., except MSCI 304,
MECH 340, and MECH 331
are not required.)

JUNIOR AND SENIOR YEARS (21 major hrs + 39 elective hrs = 60 hrs)

CAAM 335	3 credits
CAAM 336	3 credits
MECH 371	3 credits
MECH 411	3 credits
MECH 481	3 credits
Free Electives	39

Any one of the following 3 groups:

Group A:	MECH 471	3
	MECH 372	3

Group B:	MECH 412	3
	MECH 420	3

Groups C:	CEVE 400	3
	MECH 401	3

Electives for the B.A. degree must be chosen to ensure that university distribution and graduation requirements are satisfied.

See SPECIAL NOTES for Undergraduate Degree in Mechanical Engineering

Undergraduate Program in Mechanical Engineering - cont.

SPECIAL NOTES FOR UNDERGRADUATE MECHANICAL ENGINEERING DEGREE

(For students graduating under catalogs from 2000 or earlier)

1. Mechanical Engineering majors are required to take 3 hours of an approved computing course, CAAM 211 (which covers Fortran 90 and MATLAB) and are urged to satisfy this requirement as early in the freshman or sophomore year as possible.
2. For MECH 340 lab, sign up in MEMS Department Office - - on a first-come first-serve basis - - except Sophomores have preference in the Fall semester and Juniors have preference in the Spring semester. Limited enrollment, so sign up as early as possible.
3. Approved design electives: MECH 472, MECH 476, MECH 485, MECH 530, MSCI 311, MSCI 404, CENG 403, CENG 404. MECH 407 & MECH 408 usually are taken in lieu of MECH 404, in which case MECH 407 may count as the design elective.
4. The required courses for a major in Mechanical Engineering cannot be taken on a pass-fail basis.
5. Students contemplating extending their program over more than 4 years should be aware that there are certain essential sequences the order of which **must** be maintained. In particular, the Physics offerings should be taken in the order indicated as should the sequence of Math-Caam courses. Likewise, the sequence: MECH 211-MECH 311(CEVE 300)-CEVE 400-MECH 401 should be maintained in that order, as should MECH 411-MECH 412, and the sequence: MECH 200-MECH 371-MECH 372-MECH 471-MECH 481. The specific sequence of the other required courses is not important.

**UNDERGRADUATE PROGRAMS IN
MATERIALS SCIENCE AND ENGINEERING
(Non-Accredited)**

The following are recommended sequences of study for obtaining undergraduate degrees in materials science. There is some flexibility in the order in which the courses are taken, but changes in sequence should first be approved by the faculty adviser.

BACHELOR OF SCIENCE IN MATERIALS SCIENCE

91 technical hours + 43 elective hours = 134 hours (minimum)

Freshman Year (21 hours + 12 hours of electives = 33 hours)

MATH 101 (F)	3 hrs	MATH 102 (S)	3 hrs
CHEM 121 or 151 (F)	4 hrs	CHEM 122 or 152 (S)	4 hrs
PHYS 101 or 111 (F)	3 hrs	PHYS 102 or 112 (S)	4 hrs
HPER 101 (F)	0 hrs	HPER 102 (S)	0 hrs
Electives (see note 1)	<u>6 hrs</u>	Electives (see note 1)	<u>6 hrs</u>
	11 hrs + electives		10 hrs + electives

Sophomore Year (22 hours + 12 hours of electives = 34 hours)

MATH 211 (F)	3 hrs	MATH 212 (S)	3 hrs
MECH 211 (F)	3 hrs	ELEC 243 (S)	4 hrs
PHYS 201 (F) or CHEM 211 (F) or CHEM 311 (F)	3 hrs	CAAM 210 (S)	3 hrs
MSCI 301 (F or S)(Intro)	3 hrs		
Electives (see note 1)	<u>3 hrs</u>	Electives (see note 1)	<u>9 hrs</u>
	12 hrs + electives		10 hrs + electives

Junior Year (28 hours + 6 hours of electives = 34 hours)

MSCI 311 (F)(Design)	4 hrs	MSCI 411 (S)(Metallography)	3 hrs
MSCI 401 (F)(Thermo.Transp.)	4 hrs	CEVE 300 (S)	3 hrs
MSCI 402 (F)(Prop.)	3 hrs	MSCI 303 (S) (Lab)	1 hr
MSCI 500 (F or S) (see note 3)	0 hrs	MSCI 501 (F or S) (see note 3)	1 hr Seminar
CAAM 335 (F)	3 hrs	MSCI 406 (S) or MSCI 415 (S) (see note 4) (Phys.Prop.)	3 hrs
		Approved technical elective (F or S) (see note 5)	3 hrs
Electives (see note 1)	<u>3 hrs</u>	Electives (see note 1)	<u>3 hrs</u>
	14 hrs + electives		14 hrs + electives

Senior Year (20 hours + 13 hours of electives = 33 hours)

MSCI 535 (F)(Crystallography)	3 hrs	MSCI 404 (S)(Mat.Eng.)	4 hrs
MSCI 537 (F)(Sr.Lab)	1 hr	MSCI 594 (S)(Polymers)	3 hrs
Approved engineering elective (F or S) (see note 6)	3 hrs	MSCI 406 (S) or MSCI 415 (S) (see note 5)	3 hrs
MSCI 500 (F or S) (see note 3)		MSCI 501 (F or S) (see note 3)	
Approved science elective (F or S) (see note 7)	3 hrs	(Seminar)	
Electives (see note 1)	<u>7 hrs</u>	Electives (see note 1)	<u>6 hrs</u>
	10 hrs + electives		10 hrs + electives

BACHELOR OF ARTS IN MATERIALS SCIENCE

(Non-Accredited)

52 technical hours + 68 elective hours = 120 hours (minimum)

Freshman Year (21 hours + electives)

MATH 101 (F), MATH 102 (S)
CHEM 101/111 (F), CHEM 102/112 (S)
CHEM 105 (F or S)
PHYS 101/111 (F), PHYS 102/112 (S)
HPER 101 (F), HPER 102 (S)
Electives (see note 8)

Sophomore Year (9 hours + electives)

MATH 211 (F), MATH 212 (S)
MSCI 301 (F or S)
Electives (see note 8)

Junior Year (15 hours + electives)

MSCI 401 (F), MSCI 303 (S)
MSCI 402 (F), MSCI 406 (S) (see note 4)
MSCI 500 (F), MSCI 501 (S) (see note 3)
Approved science or engineering elective (F or S)
Electives (see note 8)

Senior Year (7 hours + electives)

MSCI 535 (F)
MSCI 537 (F)
MSCI 500 (F), MSCI 501 (S) (see note 3)
Approved science or engineering elective (F or S)
Electives (see note 8)

Notes:

1. Electives for the B.S. degree must be chosen to assure that university distribution and language requirements are satisfied and that a minimum of 134 semester hours have been completed.
2. Students are required to take 3 hours of an approved computing course, CAAM 210 (which covers FORTRAN 90 and MATLAB) and are urged to satisfy this requirement as early in the freshman or sophomore year as possible. Students are urged to consult their Materials Science and Engineering departmental advisors, Dr. Rick Barrera, Dr. Rex McLellan and Dr. Boris Yakobson.
3. Before graduating, the student must enroll for one semester of MSCI 500 and one semester of MSCI 501 (Materials Science Seminar). These may be taken at any time during the junior and senior years. One hour of credit will be given for MSCI 501.
4. MSCI 406 and MSCI 415 are offered on an every other year basis with MSCI 406 in the spring of even numbered years and MSCI 415 in the spring of odd numbered years. Both must be completed for the B.S. degree.
5. The technical elective must be a science, engineering (including MSCI), or math course 200 level or above. Any of a number of courses may be used provided it is approved by the faculty adviser.
6. The engineering elective cannot be a materials science course, and must qualify as an engineering science course according to ABET criteria. The student should discuss with his/her adviser how she/he plans to satisfy this requirement before enrolling in the course.
7. The approved science elective must be a basic science course 200 level or above. The student should discuss with her/his adviser how he/she plans to satisfy this requirement before enrolling in the course. Some suggested courses are BIOS 201, BIOS 202, BIOS 301, CHEM 211, CHEM 212, CHEM 311, CHEM 312, GEOL 311, PHYS 201, PHYS 202, PHYS 311, and SPAC 235.
8. Electives for the B.A. degree must be chosen to assure that university distribution requirements are satisfied and that a minimum of 120 semester hours have been completed.