MECHANICAL ENGINEERING

AND

MATERIALS SCIENCE

UNDERGRADUATE INFORMATION

2007-2008

WILLIAM MARSH RICE UNIVERSITY

HOUSTON, TEXAS

(Revised 05/07)

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. 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 of 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 formulate rationally 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.
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, "heats 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 Fluid Mechanics	232 MEB	348-4908
F. Ghorbel	Control Systems – Robotics – Biomedical Systems	205 MEB	348-3738
B. C. Houchens	Fluids - Thermal Science	230 MEB	348-3546
J. Lou	Materials – Nanotechnology	223 MEB	348-3573
R. B. McLellan	Materials - Metallurgy	236 MEB	348-4993
A. J. Meade	Fluids - Thermal Science - Aerospace	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 Mechanics and Fluid-Structure Interaction	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

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Undergraduate Program in Mechanical Engineering
(2007-2008)

This is the curriculum as of Fall 2006. 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 (132 hours):

1. Basic Mathematics and Science (30 hours)
   - CHEM 121 Chemistry (4)
   - CHEM 122 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 (9 hours)
   - 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 (4)
   - MECH 408 Mechanical Design Project II (3)

4. Labs (4 hours)
   - MECH 331 Mechanics Lab (1)
   - MECH 332 Thermo/Fluids Lab (1)
   - MECH 340 Industrial Process Lab (1)
   - MECH 431 Senior Lab (1)

5. Other Courses (34 hours)
   - MECH 200 Classical Thermodynamics (3)
   - MECH 211 Engineering Mechanics (3)
   - MECH 311 Mechanics-Deformable Solids (3)
   - MECH 343 Modeling of Dynamic Systems (4)
   - MECH 371 Fluid Mechanics I (3)
   - MECH 401 Machine Design (3)
   - MECH 403 Computer Aided Design (3)
   - MECH 412 Vibrations (3)
   - MECH 420 Feedback Control of Dynamic Systems (3)
   - MECH 481 Heat Transfer (3)
   - Limited Elective (3)**

6. Technical Electives (9 hours)

7. Distribution Electives (24 hours)

8. Free Electives (15 hours)

**STAT 305, 310, or 331

Technical Electives

Group A courses are fundamental courses in the following focus areas: Aerospace Engineering (AE), Computational Engineering (CompE), Fluid Mechanics and Thermal Science (FT), Solid Mechanics and Materials (SMM), and System Dynamics and Control (SDC). At a minimum, one course per focus area will be taught each academic year.

Group B courses are additional technical electives that complement the focus areas listed above. Major advisors may approve additional courses for Group B credit. The availability of these courses is dependent on demand and faculty availability for teaching.

Students are required to take a total of three (3) technical electives. A minimum of two (2) of these courses must come from Group A. The remaining course can come from Group A or B.

Group A

MECH 400 Advanced Mechanics of Materials (SMM)
MECH 411 Dyn and Control of Mech Sys (SDC)
MECH 417 Finite Element Analysis (CompE)
MECH 473 Advanced Fluid Mechanics I (FT)
MECH 454 Comp. Fluid Mechanics (AE, CompE)
MECH 471 App. of Thermodynamics (FT)
MECH 498 Intro to Robotics (SDC)
MECH 594 Introduction to Aerodynamics (AE, FT)

MSCI 402 Mech. Properties of Materials (SMM)

Group B

CEVE 304 Structural Ana. I
CEVE 470 Soil Mech

ELEC 481 Comp. Neurosci.
ELEC 482 Physiological Systems

MECH 404 Design Project
MECH 435 Electromechanical Devices
MECH 482 Inter. Heat Transfer
MECH 488 Design Mechatronic Sys
MECH 591 Gas Dynamics

MSCI 401 Thermo. Materials
MSCI 404 Mat. Design
MSCI 411 Metallography
MSCI 415 Ceramics and Glass
MSCI 417 Thermo Mat.

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
PHYS 101 Mechanics	3	CAAM 210 Eng. Computation	3
LPAP 101	0	CHEM 122 Chemistry	4
Electives	6	LPAP 102	0
		Electives	3
Total	16 hrs	Total	17 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
MECH 403 Comp Aided Design	3	MECH 332 Thermo/Fluids Lab	1
Electives	3	MECH 420 Feedback Control	3
		TECHNICAL ELECTIVE #1	3
Total	16 hrs	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
TECHNICAL ELECTIVE #2	3	**TECHNICAL ELECTIVE #3**	3
Limited Elective*	3	Electives	9
Electives	6		
Total	17 hrs	Total	18 hrs

Summary:
Total 132 hrs.
24 hrs University distribution electives
15 hrs free electives
83 hrs of required courses
9 hrs cluster requirements and electives

***STAT 305, 310, or 331.**

Bachelor of Arts (BA) in MECHANICAL ENGINEERING
Non-Accredited
(2007-2008)

FRESHMAN YEAR: Same as BS
(24 Major hrs + 9 elective hrs = 33 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 (29 hrs)
(25 Major + 29 electives hrs = 54 hrs)

Summary:
Total 120 hrs.

24 hrs. University distribution electives
29 hrs Free Electives
67 hrs of required Major courses

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)	6 hrs	Electives (see note 1)	6 hrs
	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)	3 hrs	Electives (see note 1)	9 hrs
	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)	3 hrs	Electives (see note 1)	3 hrs
	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) (Seminar)	
Approved science elective (F or S) (see note 7)	3 hrs		
Electives (see note 1)	7 hrs	Electives (see note 1)	6 hrs
	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.