Mechanical Engineering and Materials Science

The George R. Brown School of Engineering

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Degrees Offered: B.A., B.S.M.E., B.S.M.S., M.M.E., M.M.S., M.S., Ph.D.

Studies in mechanical engineering may lead to specialization in one of several areas, including mechanics, computational mechanics, stochastic mechanics, fluid dynamics, heat transfer, dynamics and control, robotics, biomedical systems, and aerospace sciences. Studies in materials science may lead to specialization in one of several areas, including nanotechnology, metals physics, statistical mechanics, metallic solid thermodynamics, materials chemistry, aspects of composites, coatings and thin films, and interface science.

The graduate program offers professional degrees in both materials science and engineering, which is based on undergraduate preparation in a number of related fields, and mechanical engineering, which permits specialization in the areas mentioned in the previous paragraph. Graduate students may also pursue research degrees. Faculty research areas are indicated in the previous paragraph. A joint M.B.A./Master of Engineering degree is available in conjunction with the Jesse H. Jones Graduate School of Management. Also, a combined M.D. and advanced research degree for research careers in medicine is available with Baylor College of Medicine.

The graduate program collaborates with other departments in its comprehensive educational and research activities. The Department of Computational and Applied Mathematics supports research in applied analysis and computational mathematics.

Work on expert systems and robotics is done in cooperation with the Departments of Electrical and Computer Engineering and Computer Science. Computer graphics research involves the cooperation of the Department of Computer Science and the School of Architecture. The campus-wide Rice Quantum Institute is also active in the research of electronic materials and other aspects of materials science. Finally, biomechanics and biomaterials research involves several institutions in the Texas Medical Center.

Degree Requirements for B.A., B.S.M.E. in Mechanical Engineering or B.A., B.S.M.S. in Materials Science and Engineering

The B.A. program in either mechanical engineering or materials science and engineering is highly flexible, involves less technical content, and allows students greater freedom to pursue areas of interest outside of engineering.

The two B.S. programs prepare students for professional practice of engineering. During their senior year, mechanical engineering students in the B.S. program take courses in design application while completing a major design project, and materials science and engineering students in the B.S. program work on a design problem in an industrial setting. The B.S.M.E. program is accredited by the Accreditation Board for Engineering and Technology (ABET). Departmental goals and objectives are available at http://mems.rice.edu/undergraduate/goals.html.

For general university requirements, see Graduation Requirements (pages 16–18). Lists of representative undergraduate courses and the usual order in which students take them are available from the department for either the B.A. or B.S. programs in both mechanical engineering and materials science and engineering. The B.S.M.E. degree contains a core of required courses and selected electives from 1 of 6 specialization areas. The requirements (131 hours) are:

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)

Computational and Applied Mathematics (12 hours)
COMP 110 *Computation in Science and Engineering* (3)*
CAAM 211 *Engineering Computation* (3)
CAAM 335 *Matrix Analysis* (3)
CAAM 336 *Differential Equations in Science and Engineering* (3)

Senior Design (7 hours)
MECH 407 *Mechanical Design Project I* (3)
MECH 408 *Mechanical Design Project II* (4)

Labs (3 hours)
MECH 331 *Mechanics Lab* (1)
MECH 332 *Thermo/Fluids Lab* (1)
MECH 431 *Senior Lab* (1)

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)
MECH 420 *Feedback Control of Dynamic Systems* (3)
MECH 481 *Heat Transfer* (3)
STAT 331 *Applied Probability* (3)

Specialization Area Cluster Courses (12 hours)

Distribution Electives (24 hours)

Free Electives (15 hours)

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

Specialization Area Options: The Specialization Area can be 1 of the following 5 clusters. Students must take at least 2 of the following Required Cluster courses for their selected cluster and 2 from the departmental list of the Suggested Cluster Elective courses. The cluster advisors will update elective courses as needed and maintain lists of electives in the department. Also, there is a General Mechanical Engineering cluster. The Required Cluster courses are:

1. Biomechanics
BIOE 372 *Intro Biomechanics*
MECH 380 *Tissue Mechanics*

2. Computational Mechanics
MECH 417 *Finite Element Analysis*
MECH 452 *Finite Elements in Fluids*

3. Fluid Mechanics and Thermal Science
MECH 372 *Fluid Mechanics, II*
MECH 471 *App. of Thermodynamics*

4. Solid Mechanics and Materials
CIVI 400 *Mechanics of Solids II*
MSCI 402 *Mech. Properties of Materials*

5. System Dynamics and Control
MECH 498 *Intro to Robotics*
MECH 435 *Electromechanical Systems*
or ELEC 243 *Intro to Electronics*

6. General Mechanical Engineering
Any 4 required courses listed above may be taken to define a general cluster.

B.A. Program. Students seeking the B.A. degree with a major in mechanical engineering must complete 120 hours with at least 67 semester hours in courses specified by the department along with 24 hours of university distribution electives and 29 hours of free electives. Lists of courses, including general university requirements and the usual order in which students take them are available from the department. The B.A. program mirrors the B.S.M.E. program in the freshman and sophomore years with the exceptions that MECH 340 and MECH 331 are not required. Specific major requirements are completed in the junior and senior years along with electives. A summary appears below:

Freshman Year: Same as B.S. with 23 major and 9 elective hours for 32 hours.

Sophomore Year: Same as B.S. (except MECH 340 and 331 are not required) with 20 major and 13 elective hours for 33 hours.

Junior and Senior Years: 24 major and 31 electives for 55 hours. The following courses are required in junior and senior years:

CAAM 335 *Matrix Analysis* (3)
CAAM 336 *Differential Equations in Science and Engineering* (3)
MECH 343 *Modeling of Dynamic Systems* (4)
MECH 371 *Fluid Mechanics I* (3)
MECH 401 *Machine Design* (3)
MECH 412 *Vibrations* (3)
MECH 420 *Feedback Control of Dynamic Systems* (3)
MECH 481 *Heat Transfer* (3)

Students seeking the **B.A.** degree with a major in materials science and engineering must complete at least 52 hours in courses specified by the department plus additional hours for a total of 120 hours at graduation.

Students seeking the **B.S.M.S.** must complete at least 91 semester hours in courses specified by the department within the total requirements of 134 hours. Basic departmental course requirements for the B.S.M.S. are:

CHEM 121–122 *General Chemistry*
MATH 101 and 102 *Single Variable Calculus I* and *II*
MATH 211 *Ordinary Differential Equations and Linear Algebra*
MATH 212 *Multivariable Calculus*
MECH 211 *Engineering Mechanics*
MSCI 301 *Materials Science*
PHYS 101 *Mechanics*
PHYS 102 *Electricity and Magnetism*

Specific requirements
CAAM 211 *Introduction to Engineering Computation*
CAAM 335 *Matrix Analysis*
CIVI 300 *Mechanics of Solids*
ELEC 241 *Fundamentals of Electrical Engineering I* (or ELEC 243 *Introduction to Electronics*)
MSCI 301 *Materials Science*
MSCI 303 *Materials Science Junior Lab*
MSCI 311 *Introduction to Design*
MSCI 401 *Thermodynamics and Transport Phenomena in Materials Science*
MSCI 402 *Mechanical Properties of Materials*
MSCI 404 *Materials Engineering and Design*
MSCI 406 *Physical Properties of Solids* (or MSCI 415 *Ceramics and Glasses*)
MSCI 411 *Metallography and Phase Relations* (or MSCI 415 *Ceramics and Glasses*)
MSCI 500/501 *Materials Science Seminar*
MSCI 535 *Crystallography and Diffraction*
MSCI 537 *Materials Science Senior Lab*
MSCI 594 *Properties of Polymers*

1 course from the following
PHYS 201 *Waves and Optics*
CHEM 211 *Organic Chemistry*
CHEM 311 *Physical Chemistry*

Electives
1 approved science elective (at the 200 level or higher)
1 approved engineering science elective (not MSCI)
1 approved technical elective

Degree Requirements for M.M.E., M.M.S., M.S., and Ph.D. in Mechanical Engineering or Materials Science and Engineering

Professional Degree Programs. The professional degrees offered by this department, the Master of Mechanical Engineering (M.M.E.) and the Master of Materials Science (M.M.S.), involve a fifth year of specialized study, which is integrated with the four undergraduate years leading to either the B.A. or the B.S. degree in the same areas of interest. The professional degree programs are open to students who have shown academic excellence in their undergraduate studies.

For general university requirements, see Graduate Degrees (pages 60–65). For both the M.M.E. and M.M.S. degrees, students must complete 30 semester hours of course work. Lists of suggested courses are available from the department. Students should develop a specific plan of study based on their particular interests.

Research Degree Programs. The programs leading to the M.S. and Ph.D. degrees are open to students who have demonstrated outstanding performance in their undergraduate studies. The granting of a graduate research degree presupposes academic work of superior quality and a demonstrated ability to do original research.

For general university requirements, see Graduate Degrees (pages 60–65). Course requirements for the research degrees vary, depending on the extent of individual undergraduate preparation as well as each student's performance in graduate courses and on qualifying examinations. For both the M.S. and Ph.D. degrees, students must present a thesis that comprises an original contribution to knowledge and defend it in a public oral examination.

See MECH (pages 441–447) and MSCI (pages 467–469) in the Courses of Instruction section.