**475, 476 Experiential Learning** **2 credits**
**477, 478 Experiential Learning**
See the description of these courses at the beginning of the "Curricula" section of this catalog.

**483, 484 Seminar** **2 credits**
**485, 486 Seminar**
See the description of these courses at the beginning of the "Curricula" section of this catalog.

**487, 488 Topics** **2 credits**
**489, 490 Topics**
The subject matter of these courses, announced in the annual *Class Schedule,* will vary from year to year, but will not duplicate existing courses. See the description of these courses at the beginning of the "Curricula" section of this catalog.

**491, 492 Research** **2 credits**
**493, 494 Research**
See the description of these courses at the beginning of the "Curricula" section of this catalog.

**495, 496 Individual Study** **2 credits**
**497, 498 Individual Study**
See the description of these courses at the beginning of the "Curricula" section of this catalog.

## Engineering (ENGR)

Bennett (chair), George, Greene, Hennessey, Jalkio, Zimmerman; Abraham, Cottles, Jaedike, Sparrow
Faculty from other departments and adjunct faculty from industry teach specialized courses.

The University of St. Thomas offers five tracks in engineering:

- A program in electrical engineering
- A program in mechanical engineering
- A dual degree program in mechanical engineering and business
- A pre-engineering program
- A minor in engineering

The mechanical and electrical engineering curricula combine the study of basic sciences, general engineering, design and mechanical or electrical engineering with the study of the liberal arts. Emphasis is placed on applied engineering. Our mission states: "We provide a practical, values-based learning experience that produces well-rounded, entrepreneurial engineers and technology leaders who have the technical skills, passion and courage to make a difference."

Students graduating with a major in either mechanical or electrical engineering will meet the program objectives and outcomes designed to exceed the requirements of the Accreditation Board for Engineering and Technology's (ABET) Engineering Criteria 2000. These are a comprehensive set of criteria designed to provide graduates with the technical, ethical, attitudinal and communications skills required to be a productive contributor to society and to aggressively seek life-long learning experiences. These program objectives and outcomes are designed to provide the graduate with a foundation for clear thinking and expression in a balanced liberal arts educational program. Graduates will demonstrate competence in a variety of skills that enhance their ability to solve problems in diverse ways to meet the needs of the global community. Graduates will also develop teamwork and communication skills while gaining a comprehensive understanding of the design process and engineering systems.

Graduates will be prepared for direct entry into an engineering position in industry or for advanced study in graduate school.

### Degree in Electrical Engineering (B.S.E.E.)

The bachelor of science in electrical engineering (B.S.E.E.) curriculum includes courses in circuits and electronics, signal processing and control system design, digital electronics and microprocessors, and electromagnetic fields and waves with a focus on embedded system design. The electrical engineering program is academically rigorous, complemented with a full liberal arts curriculum.

150 Introduction to Engineering (0 credit)
151 Introduction to Engineering Design (1 credit)
230 Digital Design
240 Circuit Analysis
330 Design with Microprocessors I
331 Design with Microprocessors II
340 Signals and Systems
342 Electromagnetic Fields and Waves
345 Electronics I
346 Electronics II
410 Control Systems and Automation

431 Design of Embedded Systems
480 Engineering Design Clinic I
481 Engineering Design Clinic II

*Plus one of:*
ENGR 220 Engineering Mechanics I
ENGR 361 Engineering Materials
ENGR 381 Thermodynamics
PHYS 226 Introduction to Modern Physics II
QMCS 281 Object-Oriented Design and Programming

*Allied Requirements*
MATH 113 Calculus I
MATH 114 Calculus II
MATH 200 Multi-Variable Calculus
MATH 210 Linear Algebra and Differential Equations
MATH 303 Statistics for the Applied Sciences
PHYS 111 Introduction to Classical Physics I
PHYS 112 Introduction to Classical Physics II
PHYS 225 Introduction to Modern Physics I
PHYS 341 Electricity and Magnetism
QMCS 230 Software Design Using the JAVA Language

### Degree in Mechanical Engineering (B.S.M.E.)

The bachelor of science in mechanical engineering (B.S.M.E.) is an applied engineering program, blending theory and research with practical engineering fundamentals. The program is academically rigorous, complemented with a full liberal arts curriculum. The mechanical engineering curriculum provides a foundation in: theoretical and applied mechanics, materials, electrical-electronic fundamentals, computer-aided design, automation systems, thermodynamics, heat transfer/fluid flow, manufacturing processes and practical design. The B.S.M.E. program is accredited by the Engineering Accreditation Commission (EAC) of ABET.

Students must have completed ENGR 171 and 220 to be admitted to the major.

150 Introduction to Engineering (0 credit)
151 Introduction to Engineering Design (1 credit)
171 Engineering Graphics
220 Engineering Mechanics I
221 Engineering Mechanics II
320 Machine Design and Synthesis
350 Introduction to Electronics
361 Engineering Materials
371 Manufacturing Processes
381 Thermodynamics
382 Heat Transfer and Fluid Flow
410 Control Systems and Automation
480 Engineering Design Clinic I
481 Engineering Design Clinic II

*Plus eight credits from the following:*
225 Kinematics and Mechanism Design (2 credits)
351 Electronic Instrumentation and Control Laboratory
385 Thermal Design (2 credits)
420 Rapid Product Realization
430 Applications of Thermodynamics
440 Design with Plastics
450 Vibration and Control Theory
460 Engineering Economics and Project Management
470 Fundamentals of Mechatronic Engineering I
498 Individual Study

*Allied Requirements*
CHEM 111 General Chemistry I
MATH 113 Calculus I
MATH 114 Calculus II
MATH 200 Multi-Variable Calculus
MATH 210 Linear Algebra and Differential Equations
MATH 303 Statistics for the Applied Sciences
PHYS 111 Introduction to Classical Physics I
PHYS 112 Introduction to Classical Physics II
QMCS 230 Software Design Using the JAVA Language

### Dual Degree in Mechanical Engineering (B.S.M.E.) and General Business Management (B.A.)

The dual degree program in Mechanical Engineering and General Business Management is designed for students with an interest in both engineering and business. The program combines the applied engineering concepts of mechanical engineering with knowledge of the financial, marketing and management disciplines of the business program. Students in this dual program will have skills to prepare them for a wide variety of opportunities in industry or advanced graduate education. The dual degree program requires approximately five years to complete. Upon completion, students receive a B.A. degree in Business Administration and a B.S.M.E. degree accredited by EAC of ABET.

150 Introduction to Engineering (0 credit)
151 Introduction to Engineering Design (1 credit)
171 Engineering Graphics
220 Engineering Mechanics I
221 Engineering Mechanics II
320 Machine Design and Synthesis
350 Electrical Engineering Principles
361 Engineering Materials
371 Manufacturing Processes
381 Thermodynamics
382 Heat Transfer and Fluid Flow
410 Control Systems and Automation
480 Engineering Design Clinic I
481 Engineering Design Clinic II

*Plus:*
eight credits of ENGR electives

*Plus:*
ACCT 205 Introduction to Accounting
BUS 200 Community Service (0 credit)
BUS 201 Ethics and Practice: Foundations of Business
FINC 321 Financial Management
MGMT 301 Management of Organizations and Processes
MGMT 480 Integrative Issues of Businesses and Organizations
MKTG 300 Principles of Marketing

*Plus one of:*
BLAW 301 Legal Environment of Business
BLAW 303 International Business Law

*Allied requirements*
CHEM 111 General Chemistry
COMM 105 Communications in the Workplace
ECON 251 Principles of Macroeconomics
ECON 252 Principles of Microeconomics
MATH 113 Calculus I
MATH 114 Calculus II
MATH 200 Multi-Variable Calculus
MATH 210 Linear Algebra and Differential Equations
MATH 303 Statistics for the Applied Sciences
PHYS 111 Introduction to Classical Physics I
PHYS 112 Introduction to Classical Physics II
QMCS 230 Software Design Using the JAVA Language

### Pre-Engineering

*See Affiliated Programs*

### Minor in Engineering

The engineering minor is designed for students with majors in the sciences, mathematics, quantitative methods, and business. This minor serves those who plan to go on to graduate school in engineering and those entering business and industry. The engineering minor offers the opportunity to explore the field of engineering and provides an understanding of the technology of products and processes. It also strengthens pre-med and pre-law candidates who intend to pursue specialized areas such as biomechanics or patent law.

150 Introduction to Engineering (0 credit)
151 Introduction to Engineering Design (1 credit)
171 Engineering Graphics
371 Manufacturing Processes

*Plus eight credits from the following:*
220 Engineering Mechanics I
221 Engineering Mechanics II
300 Manufacturing Management Systems
320 Machine Design and Synthesis
350 Introduction to Electronics
361 Engineering Materials
381 Thermodynamics
382 Heat Transfer and Fluid Flow
410 Control Systems and Automation

**150 Introduction to Engineering** **0 credit**
This course introduces students to engineering fields, practicing engineers and hands-on engineering work. As they become acquainted with engineering occupations and experience their potential for creativity and fun, students will understand the value and applications of the required curriculum and be motivated and stimulated to pursue further engineering studies. Offered in fall semester.

**151 Introduction to Engineering Design** **1 credit**
This course focuses on design as the central activity of engineering. Students learn a disciplined approach to design through case studies and open ended design experiences. Offered in spring semester.
Prerequisite: 150

**171 Engineering Graphics**
Students will learn to read blueprints and working drawings and become familiar with computer-aided design (CAD) terminology and technology. Topics include the elements of drafting including: the use of CAD software; principles of projection; and introductory methods of representation and constructive geometry, working drawings, conventions and standards.

**220 Engineering Mechanics I**
Principles of statics and dynamics including such topics as equilibrium, friction, distributed forces, work, kinetics of particles and rigid bodies, and vibrations. Offered in fall semester.
Prerequisites: 151, 171, MATH 114 and PHYS 111

**221 Engineering Mechanics II**
Principles of deformable body mechanics including stress, strain, basic loading situations, transformations of stress and strain, beam theory, and energy methods. Offered in spring semester.
Prerequisite: 220

**225 Kinematics and Mechanism Design** **2 credits**
Analysis and design of linkages and other mechanisms including geometry of motion and force distributions. Computer aided analysis and design tools are used as well as mathematical techniques. Offered in J-term.
Prerequisite: 220

**230 Digital Design**
Introduction to the design of digital logic. Topics include Boolean logic, design and optimization of combinational and sequential logic, the use of programmable logic devices, logic hazards, electronic implementation of logic gates. Students will be expected to specify, design, simulate, construct, and test digital circuits and document all phases of the process.
Prerequisite: QMCS 230

**240 Circuit Analysis**
Introduction to linear circuit analysis and basic electronic instrumentation. Students will learn linear models of passive components and sources as well as how real components depart from those models. Circuit analysis techniques including nodal and mesh analysis, equivalence theorems and computer simulation will be covered. Laplace transform techniques will be used to examine sinusoidal steady state and transient circuit behavior.
Prerequisites: PHYS 112 and concurrent registration with MATH 210

**295, 296 Topics** **2 credits**
**297, 298 Topics**
The subject matter of these courses, announced in the annual *Class Schedule,* will vary from year to year, but will not duplicate existing courses. See the description of these courses at the beginning of the "Curricula" section of this catalog.

**300 Manufacturing Management Systems**
Introduces engineering students to the basic management and economic concepts useful to practicing engineers working in manufacturing settings. This course covers basic principles of management, work design, work meas-

urement, incentive plans, managing for quality, statistical quality control, manufacturing cost concepts and engineering economics. Offered in fall semester.
Prerequisite: MATH 303 or permission of instructor

**320 Machine Design and Synthesis**
Focus is on advanced mechanics topics, failure theories (static and dynamic), and on an understanding of basic machine components. This course will develop the student's creative skills in conceptualizing machines to meet performance criteria by means of a design project. Machine designs will require the understanding and use of machine components such as springs, screws, bearings, basis 4-bar linkages, cams, and gears. Finally, a number of mini-labs/workshops on topics that support the design project such as dynamic analysis software, machine component design, and design for manufacture are given.
Prerequisite: 221 and MATH 210

**330 Design with Microprocessors I**
Introduction to computer architecture and assembly language programming. Topics include I/O and memory addressing modes, communication and bus protocols, A/D and D/A conversion, interrupts and common microcontroller peripherals. Tradeoffs between architectures and design approaches will be discussed.
Prerequisite: 230

**331 Design with Microprocessors II**
A continuation of 330.
Prerequisite: 330

**340 Signals and Systems**
Topics include Laplace, Fourier, and Z transforms, understanding of frequency domain characteristics, state space concepts, and modulation.
Prerequisite: 240

**342 Electromagnetic Fields and Waves**
A continuation of PHYS 341. An introduction to the practical consequences of Maxwell's equations including propagation, reflection and absorption of electromagnetic waves. Applications include antennas, waveguides, transmission lines, and shielding from electromagnetic interference.
Prerequisite: PHYS 341

**345 Electronics I**
Analysis of electronic devices and circuits. Topics include linear and non-linear models of electronic devices, feedback and circuit design techniques. Applications include amplifiers, demodulation, oscillators, logic implementation.
Prerequisites: 240 and PHYS 225

**346 Electronics II**
Continuation of 345.
Prerequisite: 345

**350 Introduction to Electronics**
This course provides scientists and engineers with a background in electronics and electronic instrumentation. Topics include DC and AC circuit analysis, frequency response, filters, feedback, operational amplifiers, semiconductor devices, power supplies, oscillators, logic gates, codes for numbers and symbols, combinational and sequential digital logic design, timing, transducers, and analog-digital conversion. The course consists of lecture, demonstration, discussion, and laboratory.
Prerequisite: A minimum grade of C- in PHYS 112

**351 Electronic Instrumentation and Control Laboratory**
Provides an understanding of the fundamentals of electrical engineering. The course covers principles and applications of transducers, instrumentation systems, amplifiers and signal conditioners, impedance matching, frequency, time response and elementary feedback systems.
Prerequisite: 350

**361 Engineering Materials**
An introduction to materials and their properties. This course introduces students to the fundamentals of materials theory, properties and applications. Topics include properties and applications of metals, polymers, ceramics and composite materials. The course emphasizes characteristics of materials in manufacturing operations and service, including open-ended design issues. Offered in fall semester.
Prerequisites: 221, CHEM 111 and PHYS 111

**371 Manufacturing Processes**
Provides an understanding of the fundamental technologies of manufacturing processes. This course covers such basic principles of manufacturing processes as metal forming, metal cutting, plastic molding and continuous processes. Students receive hands-on experience with modern production equipment. Offered in spring semester.
Prerequisite: 361

**381 Thermodynamics**
A study of thermal and mechanical energy and their applications to technology. First law of thermodynamics (energy conservation); second law of thermodynamics (restrictions on energy transformations). Thermophysical properties of substances. Power producing devices and heat pumping devices. Humidity, dew point and other characteristics of non-reacting mixtures. Reacting mixtures (combustion of fuels).
Prerequisites: PHYS 112 and MATH 114

**382 Heat Transfer and Fluid Flow**
Modes of heat transfer: convection, conduction, and radiation. Coupling of convective heat transfer with fluid flow. Fundamentals of fluid flow: statics, boundary layers, pipe flows, pressure drop, and friction factor. Convective heat transfer at external surfaces and internal surfaces. Fluid-to-fluid heat exchangers and their design. Conduction in solids of various shapes; use of heat-conducting fins to improve the performance of heat exchangers. Radiation heat transfer between surfaces.
Prerequisite: 381

**385 Thermal Design** **2 credits**
Design of systems where the transfer of heat and/or the attainment of specific temperature levels are critical to the function of the system. Applications include heat exchangers, thermal climate control devices and a focused case study. Offered in J-term.
Prerequisite: 382

**410 Control Systems and Automation**
An introduction to the scope of control systems in manufacturing and their implementation. The course focuses on analog and binary control loop theory, the use of transforms (Laplace and Z) to describe and solve analog control systems, and the use of Boolean algebra to describe and solve binary control systems. Simulation is emphasized as an important tool for plant design, layout and optimizing manufacturing methods.
Prerequisites: 350, MATH 210 and QMCS 230

**420 Rapid Product Realization**
Provides a basic understanding of computer-aided design and manufacturing (CAD/CAM) systems in modern manufacturing operations. Topics covered include solid modeling, computer simulation, and implementation of CAD/CAM systems.
Prerequisites: 171 and junior standing

**430 Applications of Thermodynamics**
Introduction to principle industrial applications of thermodynamics. The course will cover theory of operation and design considerations of these systems as well as examples of thermodynamic engineering design. Topics include heating, ventilation, and air conditioning systems (HVAC), engines, and turbomachinery.
Prerequisite: 382

**431 Design of Embedded Systems**
Advanced interfacing and programming of microprocessor systems. Applications include machine control, digital signal processing, and real time communications. Students will design microprocessor based systems as part of this course.
Prerequisite: 331

**440 Design with Plastics**
The student will learn about the most common plastic compositions in industry along with their respective applications; understand the difference between injection and vacuum molding and what to look for using either; be able to match plastics with molding technology; learn about environmental and recycling issues surrounding the plastics industry.
Prerequisites: 171 and 361

**450 Vibration and Control Theory**
This course offers fundamentals in the theory of vibrations and control of mechanical systems. The topics related to vibration include undamped and damped free vibration, forced vibration or continuous systems. The topics related to control theory include modeling of dynamic systems (mechanical, electrical, hydraulic, pneumatic and thermal), analysis of continuous time and discrete time systems, feedback control systems, and graphical design methods.
Prerequisite: 410

**460 Engineering Economics and Project Management**
A practical look at the daily activities (including cost analysis and scheduling) and challenges of project managers in an engineering setting. Significant time will be devoted to personnel related topics such as conflict resolution, time management and leadership.

**470 Fundamentals of Mechatronic Engineering I**
Introduction to basic electronic devices and microprocessor systems for measurement and control; electronic circuits; amplifiers; filters; logic gates and sequential logic applications: A/D and D/A conversion and interfacing;

transducers; controllers; motors and actuators; microprocessor fundamentals and programming; data acquisition and feedback control.
Prerequisite: 410

**475, 476 Experiential Learning** **2 credits**
**477, 478 Experiential Learning**
See the description of these courses at the beginning of the "Curricula" section of this catalog.

**480 Engineering Design Clinic I**
Serves as the first capstone course. Student design teams, under the direction of a faculty coordinator, will develop engineering solutions to practical, open-ended design projects conceived to demonstrate the value of prior basic science and engineering courses. Ethical, social, economic and safety issues in engineering practice will be considered as well.
Prerequisites: 320, 371, 382, 410 and MATH 303

**481 Engineering Design Clinic II**
The final capstone course for the application of previously learned engineering principles to the solution of real problems in an actual industrial setting. Student design teams will work under the direction of faculty advisers and industry liaisons. Opportunity will be provided for objective formulation, analysis, synthesis and evaluation of alternative solutions.
Prerequisite: 480

**483, 484 Seminar** **2 credits**
**485, 486 Seminar**
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**487, 488 Topics** **2 credits**
**489, 490 Topics**
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**491, 492 Research** **2 credits**
**493, 494 Research**
See the description of these courses at the beginning of the "Curricula" section of this catalog.

**495, 496 Individual Study** **2 credits**
**497, 498 Individual Study**
See the description of these courses at the beginning of the "Curricula" section of this catalog.

## English (ENGL)

Mikolajczak (chair), An, Bellamy, Bouwman, Callaway, Challakere, Chowdhury, Choy, Craft-Fairchild, Erdrich, Garritano, Jordan, Larson, MacKenzie, May, L. Miller, R. Miller, Muse, O'Reilley, Otto, Piorkowski, Powell, Redshaw, Reichardt, Ringnalda, Scheiber, Scheurer, Warren, Wellisch

The aims of the department are to:

- help students gain mature skills in thinking, reading and writing;
- extend to all interested students, regardless of their major, the opportunity for the self-enrichment which a study of language and literature affords;
- provide students with a solid foundation for graduate study in English and other professional fields such as law and medicine, the teaching of English in secondary and middle schools, and all careers that emphasize analysis and communication.

To attain these goals, the programs outlined below focus on the different methodologies and approaches to the study of language, literature and writing while allowing students to pursue areas of particular interest.
The Department of English offers three emphases.

1. The general major that allows students to take a variety of literature courses and to incorporate writing and cultural studies into their programs;
2. The writing emphasis that takes students through graduated sequences of writing courses (200/300/400) built upon a foundation of literature courses. Students seeking this major should plan a schedule that allows for a 400-level course so as to get the best advantage of the program;
3. The Minnesota teacher licensure program in Communication Arts and Literature that prepares students for teaching elementary, middle, and secondary school. This program requires courses in linguistics, literature, writing, and writing pedagogy. It requires, therefore, early and careful planning. Students completing this program may complete a major in English.

Students graduating with a major in English will be able to write thoughtfully about literature and life, in forms that range from engaged responses, to close readings of primary texts, to critical papers using secondary sources. They will understand and practice writing as a process that involves substantial revision and be able to reflect