

# **ALLEN SCHOOL OF ENGINEERING & TECHNOLOGY**

Trine University's Allen School of Engineering & Technology includes these Departments:

- McKetta Department of Chemical & Bioprocess Engineering
- Reiners Department of Civil & Environmental Engineering
- Department of Electrical & Computer Engineering
- Wade Department of Mechanical & Aerospace Engineering
- Department of Technology

Academic programs administered by the school are as follows:

Master of Engineering \*PAGE 63

## Majors

Biomedical Engineering  
Civil Engineering  
Mechanical Engineering

- Bachelor of Science in Chemical Engineering
- Bachelor of Science in Civil Engineering
- Bachelor of Science in Computer Engineering
- Bachelor of Science in Computer Science
- Bachelor of Science in Design Engineering Technology
- Bachelor of Science in Electrical Engineering
- Bachelor of Science in Mechanical Engineering

Minors \* SEE PAGE 70

- Minor in Aeronautical Engineering
- Minor in Biomedical Engineering
- Minor in Bioprocess Engineering
- Minor in Energy Engineering
- Minor in Environmental Engineering
- Minor in Metallurgical Engineering
- Minor in Robotics
- Minor in Structural Engineering

## **THE SCHOOL**

The Drs. Jerry and Jorja Allen School of Engineering & Technology was named in honor of Jerry Allen, a 1978 mechanical engineering graduate and member of the University's Board of Trustees, and Jorja Allen, a 1978 business administration graduate and member of the Alumni Board of Governors.

## **MISSION**

The Allen School of Engineering & Technology promotes the application of science and technology by preparing graduates for the practice of engineering and engineering technology at the professional level.

## **VISION**

The Allen School of Engineering & Technology will be nationally recognized for the quality of its graduates.

## **VALUES**

To attain its mission and vision the Allen School accepts that we must educate engineers and technologists

- who have a broad education
- who see themselves as global citizens
- who have the potential for leadership in business and public service
- who have a strong ethical foundation

## **GOALS**

The Allen School of Engineering & Technology will:

Provide quality preparation for the practice of engineering and engineering technology at the professional level.

Provide graduates with the opportunities to pursue graduate studies, lifelong learning, and to offer service to their profession.

Provide technical and educational services to the community.

## **PROGRAMMATIC ACCREDITATION**

Trine University's programs in chemical engineering, civil engineering, electrical engineering, computer engineering, and mechanical engineering are accredited by the Engineering Accreditation Commission of ABET, [www.abet.org](http://www.abet.org), 410.347.7700.

## **PROGRAMS AND DEGREE REQUIREMENTS**

The degree programs are listed and then described in the catalog section for each academic department. All undergraduate degrees require students to fulfill General Education requirements (discussed in detail under "General Education Requirements" on page 46), as well as specific program requirements.

## **GENERAL ENGINEERING**

Engineering students who are undecided about their major are classified as "general engineers." Since most courses in the first year are common to all engineering disciplines, a general engineering student will still be able to make progress toward an engineering degree, even though a major has not been selected. During this year, the student should be actively

investigating the options available in engineering by talking to faculty members and practicing engineers, attending meetings of the student chapters of professional societies, and doing library research. All general engineering students are expected to transfer into one of the engineering majors by the beginning of their second year. While classified as a general engineer, a student would normally take the following courses. The student's instructor in GE 101 Introduction to Engineering can provide additional guidance.

**FIRST SEMESTER** **15 HRS.**

CH	104	General Chemistry I	
		or	
CH	104H	Honors General Chemistry I	(4)
ENG	103	English Composition I	(3)
GE	101	Introduction to Engineering	(1)
MA	134	Calculus I	(4)
		Social Sciences & Humanities elective	(3)

**SECOND SEMESTER** **15-18 HRS.**

ENG	133	Technical Communication	(3)
MA	164	Calculus II	(4)
PH	224	University Physics I	(4)
		Social Sciences & Humanities elective	(3)
		Engineering or Science course	(1-4)

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## **MCKETTA DEPARTMENT OF CHEMICAL & BIOPROCESS ENGINEERING**

The Dr. John J. McKetta Department of Chemical & Bioprocess Engineering was named in honor of Dr. John J. McKetta, a 1937 chemical engineering graduate and member of the University's Board of Trustees. The McKetta Department of Chemical & Bioprocess Engineering offers the following degree:

- Bachelor of Science in Chemical Engineering

Chemical engineering has at its core the chemical sciences. The chemical sciences affect virtually every aspect of our lives: the food we eat, the clothes we wear, the materials for our homes and cars, our medicines and health care products, and the protection of the environment. Chemical engineers are found in every industry.

Chemical engineering is distinctive in its emphasis on chemistry. The chemistry studied by the chemical engineer includes quantitative analysis, organic chemistry, physical or biochemistry and instrumental analysis. These are the same courses that a chemist would be required to take. The chemical engineer takes these chemical principles and applies them to industrial processes.

Chemical engineering has many common elements with the other engineering disciplines. It is based upon the fundamentals of physics and mathematics. It shares the core engineering sciences of mechanics, fluid flow, heat transfer, thermodynamics, and economics. Oral and written communication skills and interpersonal skills are required for success.

Engineering design is an integral component in chemical engineering course work. Solution of open-ended problems and the design process are introduced in the department's freshman engineering course. Design of experiments is covered in the Unit Operations laboratories, and equipment and process design concepts are taught through the Unit Operations and Chemical Engineering Kinetics courses. This work culminates in the capstone courses Chemical Process Design I and Chemical Process Design II.

Chemical engineering differs from the other engineering disciplines in three main ways. First, chemical engineers work with not only pure or single component materials, but with complex mixtures or multi-component materials. A chemical engineer must characterize and predict the behavior of these complex mixtures. Second, chemical engineers are the purification and separation specialists. The processes for removing impurities or extracting a valuable product are the domain of the chemical engineer. Third, by using chemical or biochemical processes, chemical engineers create materials that did not previously exist. These new and useful components or materials improve the way we live.

Chemical engineers find themselves employed in positions of research and development, process engineering and operations, engineering design and construction, technical sales and service, and plant and corporate management. Typical industries employing chemical engineers include bulk and specialty chemical, petroleum and natural gas, consumer products, pharmaceuticals and biomedical, steel production, plastics and polymers, semiconductor and electronic materials, environmental and consulting. Chemical engineering is also an excellent preparation for those desiring to undertake graduate studies in engineering and other fields such as medicine, law or business.

Trine University's chemical engineering program is accredited by the Engineering Accreditation Commission of ABET.

### **MISSION AND OBJECTIVES**

In concert with Trine University and the Allen School of Engineering & Technology mission statements, the mission of the chemical engineering program at Trine University is to provide career-oriented higher education in chemical engineering by providing a learning environment

in which members of a diverse student body receive personal mentoring through small classes and excellent teaching. By emphasizing “hands-on” learning, the program prepares graduates to be productive early in their careers, to advance to leadership roles in their companies and professions, and to provide service to society.

To meet this mission, a graduate from the McKetta Department of Chemical & Bioprocess Engineering must be able to demonstrate:

1. Technical competence
2. Problem solving ability
3. Communication skills
4. A sense of social awareness and responsibility

### **THE CHEMICAL ENGINEERING CURRICULUM**

The curriculum requires the completion of 132 hours of course work. The average course load is 16-17 hours based on eight semesters. In the degree program description that follows, an asterisk (\*) indicates those courses that satisfy the University’s general education requirements.

## **BACHELOR OF SCIENCE IN CHEMICAL ENGINEERING      132 HRS.**

<b>PROGRAM REQUIREMENTS</b>			<b>REQUIRED HOURS</b>
<b>WRITTEN COMMUNICATION</b>			<b>6 HRS.</b>
*ENG	103	English Composition I	(3)
*ENG	133	Technical Communication	(3)
<b>ORAL COMMUNICATION</b>			<b>3 HRS.</b>
*SP	203	Effective Speaking	(3)
<b>SOCIAL SCIENCES &amp; HUMANITIES</b>			<b>12 HRS.</b>
*ECO	213	Microeconomics	
		or	
*ECO	223	Macroeconomics	(3)
*Additional hours selected in accordance with the Social Sciences & Humanities section of the General Education Requirements.			(9)
<b>MATHEMATICS &amp; SCIENCE</b>			<b>44 HRS.</b>
*MA	134	Calculus I	(4)
*MA	164	Calculus II	(4)
MA	213	Calculus III	(3)
MA	233	Differential Equations	(3)
*CH	104	General Chemistry I	
		or	
*CH	104H	Honors General Chemistry I	(4)
CH	114	General Chemistry II	
		or	
CH	114H	Honors General Chemistry II	(4)
CH	203	Organic Chemistry I	(3)
CH	211	Organic Chemistry I Laboratory	(1)

CH 3x4 Instrumental Analysis (4)

Advanced Chemistry Elective (6)

CH 213 Organic Chemistry II

or

CH 221 Organic Chemistry II Laboratory

or

CH 232 Quantitative Analysis

or

CH 354 Physical Chemistry I

or

CH 434 Biochemistry

\*PH 224 University Physics I (4)

PH 234 University Physics II (4)

**FRESHMAN STUDIES 1 HR.**

GE 101 Introduction to Engineering (1)

**ENGINEERING SCIENCE 5 HRS.**

ES 233 Engineering Materials (3)

ES 382 Engineering Economics (2)

**ANALYSIS AND DESIGN 48 HRS.**

CHE 122 Introduction to Chemical & Biological Engineering (2)

\*CHE 203 Material Balances (3)

CHE 212 Energy Balances (2)

CHE 222 Process Measurement Laboratory & Sustainability (2)

CHE 252 Introduction to Statistical and Computational Methods (2)

CHE 303 Chemical Engineering Fluid Dynamics (3)

CHE 313 Chemical Engineering Thermodynamics I (3)

CHE 333 Unit Operations Laboratory I (3)

CHE 372 Chemical Engineering Thermodynamics II (2)

CHE 373 Chemical Engineering Heat Transfer (3)

CHE 383 Mass Transfer (3)

CHE 393 Stagewise Separations (3)

\*CHE 412 Applied Numerical Methods (2)

CHE 433 Unit Operations Laboratory II (3)

CHE 453 Chemical Engineering Kinetics (3)

CHE 463 Chemical Process Dynamics and Control (3)

CHE 473 Chemical Process Design I (3)

CHE 483 Chemical Process Design II (3)

**PROFESSIONAL DEVELOPMENT 1 HR.**

GE 401 Professional Practice (1)

**CHEMICAL ENGINEERING ELECTIVES 6 HRS.**

**FREE ELECTIVES 6 HRS.**

**TOTAL IN DEGREE PROGRAM: 132 HRS.**

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## **REINERS DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING**

The Reiners Department of Civil and Environmental Engineering offers the following undergraduate degree:

- Bachelor of Science in Civil Engineering

The civil engineering profession provides for our basic needs: housing, cities, commerce, transportation, education, recreation, clean air, water, environmental projects, and energy production. Civil engineers plan, design, and construct safe and purposeful civic facilities that add to the quality of life.

Today, civil engineers explore the frontiers of high technology for solutions to global needs. They deal with the techniques of modern computer-integrated design, as well as do research for new methods and materials of construction. They design and conduct experiments to study the wind effects on tall buildings and the hydrodynamic effects on offshore structures. They use computer simulations to predict hydrologic events, assess flood damage, and manage transportation systems. They employ computers to monitor treatment facilities, lasers for precision surveying, and remote sensing technologies for geodetic surveying. The civil engineers of tomorrow will explore the frontiers of space and build space habitats where people will work and live.

Based on this vision of the future, the Reiners Department of Civil & Environmental Engineering, with the support of the Allen School of Engineering & Technology and Trine University, will excel in the education of individuals uniquely prepared for the practice of civil engineering at the professional level.

Civil engineers, individually, cannot be accomplished in all of the above areas. Therefore, they concentrate on specific areas of civil engineering, such as structures, hydraulics, geotechnics, environmental engineering, highway and transportation engineering, urban planning, or construction management. Yet, civil engineering projects require a combined knowledge of many of these areas, as well as managerial skills, which include the ability to make decisions that are based not only on sound engineering principles, but also on an understanding of the social, ethical, and economical makeup of society. Therefore, it is essential that students receive a broad foundation in the areas of mathematics, physical and engineering sciences, analytical and design methods, communication skills, and the social sciences and humanities.

Civil engineers find career opportunities with architectural and engineering firms, construction corporations, material manufacturers, material testing services, utility corporations, and the petroleum and aircraft industries. As many civil engineering entities, such as highways, bridges, dams, land reclamation and water distribution systems, belong to the public sector, a significant proportion of civil engineers work for local, state and federal governments, as well as the Army Corps of Engineers, the Air Force and the Navy. Those who pursue advanced degrees often enter teaching and research careers in universities. Presently, thirty-five percent of all civil engineers are in general management.

The civil engineering program is accredited by the Engineering Accreditation Commission of ABET.

### **MISSION AND OBJECTIVES**

The mission of the civil engineering program at Trine University is to provide graduates with quality preparation for the practice of civil engineering, to provide graduates with opportunities to pursue graduate studies, and to provide technical and educational services to their profession and communities. The following educational objectives have been developed for the civil engineering program at Trine University:

Graduates have the ability to effectively prepare and present written and verbal proposals, design reports, drawings and other technical information to a diverse audience.

Graduates understand the importance of teamwork and leadership in executing projects, including their role within the team and their impact on the scope, budget, and schedule of the project.

Graduates can effectively use state of the practice engineering tools.

Graduates can analyze and design a structure, system or process, taking into consideration the legal, ethical and other societal impacts of the design.

Graduates take an active role in professional development including achieving professional licensure and active participation in professional societies.

Graduates are engaged in business aspects of the profession, including marketing, budgeting, client or public interaction, and contracting.

Program outcomes are defined as statements that describe what the students are expected to know and are able to do by the time of graduation. The achievement of these outcomes should indicate that the student is prepared to achieve the program educational objectives given above. Upon graduation, civil engineering students are expected to have:

The ability to clearly and effectively communicate ideas in written, graphical and oral formats.

The ability to apply mathematics and science to solve civil engineering problems.

Knowledge of engineering ethics and understand the professional engineer's ethical responsibility.

The ability to conduct experiments and interpret the results.

The ability to use computers for data analysis, problem solving, and reporting.

A broad education and knowledge of contemporary issues.

The ability and understanding of the need to engage in life-long learning.

The ability to work effectively in multi-disciplinary engineering design teams.

## **CIVIL & ENVIRONMENTAL ENGINEERING CURRICULUM**

To prepare the student for a professional career in civil engineering, the curriculum listed below is specified. Its flexibility allows considerable freedom to choose courses that best fit a student's interests or objectives. Additional substitutions may be allowed when warranted.

The program design experience begins with the freshman engineering program. Introduction to the design process, ethics, professionalism, economics, and communication skills are presented and explored through individual and team assignments. As the analytical problem-solving capabilities of the students develop in their sophomore and junior years, design projects become more complex and involve engineering specifications, analysis, testing, safety, and societal constraints. Finally, the program design experience is completed with a senior design project. A multi-faceted civil engineering need is identified, and a problem statement is formulated. Alternative solutions are explored, and a detailed design is documented and presented. In the degree program description that follows, an asterisk (\*) indicates those courses that satisfy the University's General Education Requirements.

**BACHELOR OF SCIENCE IN CIVIL ENGINEERING 132 HRS.**

All civil engineering students must sit for the Fundamentals of Engineering (FE) examination as a requirement for graduation.

**PROGRAM REQUIREMENTS****REQUIRED HOURS****WRITTEN COMMUNICATION****6 HRS.**

*ENG	103	English Composition I	(3)
*ENG	133	Technical Communication	(3)

**ORAL COMMUNICATION****3 HRS.**

*SP	203	Effective Speaking	(3)
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**\*SOCIAL SCIENCES & HUMANITIES****12 HRS.**

These hours must be selected in accordance with the Social Sciences & Humanities section of the General Education Requirements.

**COMPUTER LITERACY****3 HRS.**

*EGR	153	Engineering Graphics	(3)
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**MATHEMATICS & SCIENCE****33 HRS.**

(Each course may be replaced with an Honors version.)

*MA	134	Calculus I	(4)
*MA	164	Calculus II	(4)
MA	213	Calculus III	(3)
MA	233	Differential Equations	(3)
MA	393	Probability and Statistics	(3)
CH	104	General Chemistry I	(4)
CH	114	General Chemistry II	(4)
PH	224	University Physics I	(4)
PH	234	University Physics II	(4)

**SCIENCE ELECTIVE****3 HRS.**

(Choose one of the following courses)

**(3)**

BIO	114	Principles of Biology I
BIO	213	Conservation
EAS	253	Weather & Climate
GEO	213	Physical Geography
GLY	273	Geology

**FRESHMAN STUDIES****1 HR.**

GE	101	Introduction to Engineering	(1)
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**ENGINEERING SCIENCE****14 HRS.**

ES	213	Statics	(3)
ES	243	Solid Mechanics	(3)
ES	323	Fluid Mechanics	(3)
ES	382	Engineering Economics	(2)

**ENGINEERING SCIENCE ELECTIVES****3 HRS.**

(Choose one of the 3-credit courses)

**(3)**

ES	223	Dynamics
ES	253	Electrical Circuits

ES 313 Thermodynamics

**ANALYSIS AND DESIGN**

**44 HRS.**

CE	2001	Basic Surveying Laboratory	(1)
CE	2003	Basic Surveying	(3)
CE	3301	Hydraulic Engineering Laboratory	(1)
CE	3303	Hydraulic Engineering	(3)
CE	3101	Environmental Engineering Laboratory	(1)
CE	3103	Environmental Engineering (Aqueous)	(3)
CE	3201	Civil Engineering Materials Laboratory	(1)
CE	3203	Civil Engineering Materials	(3)
CE	3503	Structural Analysis	(3)
CE	3513	Structural Steel Design	
or			
CE	3533	Reinforced Concrete Design	(3)
CE	3603	Transportation Engineering	(3)
CE	3701	Soil Mechanics Laboratory	(1)
CE	3703	Soil Mechanics	(3)
CE	4912	Civil and Envir. Engineering Design Seminar	(2)
CE	4914	Civil and Envir. Engineering Design	(4)

**GEOTECHNICAL ELECTIVES**

(Choose one of the following 3-credit courses) (3)

CE	4703	Special Topics in Geotechnical Engineering	
CE	4713	Foundation Engineering	
CE	4723	Pavement Design	

**ENVIRONMENTAL ELECTIVE**

(Choose one of the following 3-credit courses) (3)

CE	4113	Hazardous Waste Engineering	
CE	4123	Water Treatment Principles and Design	
CE	4133	Wastewater Treatment Principles and Design	

**WATER RESOURCES ELECTIVE**

(Choose one of the following 3-credit courses) (3)

CE	4303	Open Channel Hydraulics	
CE	4323	Engineering Hydrology	
CE	4333	Water Distribution and Design of Sewers	

**BUSINESS ELECTIVE**

**3 HRS.**

(Choose one of the following 3-credit courses) (3)

AC	203	Accounting I	
BA	123	Introduction to Business	
BA	343	International Business	
ENT	303	Entrepreneurial Leadership	

**PROFESSIONAL DEVELOPMENT**

**10 HRS.**

GE	401	Professional Practice	(1)
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**IN CONSULTATION WITH ACADEMIC ADVISOR,**

select 9 hours of courses that further professional and career development. (9)

**TOTAL IN DEGREE PROGRAM:**

**132 HRS.**

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# **DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING**

The Department of Electrical and Computer Engineering offers the following degrees:

- Bachelor of Science in Electrical Engineering
- Bachelor of Science in Computer Engineering
- Bachelor of Science in Computer Science

To prepare students for the innovative work required in these areas, students are provided an undergraduate preparation with a foundation in mathematics and science, proper development in communication skills, an understanding of the relevance and impact of engineering and technology on society, and a combination of classroom study and “hands on” laboratory experience.

In addition to academic activities, engineering experience has become a major factor in acquiring a desired position upon graduation. A Cooperative Educational Program (Co-op) is available to enhance the educational experience and provide necessary industrial experience; students are encouraged to participate in this optional program, and the department and Career Services offer help to any student seeking Co-op or summer employment in the majors.

Both engineering programs (the electrical engineering program and the computer engineering program) are accredited by the Engineering Accreditation Commission of ABET.

## **MISSION**

Our Mission in the Department of Electrical and Computer Engineering is to provide our students with the nurturing environment of a small school accompanied by academically rigorous programs that prepare graduates for either immediate employment or entry to graduate school.

## **OBJECTIVES**

We provide programs that assure that our graduates in all programs are prepared to:

1. Devise, choose, and use diagrams or other models to design systems and to communicate engineering ideas.
2. Recognize situations that demand new information, locate it, and use it in their work.
3. Give oral and written reports for communication with peers and decision-makers.
4. Coordinate with colleagues from their own and other disciplines.
5. Recognize their ethical obligations and social responsibilities and maintain awareness of non-technical perspectives.

## **OUTCOMES**

As our accrediting body specifies, engineering programs must demonstrate that their students attain the following outcomes:

- A. An ability to apply knowledge of mathematics, science, and engineering
- B. An ability to design and conduct experiments, as well as to analyze and interpret data
- C. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- D. An ability to function on multidisciplinary teams
- E. An ability to identify, formulate, and solve engineering problems
- F. An understanding of professional and ethical responsibility
- G. An ability to communicate effectively
- H. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
- I. A recognition of the need for, and an ability to engage in, life-long learning

- J. A knowledge of contemporary issues
- K. An ability to use the techniques, skills, and modern engineering tools, necessary for engineering practice.

The Computer Science program enables students to achieve, by the time of graduation:

- A. An ability to apply knowledge of computing and mathematics appropriate to the discipline
- B. An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution
- C. An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs
- D. An ability to function effectively on teams to accomplish a common goal
- E. An understanding of professional, ethical, legal, security and social issues and responsibilities
- F. An ability to communicate effectively with a range of audiences
- G. An ability to analyze the local and global impact of computing on individuals, organizations, and society
- H. Recognition of the need for and an ability to engage in continuing professional development
- I. An ability to use current techniques, skills, and tools necessary for computing practice.

## **PURPOSES**

We of the Trine University Electrical and Computer Engineering Department, fulfill our Mission by providing a dedicated and enhanced learning environment featuring the following components:

- curriculum: rigorous, but carefully shaped to provide a path to success;
- faculty: committed to an excellent undergraduate learning experience;
- classrooms: sized and equipped to promote personal attention;
- laboratories: equipped to provide an excellent laboratory experience through many hands-on experiments with direct guidance from full-time faculty;
- mentoring: promoted at all levels - faculty to student and upperclassman to underclassman;
- peer interaction: fostered by team assignments in classes and membership in student organizations.

## **THE CURRICULA**

Electrical engineering requires 132 semester hours comprising 42 hours of University general education, which overlaps 32 hours of engineering math and sciences with at least one on-site science lab course (even if AP credit would otherwise fulfill the requirement); 60 hours of electrical and computer engineering, with at least one lecture and one lab in each of circuits, analog electronics, digital electronics, signals, systems, an advanced electrical engineering elective area and a capstone project; teamwork; and other major-related courses. For details, see the department chair.

Computer engineering requires 132 semester hours comprising 42 hours of University general education; which overlaps 32 hours of engineering math and sciences with at least one on-site science lab course (even if AP credit would otherwise fulfill the requirement); 60 hours of electrical and computer engineering, with at least one lecture and one lab in each of circuits, analog electronics, digital electronics, and systems together with courses that include lecture and

project work in: software design or engineering, an advanced computer engineering elective area and a capstone project; teamwork; and other major-related courses. For details, see the department chair.

Computer science requires 128 semester hours of course work, with a greater emphasis on the liberal arts. The Bachelor of Science in Computer Science requires that students meet Trine University general education requirements, and succeed in 30 hours of humanities and social science courses, 32 hours of technical math and science, 40 hours of computer science and computer software engineering, and select electives in consultation with a faculty advisor. For details, see the department chair.

Students will be required to provide out-of-course assessments of their learning, which may include surveys, exams, written work samples and sample working prototypes. In the following curriculum listings, an asterisk (\*) indicates that those courses satisfy the University's General Education Requirements. These courses are also placed at the beginning of each of the three program listings for the Electrical and Computer Engineering Department.

## **BACHELOR OF SCIENCE IN COMPUTER ENGINEERING 132 HRS.**

The Computer Engineering Program is accredited by the Engineering Accreditation Commission of ABET.

See the department chair for a prose description of the minimum requirements; the program described below meets all requirements with courses offered at Trine University.

### **PROGRAM REQUIREMENTS** **REQUIRED HOURS**

#### **WRITTEN COMMUNICATION** **6 - 7 HRS.**

- \*ENG 103 English Composition I
  - or
  - \*ENG 104 Intensive English Composition I (3-4)
  - \*ENG 133 Technical Communication (3)
- (Note: With permission, ENG 113 may substitute for ENG 133.)

#### **ORAL COMMUNICATION** **3 HRS.**

- \*SP 203 Effective Speaking (3)

#### **\*SOCIAL SCIENCE AND HUMANITIES** **12 HRS.**

- (University General Education restrictions apply.) (12)

#### **COMPUTER LITERACY** **3 HRS.**

- \*CS 1113 Object-Oriented Java Programming (3)

#### **MATHEMATICS AND SCIENCE** **32 HRS.**

- \*MA 134 Calculus I (4)
- \*MA 164 Calculus II (4)
- MA 213 Calculus III (3)
- MA 233 Differential Equations (3)
- MA 393 Probability & Statistics (3)
- MA 473 Discrete Mathematics (3)
- \*CH 104 General Chemistry I
- or
- \*CH 104H Honors General Chemistry I (4)
- \*PH 224 University Physics I
- or

*PH	224H	Honors University Physics I	(4)
*PH	234	University Physics II	
		or	
*PH	234H	Honors University Physics II	(4)

**ENGINEERING SCIENCE** **5 -6 HRS.**  
(This may not include ES 253, Electrical Science)

**GENERAL ENGINEERING** **2 HRS.**  
GE 101 Introduction to Engineering (1)  
GE 401 Professional Practice (1)

**ELECTRICAL AND COMPUTER ENGINEERING COMMON CORE** **31 HRS.**  
ECE 103 Prototyping and Projects (3)  
ECE 211 Circuit Analysis Lab (1)  
ECE 213 Circuit Analysis (3)  
ECE 231 Discrete Electronics Laboratory (1)  
ECE 233 Discrete Electronics (3)  
ECE 243 Analog Signals (3)  
ECE 261 Digital Systems Lab (1)  
ECE 263 Digital Systems (3)  
ECE 271 Microcontrollers Lab (1)  
ECE 273 Microcontrollers (3)  
ECE 453 Random Processes in ECE (3)  
ECE 4001 Contemporary Issues for Engineers (1)  
ECE 4002 Project Management (2)  
ECE 4003 Design Project (3)

**COMPUTER ENGINEERING CONCENTRATION COURSES** **23 HRS.**  
CS 1123 C++ and Object-Oriented Design (3)  
ECE 361 Logic and Computer Design Lab (1)  
  
ECE 363 Logic and Computer Design (3)  
ECE 371 Embedded Systems Lab (1)  
ECE 373 Embedded Systems (3)  
CO/CS/ECE Elective (12)

**OTHER ELECTIVES** **15 HRS.**  
Choose other technical or non technical electives with your advisor's consent to reach 132 hours from among all ECE courses.

**TOTAL IN DEGREE PROGRAM:** **132 HRS.**

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In the following curriculum listings, an asterisk (\*) indicates that those courses satisfy the University's General Education Requirements.

**BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING 132 HRS**

The Electrical Engineering Program is accredited by the Engineering Accreditation Commission of ABET. See the department chair for a prose description of the minimum requirements; the program described below meets all requirements with courses offered at Trine University

<b>PROGRAM REQUIREMENTS</b>	<b>REQUIRED HOURS</b>
<b>WRITTEN COMMUNICATION</b>	<b>6 - 7 HRS.</b>
*ENG 103 English Composition I	
or	
*ENG 104 Intensive English Composition I	(3-4)
*ENG 133 Technical Communication	(3)
(Note: With permission, ENG 113 may substitute for ENG 133.)	
<b>ORAL COMMUNICATION</b>	<b>3 HRS.</b>
*SP 203 Effective Speaking	(3)
<b>*SOCIAL SCIENCE AND HUMANITIES</b>	<b>12 HRS.</b>
(University General Education restrictions apply.)	
	(12)
<b>COMPUTER LITERACY</b>	<b>3 HRS.</b>
*CS 1113 Object-Oriented Java Programming	(3)
<b>GENERAL EDUCATION MATHEMATICS AND SCIENCE</b>	<b>32 HRS.</b>
*MA 134 Calculus I	(4)
*MA 164 Calculus II	(4)
MA 213 Calculus III	(3)
MA 233 Differential Equations	(3)
MA 393 Probability & Statistics	(3)
MA Advanced Math Elective	(3)
*CH 104 General Chemistry I	
or	
*CH 104H Honors General Chemistry I	(4)
*PH 224 University Physics I	
or	
*PH 224H Honors University Physics I	(4)
*PH 234 University Physics II	(4)
or	
*PH 234H Honors University Physics II	(4)
<b>ENGINEERING SCIENCE</b>	<b>5 - 6 HRS.</b>
(This may not include ES 253, Electrical Science)	
<b>GENERAL ENGINEERING</b>	<b>2 HRS.</b>
GE 101 Introduction to Engineering	(1)
GE 401 Professional Practice	(1)
<b>ELECTRICAL AND COMPUTER ENGINEERING COMMON CORE</b>	<b>31 HRS.</b>
ECE 103 Prototyping and Projects	(3)
ECE 211 Circuit Analysis Lab	(1)
ECE 213 Circuit Analysis	(3)
ECE 231 Discrete Electronic Laboratory	(1)
ECE 233 Discrete Electronics	(3)
ECE 243 Analog Signals	(3)
ECE 261 Digital Systems Lab	(1)
ECE 263 Digital Systems	(3)
ECE 271 Microcontrollers Lab	(1)

ECE	273	Microcontrollers	(3)
ECE	453	Random Processes in ECE	(3)
ECE	4001	Contemporary Issues for Engineers	(1)
ECE	4002	Project Management	(2)
ECE	4003	Design Project	(3)

**ELECTRICAL ENGINEERING CONCENTRATION 23 HRS.**

ECE	301	Electrical Machines Laboratory	(1)
ECE	303	Electrical Machines	(3)
ECE	323	Dynamic Electromagnetic Fields	(3)
ECE	481	Instrument Systems Laboratory	(1)
ECE	483	Instrument Systems	(3)
CO/CS/ECE		Elective Courses	(12)

\*Must include DSP and Lab or Communications and Lab.

**OTHER ELECTIVES 15 HRS.**

Choose other technical or non-technical electives with your advisor's consent to reach 132 hours.

**TOTAL IN DEGREE PROGRAM: 132 HRS.**

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**BACHELOR OF SCIENCE IN COMPUTER SCIENCE 128 HRS.**

**PROGRAM REQUIREMENTS REQUIRED HOURS**

**WRITTEN COMMUNICATION 6-7 HRS.**

*ENG	103	English Composition I	
or			
*ENG	104	Intensive English Composition I	(3-4)
*ENG	133	Technical Communication	(3)

(Note: With permission, ENG 113 may substitute for ENG 133.)

**ORAL COMMUNICATION 3 HRS.**

*SP	203	Effective Speaking	(3)
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**\*GENERAL EDUCATION SOCIAL SCIENCE AND HUMANITIES 12 HRS.**

(University General Education restrictions apply.) (12)

**COMPUTER SCIENCE PROGRAM HUMANITIES & SOCIAL SCIENCE 18 HRS.**

Additional courses as listed in the table of Social Sciences and Humanities under General Education Requirements for All Bachelor's Degrees.

**COMPUTER LITERACY 3 HRS.**

*CS	1113	Object-Oriented Java Programming	(3)
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**MATHEMATICS AND SCIENCE 32 HRS.**

*MA	134	Calculus I	(4)
*MA	164	Calculus II	(4)
MA	213	Calculus III	(3)
MA	323	Operations Research	(3)
MA	393	Probability and Statistics	(3)

MA	473	Discrete Mathematics	(3)
		Lab Science Electives	(12)

**GENERAL ENGINEERING** **2 HRS.**

GE	101	Introduction to Engineering	(1)
GE	401	Professional Practice	(1)

**COMPUTER SCIENCE CORE** **38 HRS.**

CS	1123	C++ & Object-Oriented Design	(3)
CS	1303	Introduction to the World Wide Web	(3)
CS	2103	Algorithm Design & Analysis	(3)
CS	2213	Architecture and Operating Systems	(3)
CS	2503	Software Engineering & User Interfaces	(3)
CS	2613	AI & Information	(3)
CS	3223	Network Architecture	(3)
CS	3303	Net-Centric Computing	(3)
ECE	261/263	Digital Systems and Lab	(4)
ECE	271/273	Microcontrollers and Lab	(4)
ECE	393	Software Analysis and Design	(3)
CS	4903	Capstone Project	(3)

**COMPUTER SCIENCE ADVANCED TECHNICAL ELECTIVE** **3 HRS.**

CS	4033	Special Topics	
		or	
CS	4023	Compiler Construction	
		or	
CS	4013	Computer Graphics	(3)

**COMPUTER SCIENCE OTHER PROGRAM ELECTIVES** **10-11 HRS.**

Choose with the direction of your advisor. Especially encouraged are the Computer Science Technical Electives above, ECE 371/373 Embedded Systems, advanced mathematics, and Entrepreneurship (ENT) Courses.

**TOTAL IN DEGREE PROGRAM** **128 HRS.**

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## **WADE DEPARTMENT OF MECHANICAL & AEROSPACE ENGINEERING**

The Dr. Forrest V. Wade Department of Mechanical & Aerospace Engineering was named in honor of Dr. Forrest V. Wade, a 1930 mechanical engineering graduate. The department offers the following undergraduate degree:

- Bachelor of Science in Mechanical Engineering

Mechanical engineering is, perhaps, the most diverse and general of all the engineering fields. Mechanical engineers can be found working in almost any company. Manufacturing, transportation, health care, and insurance are some of the types of firms that employ mechanical engineers. No other field of engineering provides a better professional base for interdisciplinary activities.

Mechanical engineers design machines of all types, from paper clips to space shuttles. They plan, design, and direct the manufacture, distribution, and operation of these machines. Mechanical engineers also design the power sources needed to operate the machines and provide for the environment in which they function. In fact, mechanical engineering involves all phases of energy production and utilization: engines, power plants, electrical generation, heating, ventilating, and air conditioning.

Those mechanical engineers who choose to specialize in the aerospace area are particularly suited for employment in vehicle design. They may be involved in the design of aircraft, spacecraft, missiles, automobiles, trucks, buses, trains, or ships. Their specialized knowledge of lightweight structures and efficient, low drag design take on added importance as fuel costs increase.

Other mechanical engineers may specialize in the area of metallurgy and focus on the relationships among the structure, properties, processing and performance of metals. These engineers will be involved in product design, process development, and equipment design in addition to material specification, failure analysis, and implementing manufacturing processes.

### **BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING**

Due to the diverse nature of the profession, the mechanical engineering education must provide a very broad base of studies. To be successful a mechanical engineer must be able to communicate knowledge and ideas to others; thus communication skills are an important part of the engineer's preparation. Studies in the social sciences and humanities develop an understanding of the relevance and impact of engineering and technology on society. Mathematics provides the engineer with the tools needed to build on the scientific foundations of chemistry and physics. The engineering sciences, common to all engineering disciplines, provide a broad foundation for the design of both thermal and mechanical systems, which are at the core of mechanical engineering.

Engineering creativity cannot be developed by theory alone; an engineer learns by doing. Thus, the laboratory courses stress hands-on work and the project design courses involve real-world problems. Multidisciplinary teams, involving students from business, technology, and/or other engineering programs in the senior design projects prepare students for the team design approach common in industry. A cooperative education program, incorporating alternating periods of full-time work and fulltime school, is available to enhance the education and provide valuable engineering experience. Students are encouraged to participate in this optional program.

The mechanical engineering program is accredited by the Engineering Accreditation Commission of ABET.

## **MISSION AND OBJECTIVES**

The mission of the mechanical engineering program at Trine University is to enable students to become productive mechanical engineers, to advance to leadership roles in the profession, and to provide service to society. To meet these goals the program has established the following educational objectives:

To provide graduates with high quality preparation for the practice of mechanical engineering and related disciplines at the professional level;

To offer graduates opportunities to pursue graduate studies, lifelong learning, and to offer services to their professions;

To supply technical expertise and engineering and education services to industry and the community.

At graduation the mechanical engineering student must have:

The ability to communicate ideas clearly and effectively in writing, orally, and graphically;

An awareness of the engineer's social responsibilities with an appreciation of human achievements and insight into human behavior and culture;

Knowledge of multivariate calculus and differential equations and familiarity with linear algebra and statistics and the ability to apply this knowledge to the solution of engineering problems;

Fundamental knowledge of natural phenomena and their quantitative expression in chemistry and physics;

Knowledge of the engineering sciences, including electrical science, and the ability to apply this knowledge creatively;

The ability to work professionally in the areas of both thermal and mechanical systems design;

The ability to integrate technical knowledge through tradeoff studies leading to an engineering design;

Knowledge of contemporary analytical, computational, and experimental practices; and

Competence in experimental design, data collection, data analysis, and the use of computational tools.

## **THE MECHANICAL ENGINEERING CURRICULUM**

The first year of the mechanical engineering program is devoted to developing knowledge and skills in communication, mathematics, and the natural sciences. Students are introduced to the mechanical engineering profession through the courses "Introduction to Engineering" and "Engineering Graphics." In the second year the fundamental courses in the engineering sciences provide the foundation for engineering design. The design process is formalized in the junior year in the courses "Computer-Aided Machine Design" and "Thermo-Fluid Component Design." The other courses in the third year emphasize engineering analysis and design in the areas of thermal and mechanical systems. The year-long senior design project integrates the previous studies into the design of a machine or system, often resulting in fabrication and testing of a prototype. A professional atmosphere is developed through multidisciplinary teams and industry originated projects in the senior design sequence. In the following curriculum listing, an asterisk (\*) indicates that those courses satisfy the University's General Education Requirements.

<b>PROGRAM REQUIREMENTS</b>	<b>REQUIRED HOURS</b>
<b>COMMUNICATION SKILLS</b>	<b>12 HRS.</b>
*ENG 103 English Composition I	(3)
*ENG 133 Technical Communication	(3)
EGR 143 Engineering Graphics	(3)
*SP 203 Effective Speaking	(3)
 <b>*SOCIAL SCIENCE AND HUMANITIES</b>	 <b>12 HRS.</b>
ECO 213 Microeconomics	(3)
Social Science and Humanities Electives	(9)
Students must choose social science and humanities electives that, with ECO 213, satisfy the University's General Education Requirements. See page 48.	
 <b>*MATHEMATICS</b>	 <b>20 HRS.</b>
MA 134 Calculus I	(4)
MA 164 Calculus II	(4)
MA 213 Calculus III	(3)
MA 233 Differential Equations	(3)
MA 313 Linear Algebra	(3)
MA 393 Probability and Statistics	(3)
 <b>*SCIENCE</b>	 <b>12 HRS.</b>
CH 104 General Chemistry I	
or	
CH 104H Honors General Chemistry I	(4)
PH 224 University Physics I	
or	
PH 224H Honors University Physics I	(4)
PH 234 University Physics II	
or	
PH 234H Honors University Physics II	(4)
 <b>ENGINEERING SCIENCE</b>	 <b>23 HRS.</b>
ES 213 Statics	(3)
ES 223 Dynamics	(3)
ES 233 Engineering Materials	(3)
ES 243 Solid Mechanics	(3)
ES 253 Electrical Science	(3)
ES 313 Thermodynamics	(3)
ES 343 Heat Transfer	(3)
ES 382 Engineering Economics	(2)
 <b>MECHANICAL ENGINEERING CORE</b>	 <b>36 HRS.</b>
MAE 203 Mechanical Engineering Analysis	(3)
MAE 243 Manufacturing Processes and Equipment	(3)
MAE 303 Mechanics of Machinery	(3)
MAE 323 Thermodynamics II	(3)
MAE 3033 Fluid Dynamics for Mechanical Engineers	(3)
MAE 353 Machine Component Design	(3)
MAE 373 Computer-Aided Machine Design	(3)
MAE 413 Thermo-Fluid Component Design	(3)

MAE	453	Mechanical Vibration	
or			
MAE	4023	System Dynamics & Controls	(3)
MAE	463	Measurement Laboratory	(3)
MAE	4053	Mechanical Engineering Design I	(3)
MAE	4063	Mechanical Engineering Design II	(3)

**PROFESSIONAL DEVELOPMENT** **2 HRS.**

GE	101	Introduction to Engineering	(1)
GE	401	Professional Development	(1)

**MECHANICAL ENGINEERING ELECTIVES** **9 HRS.**

Electives may be 300-level or higher, for an Architectural or Robotics minor, electives may be selected from other technical discipline.

UNRESTRICTED ELECTIVES 6 HRS.

**TOTAL IN DEGREE PROGRAM:** **132 HRS.**

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## **DEPARTMENT OF TECHNOLOGY**

The Department of Technology offers the following degree:

- Bachelor of Science in Design Engineering Technology

Modern society demands a variety of skills and educational achievements to cover a wide range of scientific and technological positions. The problems confronting business, industry, and government require large numbers of technicians and technologists, as well as engineers and scientists.

The Department of Technology curricula emphasize many of the underlying principles of component design and the skills required to communicate with the engineer, scientist, and production personnel. Elective course offerings within the academic programs provide the student with the opportunity to minor in areas such as business, management, or finance.

### **DESIGN ENGINEERING TECHNOLOGY CURRICULUM**

The Design Engineering Technology curriculum places an emphasis on the activities of the modern engineering department. The program provides the skills and knowledge to advance in industry to the upper levels of supervision. Knowledge of computers, management, advanced CAD, engineering specifications, and applied engineering design are part of this program. The technologist trained in this area will be able to supervise and develop the technical communications necessary in the engineering and scientific professions. This program is approved and supported by industries in need of professionally trained technologists.

In the degree program descriptions that follow, an asterisk (\*) indicates that those courses satisfy the University's General Education Requirements.

### **BACHELOR OF SCIENCE IN DESIGN ENGINEERING TECHNOLOGY 127 HRS.**

#### **DESIGN ENGINEERING TECHNOLOGY MAJOR**

##### **PROGRAM REQUIREMENTS**

##### **REQUIRED HRS.**

##### **WRITTEN COMMUNICATION**

**6 HRS.**

\*ENG 103 English Composition I

(3)

\*ENG 133 Technical Communication

(3)

##### **ORAL COMMUNICATION**

**3 HRS.**

\*SP 203 Effective Speaking

(3)

##### **SOCIAL SCIENCES & HUMANITIES**

**14 HRS.**

\*ECO 213 Microeconomics

(3)

\*ECO 223 Macroeconomics

(3)

Humanities Elective

(2)

Electives

(6)

(These hours must also be selected in accordance with the Social Sciences & Humanities section of the University's general education requirements found on page 48.)

##### **COMPUTER LITERACY**

**3 HRS.**

\*INF 103 Information Technology Applications

(3)

##### **MATHEMATICS & SCIENCE**

**25 HRS.**

\*MA 113 College Algebra

(3)

*MA	123	Trigonometry	(3)
*MA	134	Calculus I	(4)
MA	253	Statistics	(3)
*PH	154	College Physics I	(4)
*PH	164	College Physics II	(4)
*CH	144	Chemistry - Ideas and Applications	(4)

**FRESHMAN STUDIES** **1 HR.**

UE	101	University Experience	(1)
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**AREA OF CONCENTRATION** **48 HRS.**

ETD	103	Basic Technical Drawing	(3)
ETD	113	Geometric Dimensioning and Tolerancing	(3)
ETD	123	Manufacturing Materials and Processes	(3)
ETD	163	Environmental Health & Safety	(3)
ETD	173	Computer Aided 3-D Modeling (Solid Works)	(3)
ETD	203	Basic Mechanisms	(3)
ETD	233	Engineering & Manufacturing Systems	(3)
ETD	243	Statics and Strength of Materials	(3)
ETD	253	Dimensional Metrology	(3)
ETD	263	Design, Analysis & Prototyping	(3)
ETD	273	Electrical Fundamentals	(3)
ETD	323	Product Design & Development	(3)
ETD	363	Elements of Machines	(3)
ETD	423	Senior Design Project	(3)
ETD	433	Computer Numerical Control	(3)
EGR	453	Advanced Parametric Design (Unigraphics)	(3)

**MANAGEMENT** **9 HRS.**

MGT	363	Organizational Behavior	(3)
Business electives			(6)

**ELECTIVES** **18 HRS.**

Twelve (12) credit hours must be selected from any 300- or 400-level course offered with approval of the advisor. Six (6) credit hours may be selected from any course offered with approval of the advisor.

**TOTAL IN DEGREE PROGRAM:** **127 HRS.**

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