

## ENGINEERING & DESIGN

*College of Science, Health & Engineering*

Claudio Talarico, Chair

319E Computing &  
Engineering Building

509.359.4780

BS

Minor

*Faculty:*

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### UNDERGRADUATE PROGRAMS

Students studying in the Department of Engineering & Design (DESN/ENGR/TECH) may select from a broad number of disciplines that include Electrical Engineering, Mechanical Engineering Technology, Mechanical Engineering, Visual Communication Design, Construction, Design and Manufacturing. The primary goal of the Department of Engineering & Design is to provide students with the technical background required for careers in business and industry. Coursework within each program offers experiences in many areas of technology that enhance the preparation of technology graduates.

The Department of Engineering & Design faculty, facilities and equipment reflect a commitment to maintaining program relevance. Computer-assisted drafting and manufacturing, networking, signal processing, microprocessors, power systems, digital communication, electronics, integrated circuits design, graphic design/web design, robotics and materials processing laboratories and a variety of engineering/engineering technology laboratories are constantly being updated with new equipment. Articulation and research with industry have resulted in programs that address the latest trends in industry. These efforts have consistently offered graduates excellent job placement and employment opportunities.

**Engineering & Design Departmental Scholarship Information:** The department awards two scholarships annually: the M. W. Consulting Engineering Scholarship and Aaron G. Mertens memorial scholarship. These scholarships are awarded to our majors based on academic qualifications and need.

**General Admissions Information for Engineering & Design:** Students entering the Bachelor of Science degree program as juniors should have completed one year of physics as well as mathematics through precalculus. Failure to complete the mathematics and physics requirements before the junior year likely will delay graduation.

In order to graduate, students majoring in the department must earn a 2.5 GPA in departmental coursework. Students getting a minor in the department must also earn a 2.5 GPA in departmental coursework.

**Pre-Engineering Program (Engineering Transfer):** This engineering transfer program prepares students for transfer to other four-year engineering schools that offer programs not available at Eastern Washington University. Engineering students may select from many areas of engineering including aeronautical, computer, mechanical, civil, chemical, metallurgical, industrial and agricultural. This program has been coordinated with Washington State University and the University of Washington. Typically, engineering students transfer at the beginning of their junior year.

**Required courses in the following programs of study may have prerequisites. Reference the course description section for clarification.**

### **BACHELOR OF SCIENCE (BS)**

**STUDENT LEARNING OUTCOMES – STUDENTS WILL**

- design and conduct experiments, as well as analyze and interpret data;
- develop an understanding of professional and ethical responsibility;
- develop a knowledge of contemporary issues in the field;
- use the techniques, skills and modern engineering tools necessary for engineering practice;
- 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;
- communicate effectively.

### **ELECTRICAL ENGINEERING (150-152 CREDITS)**

This degree combines studies in selected areas of engineering, physics, mathematics, and science to prepare students to solve real-world problems in electrical engineering. The Electrical Engineering curriculum is accredited by the Technology Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4102, telephone 410.347.7700.

The first two years of the curriculum allow students to establish a solid foundation in mathematics and sciences. The third year curriculum introduces students to a broad spectrum of electrical engineering coursework with specialization and capstone introduced into the fourth year. The senior year capstone course allows the students to consolidate their education experience with the solution of practical engineering problems provided by industry.

The primary objective of the electrical engineering program is to prepare students to enter and progress in electrical engineering positions in business, industry and government. Graduates are generally expected to work in the research and development of ideas, products and processes by applying engineering principles to the solution of practical problems in the electrical engineering field.

**Required Courses (77-78 credits)**

- ENGR 160 Digital Circuits (4)
- ENGR 209 Circuit Theory I (5)
- ENGR 210 Circuit Theory II (5)
- ENGR 250 Digital Hardware (2)
- ENGR 260 Microcontroller Systems (4)
- ENGR 320 Signals and Systems I (5)
- ENGR 321 Signals and Systems II (5)
- ENGR 330 Microelectronics I (5)
- ENGR 331 Microelectronics II (5)
- ENGR 350 Energy Systems (5)
- ENGR 360 Hardware Description Languages (5)
- ENGR 401 Engineering Applied Electromagnetics (5)  
or PHYS 401 Electromagnetism I (4)
- ENGR 420 Digital Signal Processing (5)
- ENGR 430 CMOS Integrated Circuits Design (5)
- ENGR 440 Digital Communication Systems (5)
- ENGR 490 Senior Capstone: Design Laboratory (4)  
or TECH 490 Senior Capstone: Production Laboratory (4)
- TECH 393 Technology in World Civilization (4)

**Supporting Courses (64 credits)**

- CHEM 151 General Chemistry (5)
- CSCD 255 C Programming for Engineers (5)
- ENGL 205 Introduction to Technical Writing (5)  
or ENGR 381 Laboratory Analysis and Report (5)
- ENGR 383 Applied Stochastic Processes (4)  
or MATH 383 Stochastic Processes (4)
- ENGR 388 Applied Stochastic Processes Lab (1)  
or MATH 307 Mathematical Computing Laboratory (1)
- MATH 161 Calculus I (5)
- MATH 162 Calculus II (5)
- MATH 163 Calculus III (5)
- MATH 231 Linear Algebra (5)
- MATH 241 Calculus IV (5)
- MATH 347 Introductory Differential Equations (4)
- PHYS 151 General Physics I (4)
- PHYS 152 General Physics II (4)
- PHYS 153 General Physics III (4)
- PHYS 161 Mechanics Lab (1)
- PHYS 162 Heat and Optics Lab (1)
- PHYS 163 Instrumentation Lab I (1)

**Electrical Engineering electives chosen from the following (10 credits)**

- ENGR 450 Power Systems Analysis (5)
- ENGR 460 Computing Systems: Organization and Design (5)
- ENGR 461 Embedded System Design (5)
- ENGR 470 Control Systems (5)
- ENGR 495 Internship (5)
- PHYS 221 Physics IV (4)  
and PHYS 164 Instrumentation Lab II (1)

**Required program credits**

**77-78 credits**

**Supporting credits**

**64 credits**

**Electrical engineering elective credits**

**10 credits**

**Minimum total credits for above degree**

**151 credits**

*Note:* Including university requirements, the above program requires a minimum of 183 credits, or an average of 15.25 credits per quarter for a 12 quarter, four-year program. The 183 credits are based upon the following assumptions: a. Students will enter EWU prepared to take calculus. If this assumption is not true, then the student will have to complete MATH 105 *Precalculus I* (5) and MATH 106 *Precalculus II* (5); b. Students will have satisfied university competencies. If this assumption is not true, then the student will have to complete up to six more credits of classes. (See university competencies in this catalog.)

## **BACHELOR OF SCIENCE (BS)**

### **STUDENT LEARNING OUTCOMES – STUDENTS WILL:**

- show respect for diversity and a knowledge of contemporary professional, societal and global issues;
- develop the ability to understand professional, ethical or social responsibilities.
- function effectively on teams;
- communicate effectively;
- develop appropriate mastery of the knowledge, techniques, skills and modern tools of their disciplines;
- conduct, analyze and interpret experiments and apply results to improve processes.

## **MECHANICAL ENGINEERING (145–146 CREDITS)**

This degree combines studies in selected areas of engineering, physics, mathematics, and science to prepare students to solve real-world problems in mechanical engineering. The first two years of the curriculum allow students to establish a solid foundation in mathematics, sciences and introduces foundation subjects in mechanical engineering. The third and fourth year curriculum explores further areas in Mechanical Engineering and a capstone is introduced into the fourth year. The senior year capstone course allows the students to consolidate their education experience. The primary objective of the Mechanical Engineering program is to prepare students to enter and progress in mechanical engineering positions in business, industry and government. Graduates are generally expected to work in the research and development of ideas, products and processes by applying engineering principles to the solution of practical problems in the mechanical engineering field.

Please note that the BSME program at Eastern Washington University is a new program and has not yet been accredited by ABET. As a new program, we cannot apply for certification until our first cohort of students receives their degrees. Once the accreditation is formally granted our graduating students will be retroactively included. Our BSME program has been modeled after other ABET-accredited programs and EWU will apply for ABET as soon as the first cohort of students receives their degree. In the state of Washington to have a non-ABET engineering degree may delay one's possibility to apply for engineering licensure. For more information about the engineering licensure in the state of Washington, please visit [HTTP://WWW.DOL.WA.GOV/BUSINESS/ENGINEERSANDSURVEYORS/ELREQ.HTML](http://www.dol.wa.gov/business/engineersandsurveyors/elreq.html). For more information about the ABET accreditation process, please visit [HTTP://WWW.ABET.ORG](http://www.abet.org).

### **Required Courses (100–101 credits)**

- ENGR 201 Introduction to Matlab (4)  
or CSCD 255 C Programming for Engineers (5)
- ENGR 207 Electricity (4)
- ENGR 217 3D Parametric Computer Aided Drafting (4)
- ENGR 240 Statics (4)
- ENGR 241 Strength of Materials (4)
- ENGR 242 Dynamics (4)
- ENGR 353 Industrial Materials (5)
- ENGR 380 Thermodynamics (5)
- ENGR 381 Laboratory Analysis and Reports (5)
- ENGR 382 Fluid Mechanics (5)
- ENGR 385 Robotics and Automation (5)
- ENGR 386 Engineering Numerical Analysis (5)
- ENGR 405 Design of Machine Elements (5)
- ENGR 407 Heating, Ventilating and Air Conditioning (5)
- ENGR 412 Fundamentals of Engineering (2)
- ENGR 444 Heat Transfer (5)
- ENGR 452 Engineering Economics (2)
- ENGR 456 Engineering Ethics, Contracts and Patents (2)
- ENGR 490 Senior Capstone: Design Laboratory (4)
- ENGR 492 Finite Element Analysis (5)
- ENGR 493 Senior Seminar (1)
- ENGR 495 Internship (6)\*
- TECH 301 Metallic Processes (5)
- TECH 393 Technology in World Civilization (4)

### **Supporting Courses (45 credits)**

- CHEM 151 General Chemistry (5)
- MATH 161 Calculus I (5)
- MATH 162 Calculus II (5)
- MATH 163 Calculus III (5)
- MATH 241 Calculus IV (5)
- MATH 347 Differential Equations (5)
- PHYS 151 General Physics I (4)
- PHYS 152 General Physics II (4)
- PHYS 153 General Physics III (4)
- PHYS 161 Mechanics Lab (1)
- PHYS 162 Heat and Optics Lab (1)
- PHYS 163 Instrumentation Lab I (1)

### **Required program credits**

**100–101 credits**

### **Supporting credits**

**45 credits**

### **Minimum total credits for above degree**

**145 credits**

\* If an internship cannot be found by student, independent study TECH 491 Senior Project (6) may be substituted.

*Note:* Including university requirements for the degree the above program requires a minimum of 186 credits or an average load of 15.5 credits per quarter, for a 12 quarter, four-year program. The 186 credits are based on the following assumption: a. Students have had one year of high school drafting. If this assumption is not true, then the student will have to take ENGR 102 (4).

## **BACHELOR OF SCIENCE (BS)**

### **STUDENT LEARNING OUTCOMES – STUDENTS WILL:**

- show respect for diversity and a knowledge of contemporary professional, societal and global issues;
- develop the ability to understand professional, ethical or social responsibilities.
- function effectively on teams;
- communicate effectively;
- develop appropriate mastery of the knowledge, techniques, skills and modern tools of their disciplines;
- conduct, analyze and interpret experiments and apply results to improve processes.

## **MECHANICAL ENGINEERING TECHNOLOGY (143 CREDITS)**

This degree combines studies of Mathematics, Computer Science, Physics and Engineering Technology. The Mechanical Engineering Technology curriculum (accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology 111 Market Place, Suite 1050, Baltimore, MD 21202; telephone (410.347.7700) includes courses fundamental to Mechanical Engineering Technology with an emphasis on applications. Before graduation each student will participate in a design project or an internship in industry to gain industrial experience during his or her academic career before employment. The emphasis of this program is the application of engineering principles to the solution of practical problems. MET graduates are in great demand and are employed in a variety of interesting, high-tech careers throughout the state and region. Employment opportunities are available in mechanical design, industrial engineering technology, industrial management, manufacturing, CAD, applied research and sales and service.

### **Required Courses (79 credits)**

- ENGR 110 Engineering Graphics (5)
- ENGR 207 Electricity (4)
- ENGR 217 3D Parametric Computer Aided Drafting (4)
- ENGR 353 Industrial Materials (5)
- ENGR 380 Thermodynamics (5)
- ENGR 382 Fluid Mechanics (5)
- ENGR 385 Robotics and Automation (5)
- ENGR 405 Design of Machine Elements (5)
- ENGR 412 Fundamentals of Engineering (2)
- ENGR 452 Engineering Economics (2)
- ENGR 456 Engineering Ethics, Contracts, and Patents (2)
- TECH 301 Metallic Processes (5)
- TECH 340 Statics (4)
- TECH 341 Strength of Materials (4)
- TECH 342 Dynamics (4)
- TECH 393 Technology in World Civilization (4)
- TECH 403 Computer-Aided Design and Project Management (4)
- TECH 490 Senior Capstone: Production Laboratory (4)
- TECH 495 Internship (6)\*

### **Supporting Courses (39–40 credits)**

- CHEM 151 General Chemistry (5)
- CSCD 255 C Programming for Engineers (5)  
or CSCD 409 Introduction to Systems Modeling (4) (see note below)  
or ENGR 201 MATLAB (4)
- ENGL 205 Introduction to Technical Communication (5)  
or ENGR 381 Laboratory Analysis and Reports (5)
- MATH 161 Calculus I (5)
- MATH 162 Calculus II (5)
- PHYS 131 Introductory Physics I (4)  
or PHYS 151 General Physics I (4)
- PHYS 132 Introductory Physics II (4)  
or PHYS 152 General Physics II (4)
- PHYS 133 Introductory Physics III (4)  
or PHYS 153 General Physics III (4)
- PHYS 161 Mechanics Lab (1)
- PHYS 162 Heat and Optics Lab (1)
- PHYS 163 Instrumentation Lab I (1)

**Electives (from the following areas) (10 credits)**

MATH electives (typically MATH 105 and 106) (10)

**Choose one of the following Tracks**

**Design Track (16 credits)**

- ENGR 407 Heating, Ventilation and Air Conditioning (5)
- ENGR 384 Energy Management and Utilization (5)
- ENGR 492 Finite Element Analysis (5)
- ENGR 493 Senior Seminar (1)

**Manufacturing Track (15 credits)**

- ENGR 493 Senior Seminar (1)
- TECH 402 Machine Tool I (5)
- TECH 404 Computer Numerical Control (5)
- TECH 458 Quality Assurance (4)
  - or TECH 462 Industrial Safety Engineering (4)
  - or TECH 406 Welding Technology (4)

**Total required credits** **79 credits**

**Minimum total supporting credits** **39 credits**

**Minimum total mathematics elective credits** **10 credits**

**Total engineering technology track credits** **15–16 credits**

**Minimum total credits for above degree** **143 credits**

*\* If an internship cannot be found by student, independent study TECH 491 Senior Project (6) may be substituted.*

*Note:* Including university requirements for the degree the above program requires a minimum of 186 credits or an average load of 15.5 credits per quarter, for a 12 quarter, four-year program. The 186 credits are based on the following assumption: a. Students have had one year of high school drafting. If this assumption is not true, then the student will have to take ENGR 102 (4).

## **BACHELOR OF SCIENCE (BS)**

**STUDENT LEARNING OUTCOMES – STUDENTS WILL:**

- develop an appropriate mastery of the knowledge, techniques, skills and modern tools of their disciplines;
- develop a recognition of the need for, and the ability to engage in, lifelong learning;
- develop a commitment to quality, timeliness and continuous improvement;
- communicate effectively;
- identify, analyze and solve technical and creative problems;
- develop an ability to understand professional, ethical or social responsibilities.

## **TECHNOLOGY WITH APPLIED TECHNOLOGY OPTION (91 CREDITS)**

This program is designed for students who have graduated with an associate degree in applied arts and sciences (AAAS), associate degree in applied science (AAS), associate degree in technical arts (ATA) in computer technology, electronics technology, mechanical engineering technology, civil engineering technology, drafting/design technology and similarly named programs at community colleges. This degree allows these students to continue their education by taking liberal arts courses, additional advanced technology courses and supporting courses to complete a Bachelor of Science Degree.

**Required Coursework (46 credits)**

- ENGR 452 Engineering Economics (2)
- ENGR 456 Engineering Ethics, Contracts and Patents (2)
- TECH 330 Technology Problem Analysis and Design I (3)
- TECH 331 Technology Problem Analysis and Design II (3)
- TECH 393 Technology in World Civilization (4)
- TECH 403 Computer-Aided Design and Project Management (4)
- TECH 454 Environmental Engineering (2)
- TECH 458 Quality Assurance (4)
- TECH 462 Industrial Safety Engineering (4)
- TECH 490 Senior Capstone: Production Laboratory (4)
- TECH 491 Senior Project (4)
- TECH 495 Internship (10)

**Supporting Courses (45 credits)**

- CHEM 121 Chemistry and its Role in Society (5)
  - or CHEM 151 General Chemistry (5)
- CMST 340 Intercultural Communication (5)
- ECON 100 General Education Economics (5)
- ENGL 205 Introduction to Technical Communication (5)
- General Science Course (5)\*
- HIST 110 American Experience: A Survey (5)
  - or HIST 305 Paths to the American Present (5)
- MATH 106 Pre-Calculus II (5)
  - or MATH 115 Mathematical Reasoning (5)
- PHIL 210 Critical Thinking (5)
- PHYS 100 Physical Science (5)

**Required program credits**

**46 credits**

**Supporting credits**

**45 credits**

**Total credits for above option**

**91 credits**

*Note:* Entrance into this program requires an AAS, AAAS, ATA or similar degree in an approved area from an accredited two-year college. Applicants must have a 2.5 GPA for the Technology coursework in the AAS, AAAS, or ATA degree. Graduation requires maintaining an overall GPA of 2.5 for this option.

*\*Note:* 5 credits in general science in any course equivalent to an EWU approved general science course.

*Note:* this program requires an average of 15–16 credits per quarter to complete in 2 years. The 91 credits are based upon the following assumption: Students will have satisfied university competencies. If this assumption is not true, then the student will have to complete up to six more credits of classes. (See university competencies in this catalog.)

## **TECHNOLOGY WITH CONSTRUCTION MANAGEMENT OPTION (121 CREDITS)**

The construction option focuses on selected areas of technology, physics, construction materials and techniques, emphasizing courses such as construction estimating, soils and surveying, building codes, and architecture. This concentration prepares graduates to enter and progress in supervisory or management positions in the construction industry. Initial employment may be as an estimator, laboratory technician in materials testing, construction inspector or field engineer.

**Required Courses (81 credits)**

- ENGR 110 Engineering Graphics (5)
- ENGR 452 Engineering Economics (2)
- ENGR 456 Engineering Ethics, Contracts and Patents (2)
- TECH 235 Construction Materials and Techniques (5)
- TECH 305 Construction Estimating (4)
- TECH 320 Non-Metallic Processes (5)
- TECH 330 Technology Problem Analysis and Design I (3)
- TECH 331 Technology Problem Analysis and Design II (3)
- TECH 335 Architecture (4)
- TECH 340 Statics (4)
- TECH 341 Strength of Materials (4)
- TECH 345 Soils/Surveying (4)
- TECH 354 Building Codes (4)
- TECH 393 Technology in World Civilization (4)
- TECH 403 Computer-Aided Design and Project Management (4)
- TECH 454 Environmental Engineering (2)
- TECH 458 Quality Assurance (4)
- TECH 462 Industrial Safety Engineering (4)
- TECH 490 Senior Capstone: Production Laboratory (4)
- TECH 491 Senior Project (4)
- TECH 495 Internship (6)

**Supporting Courses (40 credits)**

- CHEM 121 Chemistry and its Role in Society (5)
  - or CHEM 151 General Chemistry (5)
- CMST 340 Intercultural Communication (5)
- ECON 100 General Education Economics (5)
- ENGL 205 Introduction to Technical Communication (5)
- HIST 110 American Experience: A Survey (5)
  - or HIST 305 Paths to the American Present (5)
- MATH 106 Pre-Calculus II (5)
- PHIL 210 Critical Thinking (5)
- PHYS 131 Introductory Physics I (4)
- PHYS 161 Mechanics Lab (1)

**Required program credits**

**81 credits**

**Supporting credits**

**40 credits**

**Total credits for above option**

**121 credits**

*Note:* Including university requirements, the above program requires a minimum of 180 credits, an average of 15 credits per quarter for a 12 quarter, four-year program. The 180 credits are based upon the following assumptions: a. Students have had one year of high school drafting. If this assumption is not true, then the student will have to take ENGR 102 *Introduction to Engineering Graphics* (4); b. Students will have satisfied university competencies. If this assumption is not true, then the student will have to complete up to six more credits of classes. (See university competencies in this catalog.)

## TECHNOLOGY WITH DESIGN OPTION (128 CREDITS)

The design option prepares the graduate for placement in the world of manufacturing. A student graduating with this option should have mastered the basic skills appropriate for the design, development, manufacturing and sale of consumer products. Students should enter the labor force at the middle-management level. The breadth of preparation in the design option provides a broad foundation from which to build and progress.

### Required Courses (83 credits)

- ENGR 110 Engineering Graphics (5)
- ENGR 217 3D Parametric Computer Aided Drafting (4)
- ENGR 353 Industrial Materials (5)
- ENGR 452 Engineering Economics (2)
- ENGR 456 Engineering Ethics, Contracts and Patents (2)
- TECH 208 Survey of Electricity (4)
- TECH 301 Metallic Processes (5)
- TECH 320 Non-Metallic Processes (5)
- TECH 330 Technology Problem Analysis and Design I (3)
- TECH 331 Technology Problem Analysis and Design II (3)
- TECH 340 Statics (4)
- TECH 341 Strength of Materials (4)
- TECH 393 Technology in World Civilization (4)
- TECH 402 Machine Tool I (5)
- TECH 403 Computer-Aided Design and Project Management (4)
- TECH 454 Environmental Engineering (2)
- TECH 458 Quality Assurance (4)
- TECH 462 Industrial Safety Engineering (4)
- TECH 490 Senior Capstone: Production Laboratory (4)
- TECH 491 Senior Project (4)
- TECH 495 Internship (6)

### Supporting Courses (45 credits)

- CHEM 121 Chemistry and its Role in Society (5)  
or CHEM 151 General Chemistry (5)
- CMST 340 Intercultural Communication (5)
- ECON 100 General Education Economics (5)
- ENGL 205 Introduction to Technical Communication (5)
- HIST 110 American Experience: A Survey (5)  
or HIST 305 Paths to the American Present (5)
- MATH 106 Pre-Calculus II (5)
- PHIL 210 Critical Thinking (5)
- PHYS 131 Introductory Physics I (4)
- PHYS 132 Introductory Physics II (4)
- PHYS 161 Mechanics Lab (1)
- PHYS 162 Heat and Optics Lab (1)

**Required program credits** **83 credits**

**Supporting credits** **45 credits**

**Total credits for above option** **128 credits**

*Note:* Including university requirements, the above program requires a minimum of 180 credits, an average of 15 credits per quarter for a 12 quarter, four-year program. The 180 credits are based upon the following assumptions: a. Students have had one year of high school drafting. If this assumption is not true, then the student will have to take ENGR 102 *Introduction to Engineering Graphics* (4); b. Students will have satisfied university competencies. If this assumption is not true, then the student will have to complete up to six more credits of classes. (See university competencies in this catalog.)

## TECHNOLOGY WITH MANUFACTURING OPTION (129 CREDITS)

The manufacturing option focuses on select areas of technology, science and methods of materials processing. This option prepares the student to enter and progress in industry in a variety of areas including, quality assurance, inventory control, production line supervision or process management.

### Required Courses (89 credits)

- ENGR 110 Engineering Graphics (5)
- ENGR 217 3D Parametric Computer Aided Drafting (4)
- ENGR 452 Engineering Economics (2)
- ENGR 353 Industrial Materials (5)
- ENGR 456 Engineering Ethics, Contracts and Patents (2)
- TECH 208 Survey of Electricity (4)
- TECH 301 Metallic Processes (5)
- TECH 320 Non-Metallic Processes (5)
- TECH 330 Technology Problem Analysis and Design I (3)
- TECH 331 Technology Problem Analysis and Design II (3)
- TECH 393 Technology in World Civilization (4)
- TECH 402 Machine Tool I (5)
- TECH 403 Computer-Aided Design and Project Management (4)
- TECH 404 Computer Numerical Control (5)
- TECH 406 Welding Technology (4)
- TECH 430 Machine Tool II (5)
- TECH 454 Environmental Engineering (2)
- TECH 458 Quality Assurance (4)
- TECH 462 Industrial Safety Engineering (4)
- TECH 490 Senior Capstone: Production Laboratory (4)
- TECH 491 Senior Project (4)
- TECH 495 Internship (6)

### Supporting Courses (40 credits)

- CHEM 121 Chemistry and its Role in Society (5)  
or CHEM 151 General Chemistry (5)
- CMST 340 Intercultural Communication (5)
- ECON 100 General Education Economics (5)
- ENGL 205 Introduction to Technical Communication (5)
- HIST 110 American Experience: A Survey (5)  
or HIST 305 Paths to the American Present (5)
- MATH 106 Pre-Calculus II (5)  
or MATH 115 Mathematical Reasoning (5)
- PHIL 210 Critical Thinking (5)
- PHYS 100 Physical Science (5)

**Required program credits** **89 credits**

**Supporting credits** **40 credits**

**Total credits for above option** **129 credits**

*Note:* Including university requirements, the above program requires a minimum of 180 credits, an average of 15 credits per quarter for a 12 quarter, four-year program. The 180 credits are based upon the following assumptions: a. Students have had one year of high school drafting. If this assumption is not true, then the student will have to take ENGR 102 *Introduction to Engineering Graphics* (4); b. Students will have satisfied university competencies. If this assumption is not true, then the student will have to complete up to six more credits of classes. (See university competencies in this catalog.)

*Note:* technology majors with applied, construction, design or manufacturing options are not accredited by the Technology Accreditation Commission of ABET.

## MINOR

### TECHNOLOGY MINOR (24 CREDITS)

#### Required Courses (9 credits)

- ENGR 110 Engineering Graphics (5)
- TECH 393 Technology in World Civilization (4)

#### Electives (15 credits)

With prior approval of your Department of Engineering & Design advisor, select Technology courses, 8 credits of which must be upper-division courses.

**Required program credits** **9 credits**

**Elective credits** **15 credits**

**Total credits for above minor** **24 credits**

*Note:* For the above minor the following assumption has been made: students have had one year of high school drafting. If this assumption is not true then the student will have to take ENGR 102 *Introduction to Engineering Graphics* (4)

## GRADUATE PROGRAM

Engineering & Design offers courses that students may use as part of a degree in communications, multimedia programming and other interdisciplinary areas. These programs are listed in their respective graduate catalog sections.

## Engineering Courses

*Terms offered:* fall, winter, spring, summer (FWSU). If no terms are indicated check with the department or EagleNET.

### ENGR 102 Introduction to Engineering Graphics (4)

*Graded Pass/Fail.*

This course offers an introduction to the fundamentals of technical drawing. It emphasizes the technical methods used to describe the size and shape of objects. This course will not satisfy elective requirements for a major or minor in Technology.

### ENGR 110 Engineering Graphics (5)

*Prerequisites:* ENGR 102, two years of high school drafting or equivalent.

A study of the technical portion of the graphics language. This language, technical drawing, is used by engineers to communicate proposed designs and new ideas. Includes the theory and practice of descriptive geometry and the graphic representation of data.

### ENGR 160 Digital Circuits (4)

*Prerequisite:* MATH 104B or equivalent.

Fundamentals of digital computer design including appropriate number systems, boolean algebra and basic digital circuits. Methods introduced will include the use of Karnaugh Maps and the Quine-Mccluskey procedure. Computer laboratory work will involve the use of current software for the design, analysis and simulation of digital circuits.

### ENGR 201 Introduction to MATLAB (4)

*Prerequisite:* MATH 105

This course introduces the student to the application of basic MATLAB building blocks to engineering problems. Students will get a thorough introduction to data visualization, data analysis, symbolic calculations, numeric computations and other basic skills related to MATLAB.

### ENGR 207 Electricity (4)

*Prerequisite:* MATH 162, PHYS 133 or PHYS 153.

This course is intended to provide students with a basic understanding of electricity and its applications. In this course, basic concepts of current, voltage and resistance will be presented as well as basic circuit-analysis methods including inductor and capacitor.

### ENGR 209 Circuit Theory I (5)

*Prerequisites:* PHYS 153 or permission of the instructor.

This course is intended to provide electrical engineering students with an understanding of electricity and its applications. Topics include AC/DC circuit-analysis methods such as nodal and mesh analysis, superposition, Norton Theorem, Thevenin Theorem and transient analysis.

### ENGR 210 Circuit Theory II (5)

*Prerequisites:* ENGR 209 or permission of the instructor.

This course covers small signal analysis, DC operating point, first-order circuits, second-order circuits, circuit simulation methods, sinusoidal steady state, phasors, poles and zeros of network functions, ideal transformed linear and non-linear two-port networks.

### ENGR 217 3D Parametric Computer Aided Drafting (4)

*Prerequisite:* ENGR 110 or High School AUTOCAD or permission of instructor

This course uses the computer to draft parametric models in three dimensions. File management methods, rapid prototyping and 2D drawing development techniques are discussed. (4 hours per week.)

### ENGR 240 Statics (4)

*Prerequisites:* PHYS 151, MATH 161 or Technical Calculus I or equivalent.

Fundamentals of applied mechanics, equivalent force systems, equations of equilibrium, structures, three dimensional force systems and friction. (two hours lecture, four hours laboratory per week)

### ENGR 241 Strength of Materials (4)

*Prerequisites:* ENGR 240, MATH 162, PHYS 152 or Technical Calculus II or equivalent.

A study of the internal stresses, internal deformations and deflections of materials. Topics may include: shear and moment diagrams for beams, combined loading on beams, temperature stresses and torsional loading. (four hours lecture per week)

### ENGR 242 Dynamics (4)

*Prerequisite:* ENGR 240.

Kinematics and kinetics of particles and rigid bodies using vector analysis; force mass acceleration, work and energy, impulse and momentum, translating and rotating coordinate system. (four hours lecture per week)

### ENGR 250 Digital Hardware (2)

*Prerequisite:* ENGR 160.

A continuation of ENGR 160, this course presents logic families, hardware characteristics, noise control and modern programmable logic.

### ENGR 260 Microcontroller Systems (4)

*Prerequisite:* ENGR 160; CSDC 255 or permission of the instructor.

This is an introductory course on microprocessor and microcontroller systems organization. It provides low-level programming principles for microcomputer based systems. The course emphasizes assembly and C language programming techniques and laboratory experiments in input/output programming, memory organization, interrupts and interfacing methods.

### ENGR 320 Signals and Systems I (5)

*Prerequisite:* ENGR 210 or concurrent enrollment in ENGR 210 or permission of the instructor

This course is an introduction to continuous-time signal analysis. Topics include: generalized functions and the relationship to basic signals including impulses, pulses and unit step; system properties such as linearity, time-invariance and causality; and Fourier analysis.

### ENGR 321 Signals and Systems II (5)

*Prerequisite:* ENGR 320.

Introduction to Laplace Transform, Z-transform, the Fourier Series, the Fourier Transform, the Discrete Fourier Transform (DFT), the Discrete-Time Fourier Transform (DTFT) and Sampling Theorem. Introduction to analysis of Linear Time Invariant (LTI) system using above techniques for continuous and discrete time.

### ENGR 330 Microelectronics I (5)

*Prerequisites:* ENGR 210 or concurrent enrollment in ENGR 210, or permission of instructor.

This course introduces modeling, characterization and application of semiconductor devices and integrated circuits. It includes the development of models for circuit-level behavior of diodes, bipolar transistors, field effect transistors and op-amps and applies the models to the analysis and design of linear amplifiers.

### ENGR 331 Microelectronics II (5)

*Prerequisite:* ENGR 330 or permission of the instructor.

This course is the second in modeling and application of semiconductor devices and integrated circuits. Topics include advanced transistor amplifier analysis, feedback effects, power amplifiers, op-amps, analog filters, oscillators, A/D and D/A converters, and power converters.

### ENGR 350 Energy Systems (5)

*Prerequisites:* ENGR 210.

This course provides an introduction to the different energy sources, methods of electric energy conversion, the electric power system, transformers and electrical machines.

### ENGR 353 Industrial Materials (5)

*Prerequisite:* CHEM 151 or permission of instructor.

Students in this course achieve a thorough understanding of engineering materials, their properties, responses and applications. Laboratory work includes destructive and non-destructive testing and image analysis of microscopic structures of industrial materials.

### ENGR 360 Hardware Description Languages (5)

*Prerequisite:* ENGR 160.

This course introduces methodologies and computer-aided design (CAD) tools for the design of complex electronic systems. The emphasis is on high-level description languages and their use for specifying, designing, simulating and synthesizing digital very large scale integration (VLSI) circuits in MOS (metaloxide-semiconductor) technologies. Theoretical knowledge will be complemented by hands-on use of several commercial CAD tools.

### ENGR 380 Thermodynamics (5)

*Prerequisite:* PHYS 133 or PHYS 153, MATH 162.

This course explores properties of materials, work, heat, conversion of energy, conservation of mass and energy transformation processes. Emphasis is on application of the first and second laws to engineering systems.

### ENGR 381 Laboratory Analysis and Reports (5)

*Prerequisite:* PHYS 133 or PHYS 153, MATH 162.

This course examines the different aspects of laboratory analysis and report writing. This includes descriptions of engineering problems, analysis of data including error analysis and data interpretation, instrumentation and measurements. In addition, the application of spreadsheets for solving and analyzing engineering problems, creating technical graphs, trending and curve fitting and project management will be addressed.

### ENGR 382 Fluid Mechanics (5)

*Prerequisite:* PHYS 132 or PHYS 152, MATH 162.

This course introduces the student to theory, concepts and applications of fluid mechanics. Topics include static and dynamic forces; conservation of mass, energy and momentum; flow in pipes and ducts; and fan and pump performance. Laboratory work is included.

### ENGR 383 Applied Stochastic Processes (4)

*Prerequisite:* MATH 163 or permission of the instructor and must be taken concurrently with ENGR 388.

This course provides an introduction to the basic concepts of stochastic processes and their application to engineering problems. Topics include analysis of continuous and discrete random signals and systems, as well as modern estimation techniques.

### ENGR 384 Energy Management and Utilization (5)

*Prerequisite:* ENGR 380 or TECH 380.

The study of energy usage and energy management within industrial facilities. The development of Energy audit procedures including the energy saving calculations for industrial settings. Students will develop and explore the creation of industrial energy audits through the extensive use of case studies.

### ENGR 385 Robotics and Automation (5)

*Prerequisite:* ENGR 207 or TECH 208 or permission of the instructor.

This course covers various electrical and mechanical systems used in robotics and other automated industrial systems. It includes automated equipment programming and industrial planning as applied to automated systems. (3 hours lecture, 4 hours laboratory per week)

### ENGR 386 Engineering Numerical Analysis (5)

*Prerequisite:* PHYS 153, MATH 163.

This course covers a multitude of numerical approximation methods used to solve specific structural engineering problems and highlights the algorithms used in many common scientific software packages.

### ENGR 388 Applied Stochastic Processes Laboratory (1)

*Prerequisite:* MATH 163 or permission of the instructor and must be taken concurrently with ENGR 383.

This laboratory course introduces basic concepts of stochastic processes and their application to engineering problems.

### ENGR 401 Engineering Applied Electromagnetics (5)

*Prerequisite:* ENGR 210.

This course provides students with the technical basis to analyze electromagnetic applications systems. Topics include coordinate systems, vector calculus, static and dynamic fields, Maxwell's equations, power flow, circuit representation of transmission lines, electromagnetic transmission and introductory waveguides.

**ENGR 405 Design of Machine Elements (5)**  
*Prerequisite:* ENGR 241 or TECH 341 and MATH 162 or permission of instructor.

This course covers the design of machine components and mechanisms and utilizes the concepts of engineering mechanics and strength of materials.

**ENGR 407 Heating, Ventilating and Air Conditioning (5)**  
*Prerequisite:* PHYS 132 or PHYS 152

The study of the principles of Heating, Ventilating and Air Conditioning (HVAC) including the investigation of the basic calculations to determine heating and cooling loads and the study of the basic equipment design for HVAC.

**ENGR 412 Fundamentals of Engineering (2)**  
*Prerequisite:* senior standing in ME, MET, CET or EE; or permission of instructor.

This course reviews the fundamentals of engineering. It provides an overview of principles of the practice of engineering and assists students in preparation for the first steps in professional licensure.

**ENGR 420 Digital Signal Processing (5)**  
*Prerequisite:* ENGR 321.

This course provides an introduction to digital signal processing. Convolution, time invariance and stability of discrete-time systems are presented. In addition, various signal processing techniques such as Z-transform, discrete Fourier transform (DFT) and fast Fourier transform (FFT) are studied. Time and frequency domain techniques for designing and applying infinite impulse response (IIR) and finite impulse response (FIR) digital filters are introduced.

**ENGR 430 CMOS Integrated Circuits Design (5)**  
*Prerequisites:* ENGR 160; ENGR 330 or permission of the instructor.

This course provides students with the theoretical and practical knowledge required for analyzing and designing very large scale integration (VLSI) circuits and systems in complementary metal-oxide-semiconductor (CMOS) technology. Lab includes hands-on use of a variety of state-of-the-art computer-aided design (CAD) tools and design techniques.

**ENGR 440 Digital Communication Systems (5)**  
*Prerequisite:* ENGR 321.

This course provides students with a solid background in modern digital communication systems. Random processing is applied in the realm of communication theory. Common digital modulation and demodulation techniques are presented. Other topics include bandpass transmission of binary data, coherent/noncoherent communications, intersymbol interference and equalization.

**ENGR 444 Heat Transfer (5)**  
*Prerequisite:* PHYS 153, MATH 241 AND MATH 347.

This course provides a detailed calculus-based analysis of the heat transfer through solids, fluids and vacuums. Concepts include convection, conduction, radiation, heat transfer in one and two dimensions for steady and unsteady states.

**ENGR 450 Power System Analysis (5)**  
*Prerequisite:* ENGR 350.

The course provides students with the ability to analyze power systems from technical and economic perspectives. It includes symmetrical components, calculation of line parameters, power flow control, representation of transmission lines and power components.

**ENGR 452 Engineering Economics (2)**  
*Prerequisite:* junior standing or permission of instructor.

This course focuses on the systematic evaluation of the economic benefits and costs of projects involving engineering design and analysis. Engineering economics quantifies the benefits and costs associated with engineering projects to determine whether they make (or save) enough money to warrant their capital investment.

**ENGR 456 Engineering Ethics, Contracts and Patents (2)**

*Prerequisite:* junior standing or permission of instructor.  
 This course investigates the elements of professional engineering practice including their relationship to the law, to the public and the ethics of the profession. Topics covered range from ethics, contracts, patents, copyrights, sales agreements and engineering specifications to professionalism, licensing, intellectual property, liability, risk, reliability and safety. Further discussion areas involve interdisciplinary teams, team tools, codes, standards, professional organizations, careers, entrepreneurship, human factors and industrial design.

**ENGR 460 Computing Systems: Organization and Design (5)**  
*Prerequisites:* ENGR 160, CSCD 255 or permission of the instructor.

This course provides the theoretical and practical knowledge required for analyzing and designing complex computing systems. Emphasis is on the impact that the organization and interfacing of hardware/software components have on system performance. Hands-on design skills using HDL (Hardware Design Language) will be offered in weekly labs.

**ENGR 461 Embedded System Design (5)**  
*Prerequisites:* ENGR 160 or permission of the instructor.

This course provides students with the theoretical and practical knowledge required for analyzing and designing embedded computing systems. The key challenge of embedded systems is to optimize the various design metrics and to assess the impact that the organization and interfacing of hardware/software components have on system performance. Hands-on experience using various hardware, such as Field Programmable Gate Arrays (FPGA) and microcontrollers, will be offered in weekly labs.

**ENGR 470 Control Systems (5)**  
*Prerequisite:* ENGR 321.

This course reviews basic topics such as transfer function, step response and stability conditions. Other topics include feedback systems, analysis techniques such as root-locus analysis, transient and steady-state response analyses and frequency response analysis are studied. In addition, state-space analysis techniques are explained within the context of state-space system models. Analysis and design of proportional, integral and derivative (PID), PI and PD controllers are presented.

**ENGR 490 Senior Capstone: Design Laboratory (4)**  
*Prerequisites:* senior standing and ENGR 331.

**[satisfies senior capstone university graduation requirement]**  
 This course will simulate the industrial environment, where students will have to work in a team to solve a real world problem, from design to implementation. Team dynamics will be strictly monitored and each student's unique skills will be utilized in different stages of the design process. Dealing with problems typical of a team environment will result in an invaluable learning experience both in the professional and civic lives of the students.

**ENGR 491 Senior Project (1-6)**  
*Prerequisite:* permission of instructor.

Independent and/or group study and implementation of a design and development project. (variable time)

**ENGR 492 Finite Element Analysis (4)**  
*Prerequisites:* TECH 341 or ENGR 241 and MATH 162 or permission of the instructor.

This course introduces the computational methods to solve engineering problems using the finite element approach. Modeling techniques for different engineering structures such as truss, beams, frames, two and three dimensional solids, and thin-walled structures are introduced in this course. Students solve a wide variety of engineering problems dealing with statics, dynamics, fluid mechanics, heat transfer and design and material selections using the state of art FEA software.

**ENGR 493 Senior Seminar (1)**  
*Prerequisite:* senior standing or permission of instructor.

This course provides the students firsthand exposure to the latest technological advances directly from the manufacturer or researcher. This helps students in their lifelong learning and provides an opportunity to inquire about particular topics or fields of interest.

**ENGR 495 Internship (1-6)**  
*Graded Pass/Fail.*  
*Prerequisites:* permission of the instructor, department chair and college dean.

Internship.

**ENGR 499 Directed Study (1-10)**  
*Prerequisite:* permission of the instructor, department chair and college dean.

Designed for students wanting to pursue a subject beyond the scope of regular courses.

## Technology Courses

*Terms offered:* fall, winter, spring, summer (FWSU). If no terms are indicated check with the department or EagleNET.

**TECH 208 Survey of Electricity (4)**

*Prerequisite:* pre-university basic skills in mathematics.  
Introduces the student to direct current, alternating current (including residential wiring) and amplifying devices. (three hours lecture, two hours laboratory per week)

**TECH 235 Construction Materials and Techniques (5)**

*Prerequisite:* ENGR 102, two years of high school drafting or equivalent.

This course introduces various materials and techniques used in construction. Students gain an understanding of the fundamental principles of structural, physical and long-term performance of some of these materials through lecture and lab experiments. Students also gain an understanding of some of the mechanical and non-mechanical properties of various materials, common construction methods and knowledge of material properties and applications in construction.

**TECH 299 Special Studies (1-6)**

*Prerequisites:* permission of the instructor, department chair and college dean.

**TECH 301 Metallic Processes (5)**

*Prerequisite:* MATH 105  
*Metallic Processes* is a comprehensive basic course in technical metals which is designed to survey metalworking materials and processes which have been developed by modern industry. The course provides opportunity to learn the theories and scientific principles basic to the application of metalworking tools and procedures. (three hours lecture, four hours laboratory)

**TECH 305 Construction Estimating (4)**

*Prerequisite:* TECH 235 and TECH 320.  
This course provides students with the ability to estimate construction costs by reading and interpreting technical drawings. Primary focus is on calculating materials, labor and equipment cost for both residential and commercial building projects. Students generate quantity takeoffs for specific building projects.

**TECH 320 Non-Metallic Processes (5)**

*Prerequisite:* ENGR 110.  
Survey of non-metallic materials (such as woods, plastics and ceramics) and the industrial processes utilized to convert raw materials into finished products. Course includes characteristics and properties of non-metallic materials and utilization of industrial tools and processing equipment. (3 hours lecture, 4 hours laboratory per week)

**TECH 330 Technology Problem Analysis and Design I (3)**

*Prerequisites:* CPLA 101 and junior standing or permission of the instructor.

Development of advanced skills in technical problem analysis, planning, research, solution strategies, critical thinking and presentation. Computer-aided design tools such as CAD, project-planning software, spreadsheets, as well as imaging and publishing software, will be used. Emphasis will be on consideration of interconnected systems.

**TECH 331 Technology Problem Analysis and Design II (3)**

*Prerequisite:* TECH 330.  
Development of student's synthesis, design, organizational and learning skills through examination of current research and/or design topics in technology.

**TECH 335 Architecture (4)**

*Prerequisite:* ENGR 110.  
Design, layout and development of residential dwellings and large structures. (four hours lecture per week)

**TECH 340 Statics (4)**

*Prerequisites:* PHYS 131 and MATH 106 or equivalent.  
A study of applied mechanics and the principles of statics dealing with forces and with the effects of forces acting upon rigid bodies at rest. (four hours lecture per week)

**TECH 341 Strength of Materials (4)**

*Prerequisite:* TECH 340.  
A study of the relationship that exists between externally applied forces and internally induced stresses in members and parts, including the relationship existing between these same externally applied forces and the resulting deformations. (four hours lecture per week)

**TECH 342 Dynamics (4)**

*Prerequisite:* TECH 340 and MATH 162.  
This course is a study of the motion of rigid bodies and forces affecting their motion. Topics include kinematics and kinetic of motion, curvilinear motion, plane motion, work, energy and power, impulse and momentum. (four hours lecture per week)

**TECH 345 Soils/Surveying (4)**

*Prerequisite:* TECH 305 and TECH 335.  
This course introduces soil mechanics and site surveying. Through lecture and field work the course examines characteristics and compositions of soil, soil classification systems and the strength of soil masses. Students practice fundamentals of construction surveying, including taping, leveling, angular measurement, traversing, topographic surveying, building layout and grade staking.

**TECH 354 Building Codes (4)**

*Prerequisite:* ENGR 110 and TECH 305, 335.  
Building Codes is a comprehensive course pertaining to International Building Codes (IBC). Emphasis is placed on code requirements for both commercial and residential applications to include structural, mechanical, plumbing, fire, fuel gas and private sewage code requirements.

**TECH 355 Computer-Aided Design for Electronics (5)**

*Prerequisites:* ENGR 160 or permission from instructor.  
This course introduces how to use computer automation software for (a) design entry, (b) simulation and (c) layout.

**TECH 377 Microprocessors II (4)**

*Prerequisite:* TECH 277  
A continuation of TECH 277 *Microprocessors I* this laboratory course is centered around the design and development of a prototype industrial system. It covers additional input/output, programming and interfacing methods.

**TECH 393 Technology in World Civilization (4)**

*Prerequisite:* ENGL 101.  
[satisfies international studies university graduation requirement]  
Students will investigate the issues surrounding technological change in discrete cultural settings with a historical perspective of the evolution of technology in a global context. (Cross-listed HONS 393)

**TECH 402 Machine Tool I (5)**

*Prerequisites:* ENGR 110 and TECH 301.  
A comprehensive course in machine tool operations, both conventional and CNC. Course includes cutting operations, precision measurement, set up and CNC programming. (three hours lecture, four hours laboratory per week)

**TECH 403 Computer-Aided Design and Project Management (4)**

*Prerequisites:* MATH 106 or permission of the instructor and TECH 317.  
The application of spreadsheets to solve engineering problems, technical graphs, trending and curve fitting. The introduction to the use of computer-aided scheduling of projects, critical path planning, project tracking and cost collection. (three hours lecture, three hours laboratory per week)

**TECH 404 Computer Numerical Control (5)**

*Prerequisite:* TECH 301 and TECH 402.  
This course provides the learner with experience utilizing CNC processes. Programming methods will include manual, CAM software and conversational languages.

**TECH 406 Welding Technology (4)**

*Prerequisite:* TECH 301 or permission of the instructor.  
Theory and practice of welding ferrous and nonferrous metals. Practice in oxyacetylene, shielded metal arc and inert gas processes. (four hours lecture, four hours laboratory per week)

**TECH 430 Machine Tool II (5)**

*Prerequisites:* TECH 301 and TECH 402.  
Application and theory in the design, development and function of tooling, dies, molds, jigs and fixtures. Laboratory experiences provide a problem solving approach to development of prototypes in both unit and mass production applications. (five hours lecture, four hours laboratory per week)

**TECH 454 Environmental Engineering (2)**

*Prerequisite:* junior standing or permission of the instructor.  
This course explores ways to promote the design and manufacturing of environmentally sound products and processes. Benefits include environmentally-friendly products, more efficient operations and the good will of an informed public that expects a clean, healthy environment.

**TECH 458 Quality Assurance (4)**

*Prerequisite:* junior standing.  
Application and theory of quality control systems including development and use of process control charts, sampling, time and motion studies and statistical analysis. (four hours lecture, one hour laboratory per week)

**TECH 462 Industrial Safety Engineering (4)**

Fundamentals of safety, classification of hazards, accident statistics, organization problems, safety codes, machine guarding, mechanical, electrical and chemical hazards, ventilation, respiratory and safety devices. (four hours lecture per week)

**TECH 490 Senior Capstone: Production Laboratory (4)**

*Prerequisite:* senior standing.  
[satisfies senior capstone university graduation requirement]  
The course simulates the real world situation that many of the graduates from the department will face. The students will work in teams to apply techniques of production management, product design/development, plant layout, scheduling, cost accounting, assembly, inspection and quality control to produce a product. The course will simulate a real world design team concept by utilizing a design group that contains members of different program majors. The team, to accomplish its goals, is required to draw on each other's unique skills learned in stated goal. In industry often a design team is formed to develop a new product. The team is made up of members from different departments in the company. Learning to deal with the team dynamics while learning to take advantage of the synergy that can be gained by a diverse team is a valuable learning process for our business as well as civic life. Each student team is to produce a new product (to be mass produced and demonstrated by producing a minimum quantity of 25 units built with unskilled labor utilizing jigs, fixtures and/or CNC controlled machines) and create a final written report to demonstrate how the process and goals of the course have been realized.

**TECH 491 Senior Project (3-10)**

*Prerequisite:* permission of the instructor.  
Independent and/or group study and implementation of a design and development project. (variable time)

**TECH 495 Internship (1-15)**

*Graded Pass/No Credit.*  
*Prerequisites:* permission of the instructor, department chair and college dean.  
(A maximum of 5 credits may be earned toward electives for a Technology major. Students considering electives for a Technology minor should consult with their departmental advisor.)

**TECH 496 Experimental Course (1-6)**

**TECH 497 Workshops, Short Courses or Conferences (1-6)**

**TECH 498 Seminar (1-6)**

**TECH 499 Directed Study (1-5)**

*Prerequisite:* permission of the instructor, department chair and college dean.  
Designed for students wanting to pursue a subject beyond the scope of regular courses.

## TECH 504 Communication Technologies (4)

An accelerated coverage of the theory and applications of communication technologies. Emphasis is on competencies and skills required in business and industry including desktop publishing, computer-assisted image generation and manipulation, data translation and communication and presentation media development used in advertising, proposal writing, presentations and publications.

## TECH 508 Designing Web Sites (4)

This course is designed to teach professional methods for designing, producing and publishing web pages and websites. Students will create XHTML and XML based pages, along with still and animated graphics. Emphasis will be on working with clients, planning, developing effective visual and logical designs, optimization for search engines, effective use of color, as well as the technical tools such as code editors, image editors and FTP. Final project involves a live job if possible. Students should discuss options and criteria for the final project with the instructor.

## TECH 539 Special Studies in Technology (1-5)

### TECH 550 Computer Graphics (4)

*Prerequisite:*

ENGR 110.

Computer graphics hardware and software with the emphasis on computer-assisted design and graphics layout.

### TECH 596 Experimental Course (1-6)

### TECH 597 Workshop in Technology (1-6)

*Note:* only one workshop course for up to 3 credits may be used to fulfill graduate degree requirements.

### TECH 598 Seminar (1-6)

### TECH 599 Independent Study (1-6)

*Prerequisites:* permission of the instructor, department chair and college dean.

Course may be repeated within the 6 credits allowed to fulfill the student's goals and needs in specific areas.

## TECH 695 Internship (1-6)

*Prerequisites:* permission of the instructor, department chair and college dean.

## TECH 696 College Teaching Internship (1-5)

*Prerequisites:* permission of the instructor, department chair and college dean.

Teaching a lower-division college course under supervision of a regular faculty member. Includes course planning, arranging bibliographical and instructional aids, conferences with students, experience in classroom instruction and student course evaluation.

