UNDERGRADUATE PROGRAMS

Students studying in the Department of Engineering & Design (DESN/EENG/MENG/METC/TECH) may select from a broad number of disciplines that include Electrical Engineering, Mechanical Engineering, Mechanical Engineering Technology, 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 engineering and design that enhance the preparation of our 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, thermodynamics, fluid dynamics, heat transfer and materials processing laboratories and a variety of other 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 in the Engineering programs as juniors should have completed one year of physics as well as most of their mathematics. Failure to complete the mathematics and physics requirements before the junior year likely will delay graduation.

Grade Requirements

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

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:

- identify, formulate, and solve engineering problems;
- understand professional and ethical responsibility;
- communicate effectively;
- have the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context;
- use the techniques, skills and modern engineering tools necessary for engineering practice;
- apply knowledge of mathematics, science and engineering;
- design and conduct experiments, as well as analyze and interpret data;
- 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;
- function on multidisciplinary teams;

ELECTRICAL ENGINEERING

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 Bachelor of Science in Electrical Engineering Degree is accredited by the Engineering Accreditation Commission of ABET, www.abet.org.

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 in the fourth year. The senior year capstone course allows students to consolidate their education experience with the solution of real-world, practical engineering problems often 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.

Note: incoming freshmen are expected to start both the Calculus and Physics series in their first year in order to finish the degree in four years.

Required Courses Outside Department (59 credits)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 151</td>
<td>General Chemistry (5)</td>
</tr>
<tr>
<td>CSCD 255</td>
<td>C Programming for Engineers (5)</td>
</tr>
<tr>
<td>MATH 161</td>
<td>Calculus I (5)</td>
</tr>
<tr>
<td>MATH 162</td>
<td>Calculus II (5)</td>
</tr>
<tr>
<td>MATH 163</td>
<td>Calculus III (5)</td>
</tr>
<tr>
<td>MATH 231</td>
<td>Linear Algebra (5)</td>
</tr>
<tr>
<td>MATH 241</td>
<td>Calculus IV (5)</td>
</tr>
<tr>
<td>MATH 247</td>
<td>Ordinary Differential Equations (5)</td>
</tr>
<tr>
<td>PHYS 151</td>
<td>General Physics I (4)</td>
</tr>
<tr>
<td>PHYS 152</td>
<td>General Physics II (4)</td>
</tr>
<tr>
<td>PHYS 153</td>
<td>General Physics III (4)</td>
</tr>
<tr>
<td>PHYS 161</td>
<td>Mechanics Lab (1)</td>
</tr>
<tr>
<td>PHYS 162</td>
<td>Heat and Optics Lab (1)</td>
</tr>
<tr>
<td>PHYS 163</td>
<td>Instrumentation Lab I (1)</td>
</tr>
<tr>
<td>TCOM 205</td>
<td>Introduction to Technical Writing (5)</td>
</tr>
<tr>
<td>or MENG 381</td>
<td>Laboratory Analysis and Report (5)</td>
</tr>
</tbody>
</table>

Required Departmental Courses (68–69 credits)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EENG 100</td>
<td>Introduction to Engineering (1)</td>
</tr>
<tr>
<td>EENG 160</td>
<td>Digital Circuits (4)</td>
</tr>
<tr>
<td>EENG 209</td>
<td>Circuit Theory I (5)</td>
</tr>
<tr>
<td>EENG 210</td>
<td>Circuit Theory II (5)</td>
</tr>
<tr>
<td>EENG 250</td>
<td>Digital Hardware (2)</td>
</tr>
<tr>
<td>EENG 260</td>
<td>Microcontroller Systems (4)</td>
</tr>
<tr>
<td>EENG 320</td>
<td>Signals and Systems I (5)</td>
</tr>
<tr>
<td>EENG 321</td>
<td>Signals and Systems II (5)</td>
</tr>
<tr>
<td>EENG 330</td>
<td>Microelectronics I (5)</td>
</tr>
<tr>
<td>EENG 331</td>
<td>Microelectronics II (5)</td>
</tr>
<tr>
<td>EENG 350</td>
<td>Energy Systems (5)</td>
</tr>
<tr>
<td>EENG 360</td>
<td>Hardware Description Languages (5)</td>
</tr>
<tr>
<td>EENG 383</td>
<td>Applied Stochastic Processes (4)</td>
</tr>
<tr>
<td>EENG 388</td>
<td>Applied Stochastic Processes Lab (1)</td>
</tr>
<tr>
<td>EENG 401</td>
<td>Engineering Applied Electromagnetics (5)</td>
</tr>
<tr>
<td>or PHYS 401</td>
<td>Electromagnetism I (4)</td>
</tr>
<tr>
<td>EENG 490A</td>
<td>Senior Capstone: Design Laboratory I (2)</td>
</tr>
<tr>
<td>and EENG 490B</td>
<td>Senior Capstone: Design Laboratory II (3)</td>
</tr>
<tr>
<td>or TECH 393</td>
<td>Technology in World Civilization (4)</td>
</tr>
</tbody>
</table>

Electrical Engineering electives chosen from the following list (25 credits).

Students must take at least three courses from one area of concentration.

A. Power Systems

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EENG 450</td>
<td>Power Systems Analysis (5)</td>
</tr>
<tr>
<td>EENG 452</td>
<td>Protective Relays (5)</td>
</tr>
<tr>
<td>EENG 470</td>
<td>Control Systems (5)</td>
</tr>
</tbody>
</table>

B. Communications and Signal Processing

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EENG 420</td>
<td>Digital Signal Processing (5)</td>
</tr>
<tr>
<td>EENG 440</td>
<td>Digital Communication Systems (5)</td>
</tr>
<tr>
<td>EENG 470</td>
<td>Control Systems (5)</td>
</tr>
</tbody>
</table>

C. VLSI and Circuit Design

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EENG 430</td>
<td>CMOS Digital Integrated Circuits Design (5)</td>
</tr>
<tr>
<td>EENG 435</td>
<td>Analog Integrated Circuits Design (5)</td>
</tr>
<tr>
<td>EENG 460</td>
<td>Computing Systems: Organization and Design (5)</td>
</tr>
<tr>
<td>or EENG 461</td>
<td>Embedded System Design (5)</td>
</tr>
</tbody>
</table>

Other Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EENG 415</td>
<td>Introduction to Computer Communication Networks (5)</td>
</tr>
<tr>
<td>EENG 425</td>
<td>Principles of Digital Image Processing (5)</td>
</tr>
<tr>
<td>EENG 442</td>
<td>Mobile Communications (5)</td>
</tr>
<tr>
<td>EENG 471</td>
<td>Digital Control Systems (5)</td>
</tr>
<tr>
<td>EENG 495</td>
<td>Internship (1–6)</td>
</tr>
</tbody>
</table>

Minimum total credits for above degree 152 credits
**BACHELOR OF SCIENCE (BS)**

**MECHANICAL ENGINEERING**

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 Bachelor of Science in Mechanical Engineering Degree is accredited by the Engineering Accreditation Commission of ABET, [www.abet.org](http://www.abet.org). 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 in 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.

Note: pre-program prerequisites include MATH 141, MATH 142, METC 102, METC 110.

**Required Supporting Outside Department Courses (44 credits)**

MATH 161 Calculus I (5)
MATH 162 Calculus II (5)
MATH 163 Calculus III (5)
MATH 241 Calculus IV (5)
MATH 347 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 I
PHYS 162 Heat and Optics Lab I
PHYS 163 Instrumentation Lab I (1)

**Required Departmental Courses (90 credits)**

MENG 201 Introduction to Matlab (4)
or
CSCD 255 C Programming for Engineers (5)
MENG 207 Electricity (4)
MENG 217 3D Parametric Computer Aided Design (4)
MENG 240 Statics (4)
MENG 241 Strength of Materials (4)
MENG 242 Dynamics (4)
MENG 353 Industrial Materials (5)
MENG 380 Thermodynamics (5)
MENG 381 Laboratory Analysis and Reports (5)
MENG 382 Fluid Mechanics (5)
MENG 385 Robotics and Automation (5)
MENG 386 Engineering Numerical Analysis (5)
MENG 405 Design of Machine Elements (5)
MENG 412 Fundamentals of Engineering (2)
MENG 452 Engineering Economics (2)
MENG 490A Senior Capstone: Design Laboratory I (2)
MENG 490B Senior Capstone: Design Laboratory II (3)
MENG 493 Senior Seminar (1)
METC 456 Engineering Ethics, Contracts and Patents (2)
TECH 301 Metallic Processes (5)
TECH 393 Technology in World Civilization (4)

**Required Track—choose one of the following (15 credits)**

- **Materials and Computational Mechanics**
  MENG 453 Materials and Design (5)
  MENG 455 Composite Materials (5)
  MENG 492 Finite Element Analysis (5)

- **Robotics and Automation**
  MENG 485 Advanced Robotics and Automation (5)
  MENG 486 Programmable Logic Controllers in Automation (5)
  MENG 487 Sensors Theory for Automation (5)

- **Thermo Sciences**
  MENG 407 HVAC (5)
  MENG 444 Heat Transfer (5)
  MENG 482 Advanced Topics in Fluid Dynamics (5)

**Required Electives—choose two from the following**

Note: students may select electives from a different track listed above or from the list below.

- METC 417 Advanced Parametric Design (5)
- METC 468 Quality Assurance and Intro to Lean (5)
- MENG 495 Internship (5)
- or MENG 491 Senior Thesis (5)

**Minimum total credits for above degree: 149 credits**

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 METC 102 Introduction to Engineering Graphics (4).

**BACHELOR OF SCIENCE (BS)**

**MECHANICAL ENGINEERING TECHNOLOGY**

This degree combines studies of Mathematics, Computer Science, Physics and Mechanical Engineering Technology with an emphasis on applications. The Bachelor of Science in Mechanical Engineering Technology Degree is accredited by the Engineering Technology Accreditation Commission of ABET, [www.abet.org](http://www.abet.org). 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 engineering technology, industrial management, manufacturing, CAD, applied research and sales and service.

**Required Supporting Outside Department Courses (30 credits)**

CHEM 151 General Chemistry (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 I
PHYS 162 Heat and Optics Lab I
PHYS 163 Instrumentation Lab I (1)

**Required MATH supporting courses (10 credits)**

MATH electives (typically MATH 141 and MATH 142)

**Required Departmental Courses (91–92 credits)**

MENG 201 MATLAB (4)
or
CSCD 255 C Programming for Engineers (5)
or
CSCD 409 Introduction to Systems Modeling (4) (see note below)
MENG 207 Electricity (4)
MENG 217 3D Parametric Computer Aided Design (4)
MENG 353 Industrial Materials (5)
MENG 381 Laboratory Analysis and Reports (5)
MENG 385 Robotics and Automation (5)
MENG 412 Fundamentals of Engineering (2)
MENG 452 Engineering Economics (2)
MENG 493 Senior Seminar (1)
METC 110 Engineering Graphics (5)
METC 340 Statics (5)
METC 341 Strength of Materials (4)
METC 342 Dynamics (4)
METC 382 Fluid Mechanics (5)
METC 388 Thermodynamics and Heat Transfer (5)
METC 415 Design of Machine Elements (5)
METC 456 Engineering Ethics, Contracts and Patents (2)
MENG 490A Senior Capstone: Design Laboratory I (2)
MENG 490B Senior Capstone: Design Laboratory II (3)
MENG 495 Internship (6)*
TECH 301 Metallic Processes (5)
TECH 393 Technology in World Civilization (4)
TECH 403 Computer-Aided Design and Project Management (4)
Required Supporting Departmental Courses (15 credits)

Choose three of the following courses:

MENG 407 Heating, Ventilation and Air Conditioning (5)
METC 417 Advanced Parametric Analysis and Simulation (5)
METC 468 Quality Assurance and Intro to Lean (5)
TECH 404 Computer Numerical Control (5)

Minimum total credits for above degree 146 credits

Note: If an internship cannot be found by student, independent study METC 491 Senior Project (6) may be substituted.

Note: Including university requirements for the degree the above program requires a minimum of 188 credits or an average load of 15.67 credits per quarter, for a 12 quarter, four-year program. The 188 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 METC 102 Introduction to Engineering Graphics (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

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 Supporting Outside Department Courses

Any General Science course—5 credits in general science in any course equivalent to an EWU approved general science course (5)

CHEM 121 Chemistry and its Role in Society (5)
or CHEM 151 General Chemistry (5)

MATH 142 Precalculus II (5)
or MATH 107 Mathematical Reasoning (5)

PHIL 210 Critical Thinking (5)

PHYS 100 Physical Science (5)

Required Departmental Courses

TECH 330 Technology Problem Analysis and Design I (4)
TECH 331 Technology Problem Analysis and Design II (4)

TECH 393 Technology in World Civilization (4)

TECH 452 Engineering Economics (4)

TECH 320 Non-Metallic Processes (5)

TECH 354 Building Codes (4)

TECH 331 Technology Problem Analysis and Design I (4)

TECH 335 Architecture (4)

PHYS 131 Introductory Physics I (4)

CHEM 121 Chemistry and its Role in Society (5)

Required Supporting Outside Department Courses

Any General Science course—5 credits in general science in any course equivalent to an EWU approved general science course (5)

CHEM 121 Chemistry and its Role in Society (5)
or CHEM 151 General Chemistry (5)

MATH 142 Precalculus II (5)
or MATH 107 Mathematical Reasoning (5)

PHIL 210 Critical Thinking (5)
PHYS 100 Physical Science (5)

Required Departmental Courses

TECH 330 Technology Problem Analysis and Design I (4)

Total credits for above option 81 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 GPA ≥ 2.5 for the Technology coursework in the AAS, AAAS, or ATA degree. Graduation requires maintaining an overall GPA ≥ 2.5 for this option.

Note: This program requires an average of 15–16 credits per quarter to complete in two 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 the front section.)

TECHNOLOGY WITH CONSTRUCTION MANAGEMENT OPTION

This 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 Supporting Outside Department Courses

CHEM 121 Chemistry and its Role in Society (5)
or CHEM 151 General Chemistry (5)

MATH 142 Precalculus II (5)

PHYS 131 Introductory Physics I (4)

PHYS 161 Mechanics Lab (1)

Required Departmental Courses (82 credits)

METC 110 Engineering Graphics (5)

METC 340 Statics (5)

METC 341 Strength of Materials (4)

TECH 235 Construction Materials and Techniques (5)

TECH 305 Construction Estimating (4)

TECH 320 Non-Metallic Processes (5)

TECH 331 Technology Problem Analysis and Design I (4)

TECH 335 Architecture (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 452 Engineering Economics (4)

TECH 454 Environmental Engineering (4)

TECH 456 Engineering Ethics, Contracts and Patents (4)

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)*

Required Departmental Courses

TECH 305 Construction Estimating (4)

TECH 393 Technology in World Civilization (4)

Total credits for above option 103 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 assumption: a. students have had one year of high school drafting (if this assumption is not true, then the student will have to take METC 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.

TECHNOLOGY WITH DESIGN OPTION

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 Supporting Outside Department Courses

MENG 217 3D Parametric Computer Aided Design (4)

MENG 335 Industrial Materials (5)

METC 110 Engineering Graphics (5)

METC 340 Statics (5)

METC 341 Strength of Materials (4)

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 (4)

TECH 331 Technology Problem Analysis and Design II (4)

TECH 393 Technology in World Civilization (4)

TECH 402 Machine Tool I (5)

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

TECH 452 Engineering Economics (4)

TECH 454 Environmental Engineering (4)

TECH 456 Engineering Ethics, Contracts and Patents (4)

TECH 458 Quality Assurance (4)
TECH 462 Industrial Safety Engineering (4)
TECH 490 Senior Capstone: Production Laboratory (4)
TECH 491 Senior Project (4) (3–10 credits but 4 credits for this program)
TECH 495 Internship (4) (if an internship cannot be found by student, a TECH elective may be substituted—1–15 credits but 4 credits for this program)

Total credits for above option 110 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 METC 102 Introductory 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.

TECHNOLOGY WITH MANUFACTURING OPTION

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 Supporting Outside Department Courses (40 credits)
CHEM 121 Chemistry and its Role in Society (5)
or CHEM 151 General Chemistry (5)
MATH 142 Precalculus II (5)
or MATH 107 Mathematical Reasoning (5)
PHYS 100 Physical Science (5)

Required Departmental Courses (89 credits)
MENG 217 3D Parametric Computer Aided Design (4)
MENG 353 Industrial Materials (5)
METC 110 Engineering Graphics (5)
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 (4)
TECH 331 Technology Problem Analysis and Design II (4)
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 452 Engineering Economics (4)
TECH 454 Environmental Engineering (4)
TECH 456 Engineering Ethics, Contracts and Patents (4)
TECH 458 Quality Assurance (4)
TECH 462 Industrial Safety Engineering (4)
METC 110 Engineering Graphics (5)

Total credits for above option 110 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 METC 102 Introductory 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.

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

MINORS

APPLIED TECHNOLOGY MINOR

Required Courses
TECH 330 Technology Problem Analysis and Design I (4)
TECH 331 Technology Problem Analysis and Design II (4)
TECH 403 Computer-Aided Design and Project Management (4)
TECH 452 Engineering Economics (4)

Choose from the following (8 credits)
TECH 454 Environmental Engineering (4)
TECH 456 Engineering Ethics, Contracts and Patents (4)
TECH 458 Quality Assurance (4)
TECH 462 Industrial Safety Engineering (4)

Total credits for above minor 24 credits

CONSTRUCTION MANAGEMENT MINOR

Required Courses
TECH 235 Construction Materials and Techniques (5)
TECH 305 Construction Estimating (4)
TECH 320 Non-Metallic Processes (5)
TECH 335 Architecture (4)

Choose from the following (8 credits)
TECH 345 Soils/Surveying (4)
TECH 354 Building Codes (4)
TECH 403 Computer-Aided Design and Project Management (4)
TECH 494 Environmental Engineering (4)

Total credits for above minor 26 credits

MANUFACTURING MINOR

Required Courses
MENG 217 3D Parametric Computer Aided Design (4)
TECH 301 Metallic Processes (5)
TECH 320 Non-Metallic Processes (5)
TECH 458 Quality Assurance (4)

Choose from the following (10 credits)
MENG 353 Industrial Materials (5)
MENG 385 Robotics and Automation (5)
TECH 402 Machine Tool I (5)
TECH 404 Computer Numerical Contr (5)

Total credits for above minor 28 credits

MECHANICAL ENGINEERING MINOR (31 CREDITS)

Required Courses (16 credits)
MENG 217 3D Parametric Computer Aided Drafting (4)
MENG 240 Statics (4)
MENG 241 Strength of Materials (4)
MENG 242 Dynamics (4)

Choose from the following (15 credits minimum)
MENG 353 Industrial Materials (5)
MENG 380 Thermodynamics (5)
MENG 381 Laboratory Analysis and Reports (5)
MENG 382 Fluid Dynamic (5)
MENG 385 Robotics and Automation (5)
MENG 405 Design of Machine Elements (5)
MENG 407 Heating, Ventilating and Air Conditioning (5)
MENG 444 Heat Transfer (5)
MENG 492 Finite Element Analysis (5)

Total minimum number of credits 31 credits

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.

Electrical Engineering Courses

Terms offered: check with the department or EagleNET.

EENG 160 Digital Circuits (4)
Prerequisite: MATH 104 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.

EENG 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.
EENG 210 Circuit Theory II (5)  
Prerequisites: EENG 209  
This course continues circuit analysis using Laplace transform, phasors and AC analysis, AC power, three-phase circuits, magnetically coupled circuits and the ideal transformer.

EENG 250 Digital Hardware (2)  
Prerequisite: EENG 160  
A continuation of EENG 160, this course presents logic families, hardware characteristics, noise control and modern programmable logic.

EENG 260 Microcontroller Systems (4)  
Prerequisite: EENG 160; CSCD 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 assembler language and computer programming techniques and laboratory experiments in input/output programming, memory organization, interrupts and interfacing methods.

EENG 320 Signals and Systems I (5)  
Prerequisite: EENG 210 or concurrent enrollment in EENG 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, exponentials and unit step; system properties such as linearity, time-invariance and causality; and Fourier analysis.

EENG 321 Signals and Systems II (5)  
Prerequisite: EENG 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) systems using above techniques for continuous and discrete time.

EENG 330 Microelectronics I (5)  
Prerequisite: CHEM 151, EENG 210.  
This course introduces the characterization, modeling and application of semiconductor devices in the context of analog integrated circuits. Emphasis is placed on the development of models for circuit-level behavior of diodes, bipolar transistors, and MOS transistors, and applies the models to the analysis and design of linear amplifiers.

EENG 331 Microelectronics II (5)  
Prerequisite: EENG 330.  
This course is the second in the characterization, modeling and application of semiconductor devices in the context of analog integrated circuits. The emphasis is on the metal-oxide-semiconductor (MOS) transistor. Topics include amplifiers, frequency response and feedback effects.

EENG 350 Energy Systems (5)  
Prerequisites: EENG 210  
This course provides an introduction to the different energy sources, methods of electric energy conversion, the electric power system, transformers and electrical machines.

EENG 360 Hardware Description Languages (5)  
Prerequisite: EENG 115.  
This course introduces methodologies and computer-aided design (CAD) tools for the design of complex electronic systems. The emphasis is on high-level design and the use of hardware description languages and their use for specifying, designing, simulating and synthesizing digital very large scale integration (VLSI) circuits in MOS (metal-oxide-semiconductor) technologies. Theoretical knowledge will be complemented by hands-on use of several commercial CAD tools.

EENG 383 Applied Stochastic Processes (4)  
Prerequisite: MATH 163 or permission of the instructor and must be taken concurrently with EENG 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 processes and systems, as well as modern estimation techniques.

EENG 388 Applied Stochastic Processes Laboratory (1)  
Prerequisite: MATH 163 or permission of the instructor and must be taken concurrently with EENG 383.  
This laboratory course introduces basic concepts of stochastic processes and their application to engineering problems.

EENG 401 Engineering Applied Electromagnetics (5)  
Prerequisite: EENG 210, MATH 241.  
This course provides students with the technical basis to analyze electromagnetic applications Systems. Topics include waves and phasors, vector analysis, electrodynamics, magnetostatics, Maxwell’s equations for time-varying fields and plane wave propagation.

EENG 415 Introduction to Computer Communication Networks (5)  
Prerequisite: Junior standing.  
Fundamentals of data communication, telephone/ cellular/ computer networks, layered network architecture, OSI model, data link layer functions and protocols including ARQ, network layer functions and protocols including IP, transport layer functions and protocols including TCP; Basic MATLAB programming experience is necessary for this course.

EENG 420 Digital Signal Processing (5)  
Prerequisite: EENG 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.

EENG 425 Principles of Digital Image Processing (5)  
Prerequisite: EENG 331.  
Image representation, color spaces, image filtering and enhancement, image transforms and image/video coding.

EENG 430 CMOS Digital Integrated Circuits Design (5)  
Prerequisite: EENG 331.  
This course provides students with the theoretical and practical knowledge required for analyzing and designing digital integrated 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.

EENG 435 Analog Integrated Circuits Design (5)  
Prerequisite: EENG 331.  
This course provides students with the theoretical and practical knowledge required for analyzing and designing analog integrated circuits and systems in CMOS and BiCMOS technologies. Topics include operational amplifier design, biasing and reference circuits, stability, and selected applications of analog circuits (e.g. filters, comparators, data converters, transceiver blocks).

EENG 440 Digital Communication Systems (5)  
Prerequisite: EENG 383.  
This course provides students with a solid background in modern digital communication systems. Random processing is applied in the realm of communication theory. Common modulation and demodulation techniques are presented. Other topics include bandwidth transmission of binary data, coherent/noncoherent communications, intersymbol interference and equalization.

EENG 442 Mobile Communications (5)  
Prerequisites: EENG 321 and EENG 383.  
This course covers antennas and propagation, signal encoding techniques; spread spectrum, coding and error control, cellular and wireless control.

EENG 450 Power System Analysis (5)  
Prerequisite: EENG 350.  
This 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.

EENG 452 Protective Relays (5)  
Prerequisite: EENG 450.  
This course provides students with the technical basis to analyze and design protection for power systems. Topics include: symmetrical components, relay input sources, protection fundamentals, system grounding principles and protection of power system components.

EENG 460 Computing Systems: Organization and Design (5)  
Prerequisites: CSCD 255, EENG 360.  
This course provides the theoretical and practical knowledge required for analyzing and designing complex computing systems. Topics include computer performance, MIPs assembly language, integer and floating point arithmetic, designing a processor, pipelining and memory hierarchies. Assembly programming and design using VHDL are offered in weekly labs.

EENG 461 Embedded System Design (5)  
Prerequisites: EENG 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 elements of embedded system design, 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.

EENG 470 Control Systems (5)  
Prerequisite: EENG 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 responses, analyses and frequency response analysis are studied. In addition, state-space analysis techniques are examined within the context of state-space system models. Analysis and design of transfer functions, integral and derivative (PID), PI and PD controllers are presented.

EENG 471 Digital Control Systems (5)  
Prerequisite: EENG 470.  
This course provides students with the technical basis to understand and analyze digital control systems. Topics include frequency response, modeling digital control systems, steady-state error, stability, Z-domain design and state-space models. An introduction to Lyapunov techniques is presented.

EENG 490A Senior Capstone: Design Laboratory I (2)  
Prerequisites: senior standing.  
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, having in the professional and civic lives of the students.
Mechanical Engineering Courses

Terms offered: check with the department or EAGLENET.

MENG 201 Introduction to MATLAB (4)
Prerequisite: MATH 141
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.

MENG 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.

MENG 217 3D Parametric Computer Aided Design (4)
Prerequisite: METC 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.

MENG 240 Statics (4)
Prerequisites: PHYS 151, MATH 161 or Technical Calculus I or equivalent.
Prerequisites: MENG 240, MATH 162, PHYS 152 or Technical Calculus II 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.)

MENG 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.

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

MENG 444 Heat Transfer (5)
Prerequisites: MENG 332, MENG 347, MENG 380, MENG 381 (MENG 381 may be taken concurrently) and MENG 386.
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.

MENG 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.

MENG 453 Materials and Design (5)
Prerequisites: MENG 241, MENG 353.
This course expands upon the concepts covered in the Industrial Materials class. Focus is on how materials and the design of products and the processes to make them are interrelated. Students explore processing and properties of materials such as glass, ceramics, polymers and metals other than steel.

MENG 455 Composite Materials (5)
Prerequisites: MENG 201, MENG 153.
This course covers basics of composite materials including manufacturing, design and applications. Students learn anisotropic and heterogeneous material systems; types of composite constituents; physical and mechanical properties; micro, macro and failure of composite design related to strength and different failure modes; and applications of composite beams, plates and stiffened panels.

MENG 482 Advanced Topics in Fluid Dynamics (5)
Prerequisites: MATH 347, MENG 217, MENG 382.
Students apply fluid principles to various technical situations and utilize advanced methods to derive a solution. Topics covered may include Computational Fluid Dynamics (CFD), turbo machinery, compressible fluid flow, turbulence, thermo-fluid system design, and fan and pump performance.

MENG 485 Advanced Robotics and Automation (5)
Prerequisite: MENG 385.
A study of the various electrical and mechanical systems used in advanced robotics and other automated systems. Topics include automated equipment, programming and industrial planning as applied to automated systems. Topics include automated robotic vision, cooperative robotics and service robots.

MENG 486 Programmable Logic Controllers in Automation (5)
Prerequisite: MENG 385.
A study of Programmable Logic Controllers used in industrial automation and advanced robotics. Course explores autologic equipment, ladder logic programming and industrial planning as applied to automated systems.

MENG 487 Sensors Theory for Automation (5)
Prerequisite: MENG 385.
This course introduces the common sensors used in robotics and automation, including the theory of how sensors work, the circuitry involved and the programming logic for input/output.

MENG 490A Senior Capstone: Design Laboratory I (2)
Prerequisites: MENG 241, TECH 301 and senior standing.
Satisfies: senior capstone university graduation requirement.
This course simulates the industrial environment, where students work in teams to solve a real world problem from design to implementation. Team dynamics and project constraints are strictly monitored and each student's unique skills are utilized in different stages of the design process.

MENG 490B Senior Capstone: Design Laboratory II (3)
Prerequisites: MENG 490A.
Satisfies: senior capstone university graduation requirement.
See description for MENG 490A.
Mechanical Engineering Technology Courses

Terms offered: check with the department or EagleNET.

METC 102 Introduction to Engineering Graphics (4)

A study of technical and computer-aided drafting representation of the graphics language. This language, technical drawing, is used by engineers to communicate and operates. Includes the theory and practice of constructive geometry and the geometric representation of data.

Prerequisites: MENG 340 or equivalent.

Note: junior or senior status and permission of the instructor.

METC 340 Statics (5)

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.)

Prerequisite: MENG 340.

METC 341 Strength of Materials (4)

A study of the relationship that exists between externally applied forces and internally induced stresses in structural and parts, including the relationship between these same externally applied forces and the resulting deformations. (Four hours lecture per week)

Prerequisite: MENG 340 and MATH 162.

METC 342 Dynamics (4)

Prerequisite: MENG 340 and MATH 162.

This course is a study of the motion of rigid bodies and forces affecting the motion. Topics include kinematics and kinetic of motion, curvilinear motion, plane motion, work, energy and power, impulse and momentum. (Four hours lecture per week.)

Prerequisite: MENG 180.

Advanced techniques and best practices for parametric design of parts and assemblies. These advanced methodologies include design simulation and analysis including stress analysis, thermal analysis, flow analysis, vibration and motion studies, and design optimization.

Prerequisite: junior standing or permission of the instructor.

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

Prerequisite: MENG 340, MENG 353, and MATH 162 or permission of instructor.

Prerequisite: junior standing or permission of the instructor.

This course introduces 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 implement the creation of industrial energy audits through the extensive use of case studies.

Prerequisite: PHYS 152 or MATH 162; TCOM 205 or MENG 381 (may be taken concurrently).

This course introduces the student to the 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.

Prerequisite: PHYS 152 or MATH 162; TCOM 205 or MENG 381 (may be taken concurrently).

This course introduces the student to the concepts and applications of thermodynamics and heat transfer. Topics include properties of materials, work, heat, conservation of mass and energy, energy transformation processes, and heat transfer via conduction, convection and radiation.

METC 415 Design of Machine Elements (5)

Prerequisite: MENG 341, MENG 353, 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.

Prerequisite: MENG 341, MENG 353, and MATH 162 or permission of instructor.

This course introduces the student to direct current, alternating current (including residential wiring) and amplifying devices. (Three hours lecture, two hours laboratory per week.)

Prerequisite: MENG 341, MENG 353, and MATH 162 or permission of instructor.

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 the methods and non-mechanical properties of various materials, common construction methods and knowledge of material properties and applications in construction.

Prerequisite: MENG 341, MENG 353, and MATH 162 or permission of instructor.

This course simulates the industrial environment, where students work in teams to solve a real world problem from design to implementation. Team dynamics and project constraints are strictly monitored and each student's unique skills are utilized in different stages of the design process.

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

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Prerequisite: MENG 341, MENG 353, and MATH 162 or permission of instructor.

This course simulates the industrial environment, where students work in teams to solve a real world problem from design to implementation. Team dynamics and project constraints are strictly monitored and each student's unique skills are utilized in different stages of the design process.

Prerequisite: MENG 341, MENG 353, and MATH 162 or permission of instructor.
TECH 320 Non-Metallic Processes (5)  
Prerequisite: METC 110 or permission of instructor.  
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.

TECH 330 Technology Problem Analysis and Design I (4)  
Prerequisites: junior standing or permission of instructor.  
Development of foundational 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 are used. Emphasis is on consideration of interconnected systems.

TECH 331 Technology Problem Analysis and Design II (4)  
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: METC 110.  
Design, layout and development of residential dwellings and large structures. (Four hours lecture per week.)

TECH 345 Soils/Surveying (4)  
Prerequisite: 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, angles, staking and design, and designing, laying out surveying, building layout and grade staking.

TECH 354 Building Codes (4)  
Prerequisite: TECH 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 393 Technology in World Civilization (4)  
Cross-listed: HONS 393.  
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.

TECH 402 Machine Tool I (5)  
Prerequisites: METC 110, TECH 301.  
A comprehensive course in machine tool operations, both manual 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: TECH 107 or permission of the instructor.  
The application of spreadsheets to solve engineering problems, technical graphs, trending and curve fitting. The introduction to the use of computer-aided design of projects, critical path planning, project tracking and cost collection.

TECH 404 Computer Numerical Control (5)  
Prerequisite: TECH 301, TECH 402.  
This course provides the learner with experience utilizing CNC processes. Programming methods will include manual, CAM software and conversational language.

TECH 406 Welding Technology (4)  
Prerequisite: TECH 301 or permission of the instructor.  
Theoretical and practical welding processes and nonferrous 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, 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 452 Engineering Economics (4)  
Prerequisite: junior standing or permission of instructor.  
This course uses 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.

TECH 454 Environmental Engineering (4)  
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 456 Engineering Ethics, Contracts and Patents (4)  
Prerequisite: junior standing or permission of the 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.

TECH 458 Quality Assurance (4)  
Prerequisite: junior standing.  
Application of the 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)  
Prerequisites: junior or senior status and permission of the instructor.  
Fundamentals of hazardous materials, 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 a 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, project design and 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 from each of the major programs. The group, 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 formal written report to demonstrate how the process and goals of the course have been realized.

EC 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)  
Note: graded Pass/Fail.  
Prerequisites: senior or senior status and permission of the instructor, department chair and 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 standards for designing and developing 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: METC 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)  
only one workshop course for up to 3 credits may be used to fulfull graduate degree requirements.

TECH 598 Seminar (1–6)  
TECH 599 Independent Study (1–6)  
Note: may be repeated within the 6 credits allowed to fulfill the student's goals and needs in specific areas.  
Prerequisites: permission of the instructor, department chair and college dean.

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.

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