General Information

NAU’s College of Engineering and Technology offers programs in:
• computer science and engineering
• civil engineering
• environmental engineering
• electrical engineering
• mechanical engineering
• environmental technology
• construction management
• technology education
• vocational education

We also offer emphases within some of these programs.

We administer these academic programs through five departments in the College of Engineering and Technology - Computer Science and Engineering, Civil and Environmental Engineering, Electrical Engineering, Mechanical Engineering, and the Department of Technology - and we describe these academic programs in the following sections under those headings.

Design Commitment

Engineers are designers, and we are dedicated to teaching you engineering through the process of design. Design methodology and design projects are integrated throughout all four years of our curriculum, culminating in a capstone, industrial-design experience in your senior year in which you participate as a member of a design team.

You use modern design tools, both hardware and software, that are currently being used by designers in industry. We also weave concurrent engineering and total quality management concepts into our curriculum, because we are committed to providing you with excellence in a design experience in your undergraduate education.

Cooperative Education Program

We also offer a cooperative education program in which you may gain practical experience by working in selected industries during certain periods of your college years. Through this program, you can gain experience in your chosen profession as well as financial return, and companies and agencies can evaluate your potential for future permanent employment.

To be eligible for the co-op program, you must have finished your first year of college and have a C average or better, and your character and personality must be acceptable to the cooperating employer. (As
a transfer student with the above qualifications, you may be accepted after one semester of academic residence at NAU.) Finally, you must maintain a C or better average to continue in the cooperative education program.

As a co-op student, you must observe the regulations of the company that employs you. University holidays do not apply to you unless they are also granted to employees of the company, and you aren’t automatically given time off for University activities.

You may enroll for a maximum of five work periods, and if you successfully complete at least three work periods, you will be designated as a cooperative education graduate.

**Computer Science and Engineering**

Engineering Building, Room 103
PO Box 15600, Flagstaff, AZ 86011-5600
602-523-1447

**Faculty**
Lanny Mullens, Department Chair; Ken Collier, Robert Feugate, Melvin Neville, Ravi Pense, John Placer

**Introduction**

The mission of our computer science and engineering program is to prepare you:

- for entry into the professional practices of computer science and computer engineering (Our degree program provides a strong background in mathematics, science, and engineering as well as computer science.)
- for industry, by providing you with a strong design background for both hardware and software using computer-based tools (We require a capstone design project as part of all of our degree programs.)
- for further education in graduate programs (You will be ready to continue your studies in computer science, computer engineering, or possibly another field at the graduate level.)

Our computer science and engineering program is fully accredited by the Engineering Accreditation Committee of the Accreditation Board for Engineering and Technology.

**Program Admission Requirements**

All students admitted to NAU may enroll in lower-division courses in computer science and engineering, provided that you meet any required prerequisites and/or corequisites for those courses.

To advance into our professional courses, you needn’t make formal application, but you must meet any prerequisites listed in the course descriptions in this catalog.

**Degree Offered - B.S. in Computer Science and Engineering**

To earn this degree, you must complete the two components described in the following paragraphs. This degree does not require a minor.

<table>
<thead>
<tr>
<th>Major Requirements</th>
<th>101 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other Liberal Studies Requirements</td>
<td>24* hours</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>125</strong> hours</td>
</tr>
</tbody>
</table>

*See the heading Liberal Studies Requirements in this section.

**Major Requirements**

The major in computer science and engineering consists of a common engineering core, specified computer science and engineering courses, and professional electives that are selected to lead to a specific emphasis.

**Common Core**

These 60 hours provide a foundation for later studies in your major field as well as a basic understanding of other fields of engineering. The core includes courses from math and the sciences that help you meet NAU’s liberal studies requirements as well as some basic computer science and engineering courses, as shown below.

- 29 hours of required math and science courses: CHM 151 and 151L; MAT 136, 137, 226, 238, and 239; and PHY 161 and 262
- 31 hours of computer science and engineering courses: CSE 120, 122, 247, and 355 and EGR 225, 238, 239, 349, 385, and 486

**Computer Science and Engineering Courses**

The following 29 hours of required courses provide the basis for backgrounds in both computer science
You can request permission to continue in the program by petitioning the department, normally after completing a semester of acceptable work in other courses.

Civil and Environmental Engineering

Engineering Building, Room 103
PO Box 15600, Flagstaff, AZ 86011-5600
602-523-1448

Faculty
Dick Mirth, Department Chair; William Auberle, Terry Baxter, Carl Cawood, Joe Gust, Gene Loverich, Wilbert Odem, Paul Trotta

Introduction

The objectives of our civil and environmental engineering program are to:

• offer a broad design experience using modern techniques and computers to provide you with entry-level skills for employment (A capstone design project is part of the program.)
• prepare you for entry into professional practice (Our program provides a strong background in the engineering sciences, mathematics, and pure science and qualifies you to take the Fundamentals of Engineering exam for professional registration.)
• prepare you for further education in a graduate program in engineering or other fields

We offer degrees in civil and environmental engineering. For the civil engineering degree, you can choose one of two emphases - in structures or in the environment.

Our civil engineering program is fully accredited by the Engineering Accreditation Committee of the Accreditation Board for Engineering and Technology. Our environmental program will be submitted for accreditation after the first class has graduated from the program.

Program Admission Requirements

All students admitted to NAU may enroll in lower-division courses in engineering, provided that you meet any required prerequisites and/or corequisites for those courses.

To advance into the professional courses, you needn't make formal application, but you must meet any
prerequisites listed in the course descriptions in this catalog.

Continuation Requirements

To continue in the civil and environmental engineering program, you must have no more than two D or F grades in CSE or EGR courses. If you receive a third D or F grade or two successive D or F grades in the same course, you will be placed on probation. During this probationary period, you must repeat whatever courses are offered to remediate the D or F grades. If, at the end of a semester on probation, you have three or more D or F grades, you will be suspended from your major.

You can request permission to continue in the program by petitioning the department, normally after completing a semester of acceptable work in other courses.

Degrees Offered

You may pursue the following degrees in this department:

• B.S.E. in civil engineering
• B.S.E. in environmental engineering

B.S.E. in Civil Engineering

To earn this degree, you must complete the two components described in the following paragraphs. This major does not require a minor.

Major Requirements 101-102 hours
Other Liberal Studies Requirements 24-23* hours
Total 125** hours

*See the heading Liberal Studies Requirements in this section.

**Be aware that some courses required for your degree may have prerequisites that you must also take. Check all course descriptions to find out.

Major Requirements

This major consists of a common engineering core, specified civil engineering courses, and professional electives in engineering that can be structured to lead to either an environmental or structural emphasis.

Common Core. These 61 hours of courses provide a foundation for later advanced studies in your major field as well as a basic understanding of other fields of engineering. The core includes courses from math and the sciences that help to meet NAU’s liberal studies requirements as well as some basic engineering and computer science courses.

- 26 hours of math and science courses: MAT 136, 137, 238, and 239, CHM 151 and 151L, and PHY 161 and 262
- 35 hours of computer science and engineering courses: CSE 120 and 122 or 123 and EGR 180, 225, 238, 251, 252, 253, 380, 385, 391, and 395

Civil Engineering Courses. The following 19 hours provide an overview of the different areas in civil engineering and a background for further specialization in your field of interest: EGR 150, 270, 331, 333, 376, and 383.

Professional Electives. You select courses totaling 21 or 22 hours, depending on which emphasis you choose.

• environmental emphasis:
  CHM 152, EGR 330 and 486, ENV 285, and 12 hours of approved design electives
• structures emphasis:
  EGR 377 and 486, a 3-hour science elective, and 12 hours of approved design electives

Liberal Studies Requirements

NAU requires 43 hours of liberal studies coursework, as described in the General Academic Requirements chapter of this catalog. This coursework helps to broaden your background and gives you an opportunity to interact with students of varied interests and backgrounds.

For the civil engineering major, you take the following - all of which count toward your major requirements:

• 3 hours for the mathematics foundation requirement
• 8 hours in the natural sciences block
• 9 hours in the language and analysis skills block

The following hours count toward the other liberal studies requirements. Be aware that at least two of the courses in the discipline studies must have the same departmental prefix. In addition, at least 12 hours of this work must be in upper-division (300- or 400-level) courses.

• ENG 101 and 102 or ENG 105 (to meet foundation requirements)
• 3 hours in the arts block
• 6 hours in the humanities block
• 6 hours in the social sciences block
• 3 hours in the world and cultural diversity block

B.S.E. in Environmental Engineering

To earn this degree, you must complete the two components described in the following paragraphs. This major does not require a minor.
Major Requirements 102 hours
Other Liberal Studies Requirements 23* hours
Total 125* hours

*See the heading Liberal Studies Requirements in this section.

**Be aware that some courses required for your degree may have prerequisites that you must also take. Check all course descriptions to find out.

Major Requirements
This major consists of a common engineering core, specified environmental engineering courses, and electives in engineering design.

Common Core. These 64 hours of courses provide a foundation for later advanced studies in your major field as well as a basic understanding of other fields of engineering. The core includes courses from math and the sciences that help to meet NAU’s liberal studies requirements as well as some basic engineering and computer science courses.

- 32 hours of math and science courses: CHM 151, 151L, 152, and 440; MAT 136, 137, 238, and 239; and PHY 161 and 262
- 32 hours of computer science and engineering courses: CSE 120 and 122 or 123 and EGR 180, 225, 238, 251, 252, 253, 380, 391, and 395

Environmental Engineering Courses. The following 26 hours of required courses provide an overview of the different areas within civil and environmental engineering as well as a background for further specialization in your field of interest: EGR 150, 270, 280, 330, 331, 332, 333, and 383 and ENV 285.

Design Electives. You select elective courses totaling 9 hours plus EGR 486 to complete your major requirements.

Liberal Studies Requirements
NAU requires 43 hours of liberal studies coursework, as described in the General Academic Requirements chapter of this catalog. This coursework helps to broaden your background and gives you an opportunity to interact with students of varied interests and backgrounds.

For the environmental engineering major, you take the following - all of which count toward your major requirements:

- 3 hours for the mathematics foundation requirement
- 8 hours in the natural sciences block
- 9 hours in the language and analysis skills block

The following hours count toward the other liberal studies requirements. Be aware that at least two of the courses in the discipline studies must have the same departmental prefix. In addition, at least 12 hours of this work must be in upper-division (300- or 400-level) courses.

- ENG 101 and 102 or ENG 105 (to meet foundation requirements)
- 3 hours in the arts block
- 6 hours in the humanities block
- 6 hours in the social sciences block
- 3 hours in the world and cultural diversity block

Electrical Engineering
Engineering Building, Room 103
PO Box 15600, Flagstaff, AZ 86011-5600
602-523-1448

Faculty
George Hoyle, Department Chair; Henry Ablin, Tony DeCou, Marc Herniter, Walter Hopkins, Dick Neville, Dave Scott, John Seeger, David Szmyd

Introduction
The objectives of NAU’s electrical engineering program are to:

- offer a design experience that uses modern workstations and industry-standard software to provide you with entry-level skills for employment (You complete a capstone design project as part of the program.)
- prepare you for entry into professional practice (Our program provides a strong preparation in the engineering sciences, mathematics, and pure science and qualifies you to take the exams for professional registration.)
- prepare you for further education in a graduate program (You will be ready to continue your education in engineering or other fields at the graduate level.)

Our electrical engineering program is fully accredited by the Engineering Accreditation Committee of the Accreditation Board for Engineering and Technology (EAC-ABET).

Program Admission Requirements
All students admitted to NAU may enroll in lower-division courses in engineering, provided that you meet any required prerequisites and/or corequisites for those courses.

To advance into the professional courses, you needn’t make formal application, but you must meet any...
prerequisites listed in the course descriptions in this catalog.

Continuation Requirements
To continue in this program, you must have no more than two D or F grades in CSE or EGR courses. If you receive a third D or F grade or two successive D or F grades in the same course, you will be placed on probation. During this probationary period, you must repeat whatever courses are offered to remediate the D or F grades. If, at the end of a semester on probation, you have three or more D or F grades, you will be suspended from the electrical engineering major.

You can request permission to continue in the program by petitioning the department, normally after completing a semester of acceptable work in other courses.

Degree Offered - B.S.E. in Electrical Engineering
To earn this degree, you must complete the two components described in the following paragraphs. This degree does not require a minor.

Major Requirements 102 hours
Other Liberal Studies Requirements 23* hours
Total 125** hours

*See the heading Liberal Studies Requirements in this section.

**Be aware That some courses required for your degree may have prerequisites that you must also take. Check all course descriptions to find out.

Major Requirements
The major in electrical engineering consists of a common engineering core, specified electrical engineering courses, and professional electives that can be structured to lead to one of two emphases - IC electronics, design, and fabrication or systems design.

Common Core
These 64 hours of courses provide a foundation for later advanced studies in your major field as well as a basic understanding of other fields of engineering. The core include courses from math and the sciences that help to meet NAU's liberal studies requirements as well as some basic engineering and computer science courses, as shown below.

- 29 hours of math and science courses: CHM 151 and 151L; MAT 136, 137, 238, and 239; and PHY 161, 262, and 263
- 35 hours of computer science and engineering courses: CSE 120, 122 or 123, 247, and 355; EGR 180, 225, 238, 380, 385, and 486; and two courses from EGR 251, 252, 340, 391, 402, 410, 450 and 451

Electrical Engineering Courses
The following 27 hours of required courses provide an overview of the different areas within electrical engineering and a background for further specialization in your field of interest: EGR 239, 280, 348, 349, 364, 370, 388, 461, and 464.

Professional Electives
You select elective courses totaling 11 or 12 hours in one of the following emphases:
- IC electronics, design and fabrication: EGR 462, 471, 472, 482, and 488
- systems design: EGR 367 and 481 plus one course from CSE 366, 420, and 495 and EGR 448, 456, and 459

Liberal Studies Requirements
NAU requires 43 hours of liberal studies coursework, as described in the General Academic Requirements chapter of this catalog. This coursework helps to broaden your background and gives you an opportunity to interact with students of varied interests and backgrounds.

For the electrical engineering major, you take the following - all of which count toward your major requirements:
- 3 hours for the mathematics foundation requirement
- 8 hours in the natural sciences block
- 9 hours in the language and analysis skills block

The following hours count toward the other liberal studies requirements. Be aware that at least two of the courses in the discipline studies must have the same departmental prefix. In addition, at least 12 hours of this work must be in upper-division (300- or 400-level) courses.
- ENG 101 and 102 or ENG 105 (to meet foundation requirements)
- 3 hours in the arts block
- 6 hours in the humanities block
- 6 hours in the social sciences block
- 3 hours in the world and cultural diversity block

Mechanical Engineering
Engineering Building, Room 103
PO Box 15600, Flagstaff, AZ 86011-1560
602-523-1447
Introduction

The objectives of NAU's mechanical engineering program are to:

- provide you with small classes taught by full-time, professionally qualified faculty
- offer an undergraduate design experience that uses modern microcomputers and workstations with industry-standard software to provide you with entry-level skills for employment (You complete a capstone design project as part of the program.)
- prepare you for entry into professional practice (Our program provides you with strong preparation in the engineering sciences, mathematics, and pure science and qualifies you to take the professional fundamental engineering examination in your senior year.)
- prepare you for further education in graduate school (You will be ready to continue your education in engineering or other fields at the graduate level.)

Our mechanical engineering program is fully accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (EAC-ABET).

Program Admission Requirements

All students admitted to NAU may enroll in lower-division courses in engineering, provided that you meet any required prerequisites and/or corequisites for those courses.

To advance into the professional program, you needn't make formal application, but you must meet any prerequisites listed in the course descriptions in this catalog.

Degree Offered - B.S.E. in Mechanical Engineering

To earn this degree, you must complete the two components described in the following paragraphs:

Major Requirements 101 hours
Other Liberal Studies Requirements 24* hours
Total 125** hours

*See the heading Liberal Studies Requirements in this section.

**Be aware that some courses required for your degree may have prerequisites that you must also take. Check all course descriptions to find out.

Major Requirements

The mechanical engineering major consists of an engineering core, specified mechanical engineering courses, and professional electives in mechanical and other engineering courses that can be structured to lead to one of two specific emphases - mechanical design and control or energy resources and environment.

Engineering Core

These 62 hours provide the foundation for later advanced studies in your major field as well as a basic understanding of other fields in engineering. The core includes courses from mathematics and the sciences that help meet NAU's liberal studies requirements. Basic engineering and computer science courses are part of the core as well.

- 29 hours of mathematics and science courses: CHM 151 and 151L; MAT 136, 137, 238, and 239; and PHY 161, 262, and 263
- 33 hours of computer science and engineering courses: CSE 120 and 122 or 123 and EGR 180, 225, 238, 251, 252, 340, 380, 385, 391, and 486

Mechanical Engineering Courses

The following 26 hours provide an overview of the two standard branches of mechanical engineering, solid mechanics and thermal and fluid mechanics, thus giving you the background for further specialization in your emphasis of interest. These courses are EGR 239, 253, 365, 395, 402, 450, 455, and 490.

Professional Electives

You select elective courses totaling 13 hours to complete the major requirements, in one of the following emphases:

- mechanical design and control emphasis: EGR 367 and 484 and the additional hours from EGR 376, 377, and 410 and other EGR or CSE courses as approved by your adviser
- energy resources and environment emphasis: two courses from EGR 392, 396, 397, and 451 and the additional hours from EGR 410 and other EGR or CSE courses as approved by your adviser

Liberal Studies Requirements

NAU requires 43 hours of liberal studies coursework, as described in the General Academic Requirements chapter of this catalog. This coursework helps to broaden your background and gives you an opportunity to interact with students and faculty of varied interests and backgrounds. Additionally, these
courses make you more aware of the social responsibilities of engineers and better enable you to consider related factors in the decision-making process of design.

For the mechanical engineering major, you take the following - all of which count toward your major requirements:

- 3 hours for the mathematics foundation requirement
- 8 hours in the natural sciences block
- 9 hours in the language and analysis skills block

The following hours count toward the other liberal studies requirements. Be aware that at least two of the courses in the discipline studies must have the same departmental prefix. In addition, at least 12 hours of this work must be in upper-division (300- or 400-level) courses.

- ENG 101 and 102 or ENG 105 (to meet foundation requirements)
- 3 hours in the arts block
- 6 hours in the humanities block
- 6 hours in the social sciences block
- 3 hours in the world and cultural diversity block

Continuation Requirements

To continue in the mechanical engineering program, you must maintain at least a 2.25 grade point average in your major and have no more than two D or F grades in CSE or EGR courses. If you receive a third D or F grade or two successive D or F grades in the same course, you will be placed on probation. If, at the end of a semester on probation, you have three or more D or F grades, you will be suspended from the mechanical engineering program.

You can request permission to be reinstated in the program by petitioning the department, normally after completing a semester of acceptable work in other courses.

To graduate, you must have at least a 2.25 grade point average in your engineering and computer science courses. You can submit up to two grades of D to fulfill the required courses in computer science, engineering, mathematics, and the sciences.

Faculty
Gaye Luna, Department Chair; David Grider, Jerry Hatfield, Clair Hill, Grant Holdsworth, Clyde Holland, Skip Rau

Introduction

Changing demographics, new advances in technology, a complex global environment and society, and new demands on workers are bringing dramatic changes to the work place. In meeting these challenges and opportunities, NAU’s Department of Technology offers quality programs in environmental technology, construction management, and vocational and technological education. These programs prepare you for local, state, and national employment in business and industry, government, and education with strong academic fundamentals and a depth and breadth of technological knowledge and skills.

Degrees Offered

You may pursue the following degrees in the Department of Technology:

- B.S. in technology
- B.S. in education

B.S. in Technology

You may pursue one of two majors under this degree - environmental technology or construction management, as described in the sections that follow.

Environmental Technology Major

For this major, you must complete the two components described in the following paragraphs. This major does not require a minor.

<table>
<thead>
<tr>
<th>Major Requirements</th>
<th>104 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other Liberal Studies Requirements</td>
<td>21 hours</td>
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<td><strong>Total</strong></td>
<td>125 hours</td>
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</tbody>
</table>

*See the heading Liberal Studies Requirements in this section.

**Be aware that some courses required for your degree may have prerequisites that you must also take. Check all course descriptions to find out.

Major Requirements. This major consists of common core courses, major courses, and required interdisciplinary courses.

- common core:
  - ENG 302, CHM 151 and 151L, PHY 111, MAT 112, VTE 155, and COM 161
• major courses: TEC 204, 321, 359, 378, 425, 435, and 455; EGR 180 and 270; EGR 150 or ENV 101; PHY 112; ENG 101 and 102; and 10 hours of professional electives
• interdisciplinary courses: GLG 101 and 103; ENV 285 and 300; CHM 152; BIO 180 and 205; PL 201; and POS 410 or 459

Liberal Studies Requirements. NAU requires 43 hours of liberal studies coursework, as described in the General Academic Requirements chapter of this catalog. For the environmental technology major, you must take:
• 9 hours for the foundation studies requirement
• 8 hours in the natural sciences block
• 3 hours in the language and analysis skills block
For information about the remaining liberal studies coursework, see the General Academic Requirements chapter. Be aware that at least 12 hours of the discipline studies coursework must be in upper-division (300- or 400-level) courses.

Construction Management Major
For this major, you must complete the three components described in the following paragraphs.

Major Requirements 74 hours
Minor or Related Courses 21 hours
Other Liberal Studies Requirements 30* hours

Total 125** hours

*See the heading Liberal Studies Requirements in this section.

**Be aware that some courses required for your degree may have prerequisites that you must also take. Check the course descriptions at the end of this section to find out.

Major Requirements. This major consists of common core courses and a group of required major courses.
• common core: ENG 302, MAT 112, VTE 155, COM 161, and one of the following natural science options: (a) CHM 130 or 151 and PHY 111 or 141 or (b) PHY 111 and 112
• major courses: CM 120, 150, 153, 221, 224, 225, 226, 241, 328, 329, 353, 354, 391, 481, 488, and 489 and two courses from CM 122, 123, and 124

Please be aware that you may substitute up to 12 hours of management courses from the College of Business Administration for construction management hours with your adviser’s approval.

Minor Requirements. You may pursue a minor in business management, for which you take:
• three courses from ACC 255 and 256, ECO 284 and 285, and BA 201 and 205

MGT 300
• 9 hours of upper-division business management courses, such as MGT 325, 415, 460, or 496

If you don’t pursue this minor, you take the following courses: ACC 255, BA 205, ECO 285, MKT 333, and MGT 300, 310 and 325.

Liberal Studies Requirements. NAU requires 43 hours of liberal studies coursework, as described in the General Academic Requirements chapter of this catalog.

For the construction management major, you can count some common core courses toward liberal studies requirements: for foundation studies - 4 hours for MAT 112, for the language and analysis skills block - 3 hours for COM 161, and for the natural sciences block - 7 or 8 hours of CHM or PHY courses.

For information about the remaining liberal studies coursework, see the General Academic Requirements chapter. Be aware that at least 12 hours in discipline studies must be in upper-division (300- or 400-level) courses.

B.S. in Education
You may pursue one of two majors under this degree • technology education or vocational education, as described in the sections that follow.

Technology Education Major
For this major, you must complete the three components described in the following paragraphs. This major does not require a minor.

Major Requirements 64-65 hours
Professional Education Courses 31 hours
Other Liberal Studies Requirements 30-29* hours
Total 125** hours

*See the heading Liberal Studies Requirements in this section.

**Be aware that some courses required for your degree may have prerequisites that you must also take. Check all course descriptions to find out.

Major Requirements. The major in technology education consists of common core courses, required major courses, professional vocational/technological education courses, and professional education courses, as follows:
• common core:
  MAT 112, ENG 302, SC 340, and one of the following natural science options: (a) CHM 130 or 151 and PHY 111 or 141 or (b) PHY 111 and 112
• major courses:
  VTE 100, 101, 155, and 201; three courses from
  VTE 105, 110, 115, and 120; and 9 hours of VTE
  electives
• professional vocational/technological education
  courses:
  VTE 410, 465, 491, and 8 hours of VTE
  professional electives
• professional education courses:
  EOF 200; EPS 325; and ECI 308, 322, 350, 450,
  465, and 495

(You may become vocationally certified in the
state of Arizona by providing documentation of
previous occupational experience to the Teacher
Certification Unit at the Arizona Department of
Education. For more information about teacher
certification requirements, see the heading
Certification in Secondary Education within
Instructional Leadership in the Education section
of this chapter.)

Liberal Studies Requirements. NAU requires 43
hours of liberal studies coursework, as described in
the General Academic Requirements chapter of this
catalog.

For the technology education major, you can count
some common core courses toward liberal studies
requirements: for foundation studies - 4 hours for
MAT 112, for the language and analysis skills block
• 3 hours for SC 340, and for the natural sciences
block - 7 or 8 hours of CHM or PHY courses.

For information about the remaining liberal studies
coursework, see the General Academic Requirements
chapter. Be aware that at least 12 hours in discipline
studies must be in upper-division (300- or 400-level)
courses.

Vocational Education Major
You may choose one of two emphases for this major
• trade and industrial education or business
  education. Because the requirements for these two
  emphases are significantly different, we describe
each of them in separate sections.

Trade and Industrial Education Emphasis. For the
B.S. in education, vocational education major with
the trade and industrial education emphasis, you must
complete the two components described in the
following paragraphs.

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<tr>
<th>Major Requirements</th>
<th>83 hours</th>
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<tbody>
<tr>
<td>Liberal Studies Requirements</td>
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*Be aware that some courses required for your
degree may have prerequisites that you must also
take. Check all course descriptions to find out.

Major Requirements. The major in vocational
education with a trade and industrial education
emphasis consists of common core courses.

Professional vocational/technological education
courses, major courses, and electives. We describe
these requirements in a general way in the following
section; consult your adviser for more specific
information.
• 6 hours of common core courses: ENG 302 and
  VTE 155
• 17 hours of professional vocational/technological
  education courses, chosen from VTE 431, 433,
  465, 486, 496, and all 500-level VTE courses
• 55 hours of major courses
  (Up to 18 hours may be granted for previous
  occupational or internship experience, as
described in the paragraphs that follow.)
• 5 hours of elective courses selected with your
  adviser’s approval

If you have previous trade, industrial, or technical
experience, we may grant you up to 18 hours of
credit toward your major requirements through
examination and/or evaluation. We may waive up to
6 hours of supervised teaching in trade or technical
education if you present verification of at least two
years of successful, full-time, contractual teaching in
a vocational field. The Registrar’s Office records
credit for your occupational work experience or
supervised teaching on your transcript when you
complete all other degree requirements.

You can earn up to 18 hours of credit for a supervised
or approved internship in selected trades or industrial
occupations after you begin working on your degree.

Liberal Studies Requirements. NAU requires 43
hours of liberal studies coursework, as described in the
General Academic Requirements chapter of this
catalog.

For the trade and industrial education emphasis, you
must take MAT 112 for foundation studies, SC 340
in the language and analysis skills block, and one of
the following natural science options: (a) CHM 130
or 151 and PHY 111 or 141 or (b) PHY 111 and 112.

For information about the remaining liberal studies
coursework, see the General Academic Requirements
chapter. Be aware that at least 12 hours in discipline
studies must be in upper-division (300- or 400-level)
courses.

Business Education Emphasis. For the B.S. in
education, vocational education major with the
business education emphasis, you must complete the
three components described in the following
paragraphs. (For information about obtaining post-
degree certification in education, contact the chair of
the Department of Technology.)

<table>
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<tr>
<th>Major Requirements</th>
<th>64-65 hours</th>
</tr>
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<tr>
<td>Professional Education Courses</td>
<td>31 hours</td>
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<tr>
<td>Other Liberal Studies Requirements</td>
<td>29-30* hours</td>
</tr>
<tr>
<td>Total</td>
<td>125** hours</td>
</tr>
</tbody>
</table>
Major Requirements. The major in vocational education with a business education emphasis consists of common core courses, professional vocational/technological education and related courses, and designated business courses. We describe these requirements in a general way in the following section; consult your adviser for more specific information.

- 14-15 hours of common core courses: MAT 112, SC 340, and 7 or 8 hours in one of the following natural science options: (a) CHM 130 or 151 and PHY 111 or 141 or (b) PHY 111 and 112
- 30 hours of designated business courses in the following areas: business law, business communication, finance, computer information systems, accounting, economics, management, and marketing, chosen with your adviser's approval
- 20 hours of professional vocational/technological education courses, chosen from VTE 431, 433, 465, 486, 496, and all 500-level VTE courses

Professional Education Courses. You must take the following 31 hours: EDF 200; EPS 325; and ECI 308, 322, 350, 450, 465, and 495. (You may become vocationally certified in the state of Arizona by providing documentation of previous occupational experience to the Teacher Certification Unit at the Arizona Department of Education. For more information about teacher certification requirements, see the heading Certification in Secondary Education within Instructional Leadership in the Education section of this chapter.)

Liberal Studies Requirements. NAU requires 43 hours of liberal studies coursework, as described in the General Academic Requirements chapter of this catalog.

For the vocational education major with a business education emphasis, you can count some common core courses toward liberal studies requirements: for foundation studies - 4 hours for MAT 112; for the language and analysis skills block - 3 hours for SC 340; and for the natural sciences block - 7-8 hours of CHM or PHY courses.

For information about the remaining liberal studies coursework, see the General Academic Requirements chapter. Be aware that at least 12 hours in discipline studies must be in upper-division (300- or 400-level) courses.

Minor Offered - Technology Education

To complete a minor in technology education, you must take the following 24 hours of coursework: VTE 101, 105, 110, 115, 120, 330, 410 or 491, and 465.

Be aware that some courses required for your minor may have prerequisites that you must also take. Check all course descriptions to find out.

Computer Science Courses (CSE)

Please be aware that you must earn a grade of C or better in any prerequisites to the courses listed here to be eligible to register for these courses.

Also be aware that some courses may not be offered every semester. Check with the department and the current Class Schedule for information about when specific courses are offered.


CSE 121 Programming in Pascal (2). An introduction to computer programming in Pascal. Emphasis on structured programming techniques and software design. Prerequisite: CSE 120. Fall, Spring.

CSE 122 Programming in C (2). An introduction to computer programming in C. Emphasis on structured programming techniques and software design. Prerequisite: CSE 120. Fee required. Fall, Spring.

CSE 123 Programming in FORTRAN (2). An introduction to computer programming in FORTRAN. Emphasis on structured programming techniques and software design. Prerequisite: CSE 120. Fee required. Fall, Spring.

CSE 124 Programming in Ada (2). An introduction to computer programming in Ada. Emphasis on structured programming techniques and software design. Prerequisite: CSE 120. Fee required. Fall, Spring.

CSE 178 Unix Operating Systems (2). Introduction to the Unix operating system. Prerequisite: CSE 122. Fall, Spring.

CSE 184 Assembly Programming (3). Assembly-language programming and machine concepts. Prerequisite: CSE 121. 122, or 123. Fall, Spring.

CSE 247 Introduction to Digital Logic (4). Design of digital subsystems using individual components, MSI and LSI circuits; synchronous and asynchronous state machines. 3 hrs. lecture, 3 hrs. lab. Corequisite: EGR 238. Fall, Spring.

CSE 272 Software Techniques (3). Intermediate computer science, emphasizing algorithm design, C programming, and data structures. Prerequisite: CSE 122. Fee required. Fall, Spring.
CSE 247 Advanced FORTRAN Programming (2). FORTRAN techniques with intermediate algorithms and data structures. Prerequisite: CSE 121, 122, or 123. Fall, Spring.


CSE 296 Principles of Languages I (3). Intensive study of and work in a few advanced computer languages. 3 hrs. lecture, 3 hrs. lab. Prerequisite: CSE 272. Fee required. Fall, Spring.

CSE 315 Automata Theory (3). Finite and infinite models leading to an understanding of computability. Prerequisite: MAT 226. Fall.

CSE 320 Software Tools (3). Development of software tools in the C language and the UNIX operating system. Prerequisite: CSE 272. Fee required. Fall.

CSE 340 Introduction to Software Engineering (3). An introduction to the basic techniques of constructing large, complex programs in teams. Includes object-oriented design and relevant computer languages. Prerequisite: CSE 296. Fee required. Spring.

CSE 345 Non-Numeric Applications of Computers (3). String and list manipulations, as well as other non-numeric applications. Prerequisite: CSE 272. Fee required. Fall.

CSE 349 Data Structures (3). Organization of data, including efficiency measurements and algorithm design. Prerequisite: CSE 296. Fee required. Fall, Spring.

CSE 355 Microprocessors (4). Theory, design, and applications of microprocessors and microprocessor-based computers and systems; programming techniques for microcomputers: commercial microprocessors and semiconductor memory systems. Prerequisite: CSE 247. Fall, Spring.

CSE 366 Computer Architecture (4). Computer structure and organization primarily from a hardware standpoint; central processing units, input/output and memory systems. Prerequisite: CSE 247. Fall, Spring.

CSE 382 Advanced Graphics (3). Design and implementation of graphical packages. Examination of algorithms and models for computer graphics. Prerequisites: CSE 272 and 282. Fee required. Spring.

CSE 396 Principles of Languages II (3). Design concepts behind non-procedural languages. Prerequisite: CSE 296. Spring.

CSE 397 Systems Programming (3). Interface with operating systems; I/O systems, memory management, and other system functions. Prerequisite: CSE 296. Fee required. Spring.

CSE 420 Advanced Digital Design (3). Systems design of microprocessors, memories, I/O devices, and random logic controllers; internal and external digital systems communications and standards. Prerequisite: CSE 355. Fall.

CSE 425 Data Communications and Data Networks (3). Data network and communications techniques as applied to digital information transfer. Practical exercises using small computer systems. Prerequisite: CSE 355. Spring.

CSE 449 Software Engineering (3). Theory and practice of design, implementation, and maintenance of large software systems. Prerequisite: CSE 349. Fee required. Fall.

CSE 478 Artificial Intelligence (3). Introduction to artificial intelligence through conceptual analysis and programming. Prerequisites: CSE 349 and 396. Fee required. Fall.

CSE 480 Operating Systems (3). Theory behind operating systems; scheduling, memory management, I/O, and concurrency. Prerequisite: CSE 272. Spring.

CSE 481 Compilers (3). Theory and techniques of constructing compilers for programming languages. Prerequisites: CSE 315 and 349. Fee required. Spring.

CSE 495 Embedded Control (3). An introduction to real-time programming; interfacing analog systems and digital computers; interrupt handling procedures. Practical exercises using microcontrollers. Prerequisite: CSE 355. Spring.

Engineering Courses (EGR)

Be aware that you must earn a grade of C or better in all prerequisites.

Some courses may not be offered every semester. Check with the department and the current Class Schedule for information about when specific courses are offered.

EGR 150 Introduction to Environmental Engineering (3). Contemporary environmental issues. Technical and management solutions to environmental problems. Common contaminants, sources, pollutant measurements, control technologies, and regulatory strategies and policies. Prerequisite: CHM 100 or high school chemistry. Corequisite: MAT 110. Fall, Spring.


EGR 190 Energy, Ecology, and You (3). Energy use and the human race; conventional energy sources; social, economic, and environmental impacts; alternative energy sources.

EGR 225 Engineering Analysis (3). Engineering problem solving using analytical tools from statistics and probability theory, including error analysis, regression analysis, and modeling with computer applications. 3 hrs. lecture. Prerequisite: MAT 137. Fall, Spring.

EGR 238 Electrical Engineering I (4). Introduction to electrical engineering including circuit analysis, single and three-phase power, operational amplifiers, transformers and basic measurement techniques. 3 hrs. lecture, 3 hrs. lab. Prerequisite: MAT 136. Fee required. Fall, Spring.

EGR 239 Electrical Engineering II (3). Physical laws governing electrical engineering, extension of network analysis, magnetic circuits, diodes and transistors, transient
phenomena, and LaPlace transform techniques. 3 hrs. 
lecture. Prerequisite: EGR 238. Fall, Spring.

EGR 240 Technology and the Disabled (3). Status of the 
disabled in various cultures; America and technology’s role 
in improving the lives of the disabled.

EGR 251 Applied Mechanics Statics (3). Fundamentals 
of applied mechanics, vector algebra, equivalent force 
systems, equations of equilibrium, structures, moments of 
plane areas, centroids, friction. Prerequisites: PHY 161 and 
MAT 137. Fall, Spring.

EGR 252 Applied Mechanics Dynamics (3). Kinematics 
and kinetics of particles and rigid bodies using vector 
analysis; solution methods: force-mass-acceleration, work 
and energy, impulse and momentum, translating and 
rotating coordinate systems. Prerequisite: EGR 251 and 
MAT 238. Fall, Spring.

EGR 253 Mechanics of Materials (4). Effects of axial, 
flexural, torsional, and combined stresses on elastic beams, 
shafts, and columns. 3 hrs. lecture, 3 hrs. lab. Prerequisites: 
EGR 251 and MAT 238. Fee required. Fall, Spring.

EGR 270 Plane Surveying (3). Surveying instruments and 
basic procedures including error analysis; note keeping; 
measurement of distance, elevation, and angles with 
appropriate precision; traversing; stadia; and topographic 
mapping. 2 hrs. lecture, 3 hrs. lab. Prerequisite: MAT 112. 
Fee required. Fall.

EGR 280 Environmental Engineering II (3) Introductory 
design-based course in environmental engineering. The 
course applies fundamental scientific and engineering 
principles to solving environmental problems. Prerequisite: 
MAT 136.

EGR 290 Concepts of Data Acquisition (3). 
Computerized data acquisition using windows, languages, 
and spreadsheets with multisensor technology culminating 
in data organization, manipulation, and presentation.

EGR 330 Air Quality Engineering (3). Technical 
approaches to air quality problems; source identification; 
acid deposition; ozone; control of primary and toxic air 
pollutants; indoor air quality. Prerequisites: EGR 150 or 
ENV 101; CHM 152, and MAT 137. Fee required.

EGR 331 Sanitary Engineering (3). Quantity, source, 
treatment, and distribution of water; collection, treatment, 
and disposal of water. Prerequisite: EGR 333. Fee 
required. Fall.

EGR 332 Solid and Hazardous Waste Management (3). 
This course focuses on technologies used for managing and 
tracking solid and hazardous wastes. Prerequisite: CHM 
152. Fee required.

EGR 333 Applied Hydraulics (3). Hydraulic 
considerations for public works wells, pumps distribution 
systems, gravity flow systems, and treatment-plant design 
use of computer analysis techniques. Prerequisite: EGR 
395. Spring.

EGR 340 Materials Science (3). Basic relationships 
between the microstructure of materials and their physical 
and engineering properties. Prerequisite: CHM 151. 
Fall, Spring.

EGR 348 Signals, Systems, Filters (3). Transient analysis 
of networks, frequency responses, Laplace transforms.

EGR 349 Electronic Circuits I (4). Analysis and design of 
linear analog electronic circuits. Models for BJTs, FETs, 
diodes, and operational amplifiers. Single and multistage 
midband amplifiers. Design project. 3 hrs. lecture, 3 hrs. 
lab. Prerequisite: EGR 239. Fee required. Fall, Spring.

EGR 350 Electronic Circuits II (4). Frequency response, 
feedback, oscillators, amplifiers (power, tuned, pulse), 
nonlinear circuits. Design projects. 3 hrs. lecture, 1 hr. lab. 
Prerequisite: EGR 349. Fee required. Fall, Spring.

EGR 389 Cooperative Education Program (1). Study 
work plan of education with alternate semesters of 

Engineering and Technology
attendance in university and semesters of employment in industry or government related to student's major area of study. Fee required. Fall. Spring. Summer.


EGR 391 Thermodynamics I (3). Energy and entropy concepts, applications; first law principles, applications to processes and cycles; introduction to radiation, convection, conduction heat transfer. Prerequisites: CHM 151, MAT 238, and PHY 262. Fall, Spring.

EGR 392 Thermodynamics II (3). Steam and gas turbine powerplants; Maxwell's Relations; gaseous mixtures; combustion analysis; computer applications of first and second law principles. Prerequisite: EGR 391. Spring.

EGR 395 Fluid Mechanics (4). Theory, concepts, and usage of the basic laws of fluid mechanics (conservation of mass, momentum, and energy): incompressible flow of fluids with introduction of compressible flows: dimensionless analysis and similarity: laminar and turbulent flows; empirical methods. 3 hrs. lecture, 3 hrs. lab. Prerequisites: MAT 238 and EGR 252. Fee required. Fall, Spring.

EGR 396 Dynamics of Fluids (3). Continuation of fluid mechanics with topics including compressible flow phenomena, viscous flow analysis, boundary layer solutions, concepts in laminar and turbulent flow. Prerequisite: EGR 395. Spring, alternate years.

EGR 397 Aerodynamics (3). Theory, concepts, and use of basic laws of fluid mechanics and thermodynamics to obtain useful relations for analyzing internal and external fluid flows considering incompressible as well as compressible flow fields. The airfoil is used as the basic flow shape; however, the theory is applicable to other structural shapes. Prerequisites: EGR 391 and 395. Spring, alternate years.

EGR 402 Energy Environment (3). Sources of energy conversion systems, impact on environment, consequences of energy decisions. 3 hrs. lecture. Prerequisites: MAT 239 and EGR 391. Fall.

EGR 410 Environmental Engineering Design (3). Design of environmental systems for solving air-quality, water-quality, or waste-management problems. Prerequisites: CHM 152 and EGR 330 or 332.

EGR 418 Highway Engineering (3). Design of highway systems including transportation planning; design factors; capacity; traffic control devices; drainage; base courses; pavement design; concrete and asphalt materials; computer applications. Prerequisite: EGR 383. Fall.


EGR 436 Structural Steel Design (3). Tension members, compression members, flexural members, combined stresses, biaxial bending; heavy emphasis on connections; introduction to load and resistance factor design; computer applications. Prerequisite: EGR 376. Spring.

EGR 438 Reinforced Concrete Design (3). Working stress and strength design concepts, beams, columns, slabs, retaining walls, single and combined footings. Computer applications. Prerequisite: EGR 376. Fall.

EGR 448 Digital Signal Processing (3). Characteristics of discrete time systems, z and discrete Fourier transforms and digital filtering and processing techniques. Prerequisite: EGR 239.


EGR 451 Solar Engineering Analysis and Design (3). Fundamental concepts of energy and radiation with specific solar energy applications; design of integrated solar energy systems. Prerequisite: EGR 391. Fall.

EGR 455 Vibrations (3). Mechanical systems with single and multiple degrees of freedom; damping, resonance, vibration isolation and absorption, machine balancing. Prerequisites: EGR 252 and 253 and MAT 239. Fall.

EGR 456 Electric Machines (3). The analysis, application, control, and design of electromechanical energy conversion equipment. Transformers and unbalanced three-phase systems included. Prerequisite: EGR 364. Spring.

EGR 457 Power Transmission (3). Analysis of electric power transmission systems; characteristics of transmission lines, system modeling, and load flow studies. Prerequisite: EGR 350, Corequisite: EGR 364. Fall, alternate years.

EGR 459 Digital Control Systems (3). Theory of sampled data-control systems presented from the points of view of classical and modem control theory with applications involving microprocessor-based digital controllers. Prerequisite: EGR 367. Fall, alternate years.

EGR 461 Theory of Semiconductors (3). Band theory, energy distribution functions; impurities and their energy levels, holes and electrons, pn and Schottky junctions. 3 hrs. lecture. Prerequisite: EGR 239. Spring.

EGR 462 Semiconductor Fabrication Laboratory I (1). Investigation of the processes used in the construction of diodes and transistors and the construction of simple devices. 3 hrs. lab. Corequisite: EGR 461. Fee required. Spring.

EGR 464 Engineering Electromagnetics II (3). Maxwell's equations, electromagnetic waves, transmission lines, waveguides, antennas, optical waveguides, and resonators. Prerequisite: EGR 364. Spring.

EGR 467 Production Tool Design (4). Fundamentals of tool engineering, production, aircraft familiarization, value engineering, company organization, CAD, design detailing, SPC, and the team approach to research and design. 3 hrs. lecture, 3 hrs. lab. Prerequisites: EGR 180, 252, 253, and 340. Corequisite: EGR 365. Fall.

EGR 471 Integrated Circuits and Device Design (3). The theory of operation and techniques for designing bipolar and field effect transistors and optoelectronic devices. 3 hrs. lecture. Prerequisite: EGR 461. Fall.

EGR 472 Semiconductor Fabrication Laboratory II (1). Construction of transistors and integrated circuits together with investigation of the necessary processes. Prerequisite: EGR 462. Corequisite: EGR 471. Fee required. Fall.
EGR 481 Communications Systems (4). Theory and practice for electronic communications; spectral analysis, modulation and demodulation techniques, transmitting and receiving systems. 3 hrs. lecture, 3 hrs. lab. Prerequisite: EGR 348 and 349. Fee required. Fall, Spring.

EGR 482 Pulse and Digital Circuit Design (4). Waveform generators; trigger and timer circuits; interfacing between analog and digital systems ( comparators, sample and hold circuits, converters, etc.) 3 hrs. lecture, 3 hrs. lab. Prerequisite: EGR 349. Fee required. Fall, alternate years.

EGR 484 Mechanical Analysis and Synthesis (3). Kinematic and dynamic analysis of rigid body mechanisms; rotating systems, rolling and sliding bodies in contact, quadric chain, slider crank mechanism: synthesis; preliminary design. Prerequisite: EGR 252 and 253. Fall.

EGR 486 Engineering Design (3). Design methodology and decision making. Team design projects culminating with oral and written reports. Individual projects are appropriate on approval. 2 hrs. lecture, 3 hrs. lab. Prerequisite: Area-specific approval. Spring.

EGR 488 Advanced Topics in Electronics (3). Electronic network analysis and design, e.g., active filters, RF power oscillators, AD/DA conversion, industrial power conversion circuits. Noise effects. Design projects. Prerequisite: EGR 388. Fall, alternate years.

EGR 490 Experimental Methods (2). Experimental methods in analysis of solids and fluids, vibrations, dynamics, stress, strain, pressure, temperature, flow rates, sound. 1 hr. lecture, 3 hrs. lab. Prerequisites: EGR 239, 253, and either 450 or 455. Fee required. Spring.

Technology Courses (TEC)

Be aware that you must earn a grade of C or better in all prerequisites.

Also be aware that some courses may not be offered every semester. Check with the department and the current Class Schedule for information about when specific courses are offered.

TEC 145 Circuits I (4). Fundamentals of electricity and magnetism; basic direct current circuit analysis; use of basic measuring devices. 3 hrs. lecture. 3 hrs. lab. Corequisite: MAT 112. Fall.

TEC 146 Circuits II (4). Characteristics of alternating current circuits; circuit analysis techniques: use of oscilloscopes and other instruments. 3 hrs. lecture. 3 hrs. lab. Prerequisite: TEC 145. Spring.

TEC 204 Tech Calculus (4). Applications of functions, differential and integral calculus and analytical geometry, including graphical solutions, for engineering technologists. 4 hrs. lecture. Prerequisite: MAT 112. Fall, Spring.

TEC 206 Engineering Technical Calculus II (4). Differentiation; integration; coordinate systems; maxima, minima; conic sections; parametric equations; multidimensional vectors; indeterminate and differential equations; emphasizing engineering technology applications. 4 hrs. lecture. Prerequisite: TEC 204. Fall, Spring.

TEC 230 Basic Electrical Technology (4). Fundamental electrical principles and circuits for technology students not majoring in electrical engineering technology. 3 hrs. lecture. 3 hrs. lab. Prerequisite: TEC 206. Spring.

TEC 240 Electronic Circuits I (4). Analysis and design of electronic circuits using basic discrete devices. Diodes, bipolar junction transistors, field effect transistors. 3 hrs. lecture. 3 hrs. lab. Prerequisite: TEC 146. Fall.

TEC 242 Electronic Circuits II (4). Analysis and design of electronic circuits using unijunction transistors, four-layer devices, optoelectronic devices, and linear integrated circuits. 3 hrs. lecture. 3 hrs. lab. Prerequisite: TEC 240. Spring.

TEC 254 Construction Geometry (3). The visualization of principles of point, line, and plane relationships used in solving engineering-related problems. 2 hrs. lecture. 4 hrs. lab. Prerequisite: EGR 180. Spring.

TEC 271 Intermediate Surveying (3). Control systems, triangulation, traversing, leveling, coordinate systems; mapping, photogrammetry; applied astronomy, solar, Polaris, latitude and longitude; adjustment computations; analysis of errors. 2 hrs. lecture. 3 hrs. lab. Prerequisite: EGR 270. Spring.

TEC 275 Introduction to Technical Analysis (3). Application of analytical tools from statistics and probability theory for development of technical problem solving; inspection, testing, error analysis, and regression. 3 hrs. lecture. Prerequisite: TEC 204. Corequisite: TEC 206. Spring.

TEC 321 Fluid Mechanics and Hydraulics (4). Fluid statics, incompressible and compressible flow, viscous flow, open channel flow, flow through pipes, empirical and integral approach. 3 hrs. lecture. 3 hrs. lab. Prerequisite: PHY 112. Fall.

TEC 322 Applied Heat Power I (4). Basic laws of thermodynamics, heat, work and energy transformations; relation of properties; power and refrigeration cycles. 3 hrs. lecture. 3 hrs. lab. Prerequisites: PHY 112; CHM 151; CSE 121 and 122 or 123; and TEC 206. Fall.

TEC 323 Applied Heat Power II (4). Basic principles of heat transfer, with special application to problems in heating, ventilation, and air conditioning (HVAC), including duct design and layout. 3 hrs. lecture. 3 hrs. lab. Prerequisite: TEC 322. Spring.

TEC 324 Solar Energy Technology (3). Energy use; solar radiation; solar energy applications to buildings: space heating and cooling, water heating; design, operation of active and passive systems. 3 hrs. lecture. Prerequisite: TEC 322 or consent of instructor. Summer only.

TEC 336 Non-Metallic Materials of Construction (3). The physical properties and structural use of engineering materials, manufacture, behavior; inspection, testing; soils, aggregates, cements, wood, asphalts, clays, composites, 3 hrs. lecture. 3 hrs. lab. Prerequisite: CHM 151. Spring.

TEC 337 Metallic Materials (3). Ferrous and non-ferrous metals and alloys; use of phase diagrams, cooling curves, stress strain diagrams, and metallography to predict and control behavior of metals and alloys. 2 hrs. lecture. 3 hrs. lab. Prerequisites: TEC 336 and CSE 121 and 122 or 123. Fall.
TEC 341 Electrical Machines (4). Energy conversion, rotating machines, and transformers. 3 hrs. lecture, 3 hrs. lab. Prerequisites: TEC 146 or 230, PHY 112, and CSE 121 and 122 or 123. Spring.

TEC 344 Network Analysis (3). Steady state and transient network responses; LaPlace transform methods in network analysis. Prerequisites: TEC 146 and 206. Fall.

TEC 351 Applied Mechanics: Statics (3). Equilibrium of coplanar and non-coplanar force systems; analysis of structures, centroids, moment of inertia of plane areas, friction, hydrostatic pressure. Prerequisites: TEC 204 and PHY 111. Fall.

TEC 352 Applied Mechanics Dynamics (3). Fundamentals of kinematics and kinetics of particles and rigid bodies using the solution methods of force mass acceleration, work energy, and impulse momentum. Prerequisites: TEC 254 and 351 and CSE 121 and 122 or 123. Spring.

TEC 353 Inspection Procedures: Industrial (3). Industrial measurement practices in sources, receiving, in process, and final inspection; comparison of measurements with specifications and blueprints; dimensional and engineering measurement methods. 2 hrs. lecture, 3 hrs. lab. Prerequisites: VTE 335 and TEC 151. Spring.

TEC 354 Experimental Stress Analysis (3). Analysis of real structures, including nondestructive examination, strain gages, and photoelasticity. 2 hrs. lecture, 3 hrs. lab. Prerequisite: TEC 351. Fall.

TEC 355 Fundamentals of Soil Mechanics (4). Physical and mechanical properties of soils, soil moisture, structure, compressibility, consolidation, shear strength, sampling, and testing computer applications. 3 hrs. lecture, 3 hrs. lab. Prerequisites: PHY 112 and GLG 101. Fall.

TEC 361 Pulse and Switching Circuits (4). Pulse waveform analysis; pulse-generating circuits: switching applications of diodes, transistors, and integrated circuits: digital IC interfacing. 3 hrs. lecture, 3 hrs. lab. Prerequisite: TEC 242. Fall.


TEC 370 Property Surveying (3). U.S. sectionalized land system, boundary surveys, subdivisions, resurveys, descriptions, evidence, legal and professional aspects. 2 hrs. lecture. 3 hrs. lab. Prerequisite: TEC 270. Spring.

TEC 371 Route Surveying (3). Engineering surveys for transportation projects, highways, pipelines, railroads; horizontal and vertical curves, spirals, earthwork, construction survey. 2 hrs. lecture, 3 hrs. lab. Prerequisite: EGR 270. Fall.

TEC 378 Hydrology and Drainage (3). Hydrologic cycle; rainfall and runoff as they affect drainage and flood control structures; computer analysis of water surface elevations. Prerequisites: EGR 270 and TEC 321. Spring.

TEC 379 Water and Waste-Water Technology (3). Water chemistry, wastewater biology, water pollution, water distribution systems, with computer analysis, water processing, wastewater collection systems, and wastewater processing. Prerequisites: CHM 151 and TEC 321. Spring.
TEC 480 Technology Applications in Numerical Modeling (3). Introduction to design of Micro-CAE software, use of Micro-CAE software in optimizing systems design and performance; individualized design of a systems software package is a major part of this course. Prerequisites: CSE 121 and 122 or 123 and one of the following: TEC 322, 407, 445, and 464. Spring.

Construction Management Courses (CM)

Some courses may not be offered every semester. Check with the department and the current Class Schedule for information about when specific courses are offered.

CM 120 Building the Human Environment (3). Comparative study of human efforts to control their environment with constructed shelter and infrastructure on global, regional, and personal levels.

CM 121 Basic Wood Processing (3). Practical use of hand tools, power tools, and machines for processing wood. Emphasis on materials, design, and construction procedures as applied to a core project. 2 hrs. lecture, 3 hrs. lab. Fee required.

CM 122 Carpentry Framing (3). Principles of carpentry with strong emphasis in the trends of industry, upgrading of wood construction, home fabrication, hands-on experience with full-scale house. New materials, processes, and procedures. 2 hrs. lecture, 3 hrs. lab. Fee required.

CM 123 Roofing Systems (3). Selection and evaluation of various wood and metal roofing systems for residential and commercial structures. Insulation, flashing, fire proofing. 2 hrs. lecture, 3 hrs. lab. Prerequisite: CM 122. Fee required.

CM 124 Interior and Exterior Systems (3). Design and installation for stairs, wall and floor treatments, doors, windows, cabinets, and moldings. 2 hrs. lecture. 3 hrs. lab. Fee required.

CM 150 Technical Drafting (3). Sketching fundamentals, multiview projection, pictorial drawings, architectural drawings, working drawings, and introduction to computer graphics. 2 hrs. lecture, 3 hrs. lab.

CM 152 Technical Illustration (3). Illustration practices used in service manuals, catalogs, and brochures, with an emphasis on rendering techniques: studying advertisement principles, paste-up techniques, and specialized equipment used in technical illustration. 2 hrs. lecture. 3 hrs. lab.

CM 153 Construction Site Layout (3). Plane surveying; use of field notes for drawing plot plans; construction layout and grading. 2 hrs. lecture, 3 hrs. lab. Prerequisite: CM 150 or ID 110.

CM 221 Structural Steel and Construction Welding (3). Analysis of structural steel framework design and the associated erection procedures and welding techniques to facilitate assembly. Laboratory activities include practical welding and frame erection procedures. 2 hrs. lecture, 3 hrs. lab. Fee required.

CM 224 Concrete and Concrete Forms (3). Selection and evaluation of materials and forming methods used in concrete installation in residential and commercial construction. 2 hrs. lecture. 3 hrs. lab. Fee required.

CM 225 Masonry Construction (3). Theory and practice of construction with mortar, brick, block, reinforced brick, and reinforced concrete masonry. 2 hrs. lecture. 3 hrs. lab. Fee required.

CM 226 Mechanical Systems (3). Mechanical principles and techniques as they relate to heating, cooling, and plumbing systems in residential and commercial construction. Laboratory activities include system design, layout, assembly, and operation. 2 hrs. lecture, 3 hrs. lab. Fee required.

CM 230 Fundamentals of Two-Dimensional Interactive Computer Graphics (3) Practical application of computer-aided drafting with applications from industry. Prerequisite: CM 150 or ID 110. Fee required.

CM 241 Electrical Systems (3). Application of electrical principles and practices as they pertain to residential wiring. AC motor operation, and maintenance switching and control devices. 2 hrs. lecture. 3 hrs. lab. Fee required.

CM 255 Construction Geometry (3). Theory and problems in projecting points, lines, planes, and solids; emphasis on problems related to cuts and fills, strike and dip of strata, and building construction. 2 hrs. lecture. 3 hrs. lab. Prerequisite: CM 150 or ID 110.

CM 321 Cabinetmaking (3). Principles of design and construction applied to cabinetmaking; processes, materials, and machine accessories as applied to the cabinetmaking industry; strict application of these procedures in the construction of cabinets. 2 hrs. lecture, 3 hrs. lab. Prerequisite: CM 221.

CM 325 Production Methods and Processes (3). Application of production principles to various technical processes and products, including design, estimating, purchasing, mass production, and marketing. 2 hrs. lecture, 3 hrs. lab. Prerequisite: CM 121.

CM 328 Construction Estimating I (3). Residential estimating with emphasis on the quantitative calculations used for project costing. Procedure follows the standard construction sequence. Prerequisites: CM 122, 123, 124, 224, 225, 226, and 241.


CM 330 Computer-Aided Design (3). Practical application of three-dimensional computer-aided drafting and design in the industrial environment. Use of current CADD software packages. Prerequisite: CM 230.

CM 350 Machine Drafting (3). Detail and assembly drawing, including gears, cams, and other mechanisms: emphasis on drawing standard machine parts and dimensions for tolerance and numerical control. 2 hrs. lecture, 3 hrs. lab. Prerequisite: CM 150.

CM 351 Industrial Design (3). Principles of design as applied to projects constructed in wood, metal, plastics, and other media. 2 hrs. lecture. 3 hrs. lab. Prerequisite: CM 150.
CM 353 Architectural Drafting (3). Architectural design, methods, and types of construction of important details of modern dwellings, including architectural drafting practices. 2 hrs. lecture, 3 hrs. lab. Prerequisite: CM 150 or ID 110:121.

CM 354 Structural Design and Detailing (3). Review of reactions, shear bending moment, section modules, moment of inertia, and center of gravity; includes steel, wood, and reinforced concrete structures; frequent use of design and detailing tables. Prerequisite: CM 350. 3 hrs. lecture.

CM 391 Introduction to Industrial Safety (3). Emphasis on safety administration, OSHA standards, accident and fire prevention, industrial hygiene, hazardous materials, protective equipment, and related managerial concerns. 3 hrs. lecture.

CM 392 Accident Prevention (3). Development of the safety movement; problems and procedures of safety programs, OSHA regulations designed for accident prevention. 3 hrs. lecture. Prerequisite: CM 391.

CM 393 Industrial Hygiene (3). Environmental hazards in industry, their recognition and control. 3 hrs. lecture.

CM 402 Hazardous Materials Control (3). Controlling the effects of radioactive materials, chemicals, gases, dusts, pesticides, and solids of various materials in relation to their presence during emergencies and the precautions needed to eliminate or control potential risks. Prerequisites: Two physical science courses at the college level. 3 hrs. lecture.

CM 423 Materials of Construction (3). Structure and properties of woods, metals, plastics, laminates, fiberglass, and other media. 3 hrs. lecture. Prerequisite: CM 121.

CM 433 Welding Symbols and Codes (3). Welding and inspection symbols and American Welding Society, American Society of Mechanical Engineering, and American Piping Institute codes. 3 hrs. lecture. Prerequisite: CM 333 or equivalent.

CM 481 Construction Supervision I (3). Construction supervision functions, decision making, worker motivation, and communication problems related to construction management. Fee required.

CM 488 Construction Supervision II (3). Field supervision of the construction job with proper reporting and record keeping, negotiating changes and claims, and using company procedures guidelines. Fee required.

CM 489 Construction Administration (3). Project manager activities relating to construction management. Laws pertaining to construction, contract documents including general and special conditions, inspection warrantees, and various methods of scheduling are analyzed.

CM 494 Legal Aspects of Safety Programs (3). Federal and state laws and judicial interpretations that apply to safety programs, including tort liability and insurance. 3 hrs. lecture. Prerequisite: CM 391.

Vocational/Technological Education Courses (VTE)

Some courses may not be offered every semester. Check with the department and the current Class Schedule for information about when specific courses are offered.

VTE 100 Exploration of Technology (3). An exploration of the new technologies that affect your daily life and allow you to interact with the modern technological society.

VTE 101 Introduction to Industrial and Technological Systems (3). A comprehensive study of the four systems of technology as they relate to their evolution and use and significance to societal needs. Fee required.

VTE 105 Communication Systems (3). A general introduction to technical communication systems and processes within the communication industry. Fee required.

VTE 110 Construction Systems (3). Provides a working understanding of the key elements associated with designing, planning, and constructing a structure on site. Fee required.

VTE 115 Manufacturing Systems (3). Provides a general introduction to the material processing and management components of a manufacturing activity. Fee required.

VTE 120 Transportation Systems (3). The study of transportation systems dealing generally with the methods by which we move people and goods through various environments.

VTE 131 General Metals I (3). Basic experiences and information about bench metal, sheet metal, ornamental iron work, hot metal forming, metal casting, welding, and machine practice. 2 hrs. lecture and 3 hrs. lab. Fee required.

VTE 155 Computer Applications for VTE Teachers (3). Appropriate use of the computer in middle, junior high, and high school vocational/technological subject areas. Prerequisite: Keyboarding skills with a minimum of 20 wpm. Fee required.

VTE 201 Integrated Teaching and Learning (3). Teaching and learning strategies in the vocational/technological classroom. Includes learning styles, cooperative learning, and total quality management.

VTE 205 Media Communications (3). Provides a general introduction to the design, planning, and production of media used in contemporary society. Fee required.

VTE 210 Constructing and Servicing Structures and Systems (3). Provides the construction practices basic to the erection of commercial, institutional, and residential structures. Fee required.


VTE 220 Technical Elements of Transportation (3). The study of the technical elements that make up contemporary, complex transportation systems.

VTE 310 Graphic Communication Systems (3). Provide an introduction to the graphic communication field.
VTE 311 Electronic Communication Systems (3). A general introduction to contemporary communication technology including telecommunications, hard-wired, computer, light, and acoustic systems.

VTE 312 Construction Planning and Design (3). To develop students' understanding of the practices involved in initiating, designing, financing, and engineering constructed works.

VTE 313 Electro/Mechanical Systems and Servicing (3). An introduction to the various mechanical, electrical, and electronic systems in residential, commercial, and industrial structures.

VTE 314 Designing Products for Manufacture (3). An introduction to the systems used by manufacturing enterprises to design, develop, and engineer products.

VTE 315 Manufacturing Production Systems (3). Provide an introduction to the design and operation of production systems. Fee required.

VTE 316 Planning and Designing Transportation Systems (3). Analyzes the transportation system as it relates to urban, intercity, and international needs for moving people and products.

VTE 317 Human and Product Transporting Systems (3). Explores the differences and similarities between various methods of transporting goods and people from one point to another.

VTE 330 Contemporary Technology Education Programs (3). Experimental and innovative curriculum approaches used in technology education laboratories. 3 hrs. lecture.

VTE 333/334 Welding Procedures (3/3). First semester: the operation of welding equipment and related theory including AC and DC electric arc and oxyacetylene. Second semester: tungsten inert gas, metallic inert gas, equipment, metallurgy of welding, nondestructive and destructive testing procedures, and related problems. 2 hrs. lecture and 3 hrs. lab. Fee required.

VTE 335 Metal-Machining Processes (3). Basic operations and technical information about common metal-working machines and metal-machining processes. 2 hrs. lecture and 3 hrs. lab. Prequisite: VTE 131. Fee required.

VTE 392 Accident Prevention (3). Development of the safety movement; background useful for handling problems and procedures of typical school, industrial, transportation, civil defense, and emergency safety programs.

VTE 401 Research and Development in Technology Education (3). A study to pursue new knowledge or to solve a technological or industrial problem.

VTE 415 Technology Education Enterprise (3). A study of the industrial enterprise as it draws from the communication, construction, manufacturing, and transportation systems.

VTE 420 Advanced Metal Machining (3). Processes and technical information on common metal-working machines and accessories, with emphasis on design of jigs and fixtures and on a high degree of skill and accuracy on advanced projects. 2 hrs. lecture and 3 hrs. lab. Prequisite: VTE 335. Fee required.

VTE 431 Presentation of Technical Material in Vocational/Technological Education (3). Selection, design, and production of instructional media.

VTE 433 Program and Curriculum Planning in Vocational/Technological Education (3). Methods of gathering and analyzing information necessary for establishing responsive vocational/technological education programs, focusing on competency-based instruction. Special fee.

VTE 450 Destructive Testing in Welding (3). Use of tensile tester, impact, hardness, torsion, root and face benders to test and evaluate the quality and strength of welds and materials. Prequisite: VTE 333 or equivalent.

VTE 461 Robotics (3). Electrical and electronic principles involved in various types of smart controls including servomechanisms. 2 hrs. lecture, 3 hrs. lab.


VTE 486 Teaching Aids (3). Selection, design, construction, and use of mock-ups, demonstration units, charts, posters, and other teaching aids similar to those used in industry.

VTE 491 Laboratory Management (3). Laboratory administration, safety, planning and installation of equipment, purchasing and control of supplies and materials, and similar topics related to production and instructional efficiency.

VTE 496 Vocational Technological Student Organizations (3). Group dynamics in vocational/technological education.

Graduate Courses

VTE 500 Advanced Laboratory Problems in Vocational Technological Education (1-3).

VTE 503 Special Problems in Vocational/Technological Education (1-3).

VTE 532 Special Needs Populations in Vocational/Technological Education (3).

VTE 550 Grant Writing in Vocational/Technological Education (3).

VTE 566 Coordinating Cooperative Programs in Vocational Technological Education (3).

VTE 583 Vocational/Technological Student Services (3).

VTE 591 Development and Program Planning in Vocational/Technological Education (3).

VTE 592 Selection and Development of Instructional Material (3).

VTE 593 Public School In-Service Workshop (1-3).

VTE 594 Vocational/Technological Guidance (3)
VTE 595 Evaluation in Vocational/Technological Education (3).
VTE 599 Contemporary Developments (1-3).
VTE 608 Fieldwork Experience (1-12).
VTE 661 Business and Financial Management for Vocational/Technological Education (3).
VTE 670 Adult Education (3).
VTE 685 Graduate Research (1-6).
VTE 690 Personnel Management and Staff Development in Vocational/Technological Education (3).
VTE 691 Research Techniques for Vocational/Technological Education (3).
VTE 692 Instructional Management for Vocational/Technological Education (3).
VTE 696 School and Community Relations in Vocational/Technological Education (3).
VTE 697 Independent Study (1-3).
VTE 698 Graduate Seminar (1-3).
VTE 699 Thesis (1-9).