

Department of Engineering Technology and Industrial Studies

Walter W. Boles, Chair
Voorhies Industrial Studies Complex 143

Beard, Brown, Carter, Chen, Cheney, Foroudastan, Fulks, Gore, Hatfield, Mathis, McBride, Nasab, Neithalath, Redditt, Salman, Sbenaty, Sergeant, Sridhara

The purpose of Engineering Technology and Industrial Studies is to prepare students for a broad range of technical and industrial management positions. This is accomplished through nationally accredited programs, a project-based learning environment, and extensive collaboration with industry. The department faculty members have appropriate academic credentials in addition to significant industrial experience. Numerous opportunities are available for students to participate in nationally competitive projects related to topics as diverse as space robotics, solar-powered vehicles, and concrete canoes. Several programs require heavy interaction with the industrial sector, which allows students to work on projects with potential employers. Experiential learning opportunities exist through cooperative and internship classes. Highly motivated students may wish to obtain important industry-recognized certifications that exceed accreditation requirements. Students may study an array of the latest breakthroughs in topic areas such as concrete, construction and industrial systems, rapid prototyping of electrical and mechanical systems, safety, and environmental science. The combination of these programs and activities offers preparation for graduates entering the fast-paced technology sector.

The Robert E. and Georgianna West Russell Chair of Manufacturing Excellence is designed to promote quality interaction with local industry. Students are encouraged to benefit from the scheduled activities, seminars, and short courses sponsored by the Chair of Manufacturing Excellence.

The department offers Bachelor of Science degrees in Concrete Industry Management, Engineering Technology, Environmental Science and Technology, and Industrial Technology.

The Concrete Industry Management major includes two concentrations: Production, Sales, and Service and Concrete Contracting.

The Engineering Technology major includes three concentrations: Computer Engineering Technology, Electro-Mechanical Engineering Technology, and Mechanical Engineering Technology.

The Environmental Science and Technology major is an interdisciplinary program including strong science components and environmental applications under four concentrations: Energy Technology, Environmental Health and Safety, Planning and Site Analysis, and Water and Waste Management.

The Industrial Technology major has two concentrations: Construction Management Technology and Industrial Systems. (Credit for work experience can be obtained in the Industrial Systems concentration.)

Pre-professional programs are offered in Pre-architecture and Pre-engineering. In each case the student will complete his/her program after transferring to the appropriate school.

Minors are offered in Construction Management, Electronics, Environmental Science and Technology, Industrial Education, and Industrial Technology.

Courses are offered which apply toward renewal of the Occupational Education Teacher's License, Six Sigma certification, and Lean manufacturing certification.

Cooperative Education work experiences are possible for most programs. Interested students should check with their advisors.

Curricular listings include General Education requirements in Communication, History, Humanities and/or Fine Arts, Mathematics, Natural Sciences, and Social/Behavioral Sciences categories as outlined on pages 64–67.

Major in Concrete Industry Management

The major in Concrete Industry Management is designed to produce broadly educated, articulate graduates, grounded in basic science and mathematics, who are knowledgeable about concrete technology and techniques and are able to manage people and systems and to promote products or services related to the concrete industry. Examples of opportunities in the field include technical sales of products used to manufacture concrete; operations management of a concrete production facility; sales and marketing of production, construction, and finishing equipment; product distribution, supply chain management, and logistics; project management for a concrete or general contractor; work as a concrete specialist in an architectural/engineering firm or government entity; and support positions such as writer or editor for a technical magazine or professional/trade association management.

All students in the Production, Sales, and Service concentration complete a minor in Business Administration. Core classes in the major include CIM 1010, 1050, 3000, 3050, 3060, 3100, 3300, 4030, 4150, 4200, and 4910.

Grading Policy

Students majoring in the Concrete Industry Management (CIM) program must receive grades of C (2.00) or better in all CIM courses in order for the courses to count toward graduation. A minimum grade of C (2.00) is required in all CIM classes that are prerequisites to other CIM classes.

Concentration: Concrete Contracting

The Concrete Contracting concentration offers preparation for entry-level positions with general and concrete contractors, project management firms, masonry contractors, precast erection firms, or government agencies responsible for construction projects. Position opportunities include project management, estimating, field supervision, planning and scheduling, and various other management positions.

Curriculum Requirements and Recommended Sequence

| FRESHMAN | | SOPHOMORE | |
|------------------------|-----------|--------------------------|-----------|
| ENGL 1010, 1020 (Comm) | 6 | ENGL 2020 or 2030 or | |
| COMM 2200 (Comm) | 3 | HUM 2610 (Hum/FA) | 3 |
| GEOL 1040 (Nat Sci) | 4 | SPAN 1010 or approved | |
| CHEM 1110 (Nat Sci) | 4 | department elective | 3 |
| PSY 3020, Q M 2610, or | | HIST 2010, 2020, or 2030 | 6 |
| MATH 1530 | 3 | Humanities/Fine Arts | 3 |
| CIM 1010, 1050 | 2 | PSY 1410 (Soc/Beh Sci) | 3 |
| CSCI 1150 | 3 | ECON 2410 (Soc/Beh Sci) | 3 |
| MATH 1630 (Math) | 3 | CIM 3000, 3050, 3070 | 10 |
| | 28 | | 31 |
| JUNIOR | | SENIOR | |
| CIM 3060, 3080, 3100, | | CIM 3200, 4010, 4070, | |
| 3600, 4030 | 15 | 4100, 4150, 4200, 4910 | 20 |
| MGMT 3610 | 3 | ET 4420 | 3 |
| MKT 3820 | 3 | ENGL 3500 or 3520 | 3 |
| BLAW 3400 | 3 | Humanities/Fine Arts | 3 |
| FIN 3000 or 3010 | 3 | | 29 |
| ACTG 3000 | 3 | | |
| | 30 | | |

NOTE: CIM 3300 will be taken sometime after the sophomore year for two credit hours.

Concentration: Production, Sales, and Service

The Production, Sales, and Service concentration is geared toward developing technical managers for ready mix, block, and precast concrete production facilities as well as their suppliers, such as admixture, aggregate, cement, and equipment companies. Position opportunities include operations management, sales and sales management, marketing management, human resource management, technical service and quality control, or environmental and safety management.

All students in the Production, Sales, and Service concentration are required to choose a business-related cognate from the list below in addition to the CIM major requirement of completing a Business Administration minor. Twelve (12) hours must be successfully completed in a single chosen cognate area prior to graduation.

Curriculum Requirements and Recommended Sequence

| FRESHMAN | | SOPHOMORE | |
|--------------------------|--------------|------------------------------|-----------|
| ENGL 1010, 1020 (Comm) | 6 | ENGL 2020 or 2030 or | |
| MATH 1630 or 1730 (Math) | 3-4 | HUM 2610 (Hum/FA) | 3 |
| GEOL 1040 (Nat Sci) | 4 | Approved department elective | 3 |
| COMM 2200 (Comm) | 3 | Humanities and/or Fine Arts | 3 |
| CIM 1010, 1050 | 2 | CIM 3000, 3050 | 7 |
| CHEM 1110 (Nat Sci) | 4 | HIST 2010, 2020, or 2030 | 6 |
| PSY 3020, Q M 2610, or | | PSY 1410 (Soc/Beh Sci) | 3 |
| MATH 1530 | 3 | ET 3910 | 3 |
| CSCI 1150 | 3 | ECON 2410 (Soc/Beh Sci) | 3 |
| | 28-29 | | 31 |
| JUNIOR | | SENIOR | |
| ACTG 3000 | 3 | ET 4420 | 3 |
| MGMT 3610 | 3 | Cognate | 12 |
| MKT 3820 | 3 | Humanities and/or Fine Arts | 3 |
| CIM 3060, 3100, 4030, | | CIM 4060, 4150, | |
| 4050 | 12 | 4910, 4200 | 11 |
| BLAW 3400 | 3 | | 29 |
| FIN 3000 or 3010 | 3 | | |
| ENGL 3500 or 3520 | 3 | | |
| | 30 | | |

NOTE: CIM 3300 will be taken sometime after the sophomore year for two credits.

Students should consult their advisors each semester to plan their schedules.

CIM Cognate Areas

Choose one area in which to complete 12 credits.

General Management

MGMT 3630, 3650, 3810, 3890, 4490, 4500, 4510, 4620, 4640, 4650, 4660, 4680, 4690, 4710, 4730, 4830, 4920; MKT 3855, 3870, 3880, 3950, 3960, 4810; BMOM 2900

Sales and Marketing

MKT 3840, 3850, 3855, 3860, 3870, 3880, 3900, 3910, 3930, 3950, 3960, 4800, 4850, 4870, 4880

Operations, Environmental, and Safety Management

MGMT 3710, 3730, 3750, 3770, 4610, 4700, 4440, 4450; EST 2810, 4810, 4820, 4840, 4770, 4780; MKT 4810

Computer Networking and Controls

ET 3620, 3630, 3640, 3650, 4590, 4600, 4610, 4630, 4660; INFS 2720, 2730, 3100, 3200, 3700, 4200, 4500, 4740, 4760, 4790, 4830, 4900

Foreign Language (choose one language)

Elementary I and II or equivalent

Intermediate I and II or equivalent

M.B.A. Preparatory

INFS 3100; ECON 2420; Q M 3620; ACTG 3020

Major in Engineering Technology

Engineering Technology is a technologically advanced program at the Bachelor of Science level utilizing theoretical concepts and hands-on instruction. Program selection is from the following concentrations: Computer Engineering Technology, Electro-Mechanical Engineering Technology, and Mechanical Engineering Technology.

In addition to the General Education courses, the basic requirements for all Engineering Technology concentrations are

1. completion of a core of 19 hours of Engineering Technology courses
 - ET 1840 Engineering Fundamentals, 3 hours
 - ET 3601 Electrical Circuit Analysis I, 3 hours
 - ET 3602 Electrical Circuit Analysis II, 3 hours
 - ET 4420 Industrial Safety, 3 hours
 - ET 4710 Industrial Seminar, 1 hour
 - ET 4801-4804 Senior Problem in Engineering Technology, 3 hours
 - ET 4970 Engineering Economy, 3 hours
2. completion of the minimum number of Engineering Technology total credit hours required in the applicable concentration as follows:
 - Computer Engineering Technology, 51 hours
 - Electro-Mechanical Engineering Technology, 63 hours
 - Mechanical Engineering Technology, 67 hours
3. completion of other specific courses as shown under the appropriate concentration.

NOTE: A grade of C or better is required on transfer credits accepted as part of a major in Engineering Technology.

Concentration: Computer Engineering Technology

The Computer Engineering Technology concentration, accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology, 111 Market Place, Suite 1050, Baltimore, MD 21201, (410) 347-7700, provides the student with a sound technical base in electric and electronic circuits, digital systems, and computer hardware and software. Microcontroller, microprocessor, FPGA, and microcomputer applications in the area of control and automation as well as programming, data acquisition, transfer, and analysis are also emphasized.

Employment opportunities exist in various industrial fields that require the design and applications of digital computers such as manufacturing, medical, aerospace, control, instrumentation and measurements, and networking, installations, and maintenance of computers.

Curriculum Requirements and Recommended Sequence

| FRESHMAN | | SOPHOMORE | |
|---------------------------------|-----------|--|-----------|
| ENGL 1010, 1020 (Comm) | 6 | MATH 1920 | 4 |
| MATH 1730 (Math) | 4 | PHYS 2020/2021 | 4 |
| MATH 1910 | 4 | ENGL 2020 or 2030 or HUM 2610 (Hum/FA) | 3 |
| ET 1840, 3601 | 6 | ET 3602, 3620, 3630 | 9 |
| COMM 2200 (Comm) | 3 | Humanities and/or Fine Arts | 3 |
| HIST 2010, 2020, or 2030 | 6 | CSCI 1170, 2170 | 8 |
| PHYS 2010/2011 (Nat Sci) | 4 | | 31 |
| | 33 | | |
| JUNIOR | | SENIOR | |
| ENGL 3520 | 3 | Social/Behavioral Sciences | 3 |
| ET 3640, 3650, 3670, 4640, 4660 | 15 | CSCI 3180 | 3 |
| Humanities and/or Fine Arts | 3 | Technical elective* | 2 |
| Social/Behavioral Sciences | 3 | ET 4610, 4670, 4420, 4801, 4970, 4630 | 18 |
| CSCI 3160 | 3 | ET 4710 | 1 |
| CHEM 1110 (Nat Sci) | 4 | ET 4600 | 2 |
| | 31 | | 29 |

*Technical elective credits should be selected from upper-division Engineering Technology/Computer Science courses and must be approved by the student's major advisor.

Students must take three four- or five-course sequences and the capstone course as follows:

Digital Electronics (ET 3601, 3602, 3620, 3630, 3640)
 Microprocessor (ET 3620, 3640/3650, 4660, 4670)
 Instrumentation and Control (ET 3601, 3602, 3630, 4610, 4600)
 Capstone course (ET 4801)

Optional Computer Science Minor

The minor will include CSCI 1170, 2170, 3160, 3180 (14 hours) and at least 4 additional hours in upper-division computer science courses as approved by the minor and major advisors.

Students should consult their advisors each semester to plan their schedules.

Minor in Electronics

The minor in Electronics consists of at least 16 semester hours including ET 3610, 3620, and 3630 plus two courses from ET 3640, 3650, 3660, 3670, 4600, 4610, 4640, 4660, 4670, or ETIS 4790. All are three credit hours except ET 4600 which is two. Only non-majors may minor in Electronics.

Concentration: Electro-Mechanical Engineering Technology

The Electro-Mechanical Engineering Technology concentration, accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology, 111 Market Place, Suite 1050, Baltimore, MD 21201, (410) 347-7700, is structured to prepare the student for positions in industry requiring the integration of electricity (for power and control) and mechanical devices (for force and motion) to perform tasks associated with manufacturing and the performance of services.

Employment opportunities exist in fields such as robotics, fluid power, industrial electricity, heating and air conditioning, and industrial automation.

Curriculum Requirements and Recommended Sequence

| FRESHMAN | | SOPHOMORE | |
|---------------------------------------|-----------|---|-----------|
| ENGL 1010, 1020 (Comm) | 6 | ENGL 2020 or 2030 or HUM 2610 (Hum/FA) | 3 |
| MATH 1730 | 4 | Social/Behavioral Sciences | 3 |
| MATH 1910 | 4 | MATH 1530 (Math) | 3 |
| ET 1210, 1840, 2310 | 9 | HIST 2010, 2020, or 2030 | 6 |
| CHEM 1110 (Nat Sci) | 4 | PHYS 2010/2011 (Nat Sci) | 4 |
| COMM 2200 (Comm) | 3 | ET 3210, 3601, 3602, 3360 | 12 |
| | 30 | | 31 |
| JUNIOR | | SENIOR | |
| Humanities and/or Fine Arts | 3 | Humanities and/or Fine Arts | 3 |
| MATH 2110 | 1 | Social/Behavioral Sciences | 3 |
| CSCI 1170 | 4 | ENGL 3520 | 3 |
| ET 3620, 3630, 3810, 3830, 3860, 4420 | 18 | ET 3650, 4600, 4610, 4640, 4710, 4802, 4850, 4860, 4970 | 24 |
| PHYS 2020/2021 | 4 | | 33 |
| | 30 | | |

Students must take four three- or four-course sequences and the capstone course as follows:

- Robotics (ET 3810, 4850, 4860)
- Control Systems (ET 3601, 3602, 3630, 4610)
- Digital Circuits (ET 3601, 3602, 3620, 3650)
- Engineering Mechanics (ET 1840, 3830, 3860)
- Capstone course (ET 4802)

Students should consult their advisors each semester to plan their schedules.

Concentration: Mechanical Engineering Technology

The Mechanical Engineering Technology concentration at MTSU enables students to obtain the skills necessary for placement in highly competitive jobs in machine design, manufacturing, engineering, field service engineering, technical sales, thermal analysis, product design, utilities operations, air conditioning design, plant operations, and a variety of other professions. Through design projects and laboratory training, students examine how to relate such skills to a variety of fields in mechanical engineering technology including product and machine design, power generation, utilities, and manufacturing. The educational quality of this program is especially high in that it provides students with the opportunity to mesh their in-class experiences with project-oriented assignments and real-world experience in national competitions such as the Great Moonbuggy Race, the Solar BikeRayce, SAE Formula One Collegiate Competition, and the Mini Baja Race. The prospects for a graduate in mechanical engineering technology are as broad as the major concentration itself. Graduates can expect opportunities to work on a variety of projects from developing and producing engines and transportation equipment in the automobile, ship, rail, and aviation industries to working as a member on an engineering technologist design team to improve high-performance automobiles and air-conditioned environments. Students graduating from mechanical engineering technology programs often find themselves in highly responsible, challenging, and extremely rewarding positions.

Curriculum Requirements and Recommended Sequence

| FRESHMAN | | SOPHOMORE | |
|----------------------------|-----------|-----------------------------|-----------|
| ENGL 1010, 1020 (Comm) | 6 | ENGL 2020 or 2030 (Hum/FA) | 3 |
| MATH 1730 (Math) | 4 | ENGL 3520 | 3 |
| MATH 1910 | 4 | PHYS 2010/2011 (Nat Sci) | 4 |
| CHEM 1110 (Nat Sci) | 4 | Humanities and/or Fine Arts | |
| ET 1210, 1840, 2310 | 9 | (2 prefixes) | 6 |
| CSCI 1170 | 4 | MATH 1920 | 4 |
| | 31 | ET 3210, 3360, 3601, 3830 | 12 |
| | | | 32 |
| JUNIOR | | SENIOR | |
| HIST 2010, 2020, or 2030 | 6 | ET 4340, 4420, 4710 | 7 |
| COMM 2200 (Comm) | 3 | ET 4850, 4970, 4815 | 9 |
| Social/Behavioral Sciences | | ET 4860, 4803, 4830 | 9 |
| (2 prefixes) | 6 | ET electives (4 hours from | |
| ET 3260, 3602, 3840 | 9 | approved list)* | 4 |
| ET 3810, 3860, 4330 | 8 | | 29 |
| | 32 | | |

*Approved list of senior electives: ET 4230, 4600, 4640, 4990

Students must take four three-course sequences and the capstone course as follows:

- Materials/Processing (ET 1210, 3260, 4340)
- CADD (ET 2310, 3360, 4330)
- Thermal Systems (ET 3810, 4815, 4850)
- Engineering Mechanics (ET 3830, 3840, 3860)
- Capstone course (ET 4803)

Students should consult their advisors each semester to plan their schedules.

Major in Industrial Technology

Industrial Technology is a broad program designed to prepare the student for a position in the expanding technical fields in government and industry. Included are concentrations in Construction Management and Industrial Systems for manufacturing and service industries.

In addition to the General Education requirements, the minimum requirements for all Industrial Technology concentrations are

1. completion of a minimum of 55-56 hours of engineering technology and industrial studies courses as listed under the appropriate concentration;
2. completion of a core of
 - ET 2310 Computer-Assisted Drafting/Design I
 - ET 3610 Introduction to Electricity and Electronics
 - ET 3615 Principles of Electronics
 - ET 3910 Introduction to Operations Management
 - ET 4420 Industrial Safety
 - ET 4710 Industrial Seminar;
3. completion of other specific courses as listed under the appropriate concentration.

Concentration: Construction Management Technology

The Construction Management Technology concentration, accredited by the National Association of Industrial Technology (NAIT), is designed to prepare the student for supervisory or staff positions in a variety of construction-related organizations (land developers, construction firms, wholesalers of construction materials, construction material manufacturers, lumber yards, etc.). This program could include opportunities for employment in general supervision, human relations, sales, production and inventory control, and other areas.

Curriculum Requirements and Recommended Sequence

| FRESHMAN | | SOPHOMORE | |
|----------------------------|-----------|--------------------------|-----------|
| ENGL 1010, 1020 (Comm) | 6 | Humanities and/or | |
| INFS 2200 | 3 | Fine Arts (2 prefixes) | 6 |
| MATH 1720 (Math) | 3 | PHYS 2010/2011 (Nat Sci) | 4 |
| HIST 2010, 2020, or 2030 | 6 | CMT 3160 | 3 |
| ET 2310 | 4 | CMT 3180 | 3 |
| Social/Behavioral Sciences | 3 | CMT 3320 | 4 |
| COMM 2200 (Comm) | 3 | ET 3615 | 3 |
| | 28 | CMT 3150 | 3 |
| | | FIN 2450 | 3 |
| | | ENGL 2020 or 2030 or | |
| | | HUM 2610 (Hum/FA) | 3 |
| | | | 32 |

| JUNIOR | | SENIOR | |
|-------------------------------|-----------|----------------------------|-----------|
| ACTG 3000 | 3 | CMT 4110 | 3 |
| CMT 3190 | 3 | CMT 4170 or 4171 | 3 |
| GEOL 1040 (Nat Sci) | 4 | ET 3910 | 3 |
| CMT 3210, 3500 | 6 | SPAN 1010 | 3 |
| CMT 4010, 4100, 4120, 4130 | 13 | Social/Behavioral Sciences | 3 |
| ET 4420 | 3 | MKT 3820 | 3 |
| | | ET 4710 | 1 |
| | 32 | Electives | 9 |
| | | | 28 |

Students should consult their advisors each semester to plan their schedules.

Concentration: Industrial Systems

This program, accredited by the National Association of Industrial Technology (NAIT), is designed to prepare students for positions and careers in both the industrial and service sectors. Certifications can be earned in lean manufacturing, Six Sigma (Green Belt level), and safety. Typical positions include junior industrial engineer, first-level management, Quality/Six Sigma analyst/leader, lean manufacturing leader, safety/ergonomics coordinator, production/project scheduler, inventory analyst, work team leader, and other related positions.

Work-based (Experiential) Learning: Maximum 30 semester hours. Up to 18 semester hours may be granted for approved work experience. Up to 18 semester hours may be granted for approved work-based learning. The total hours for both work experience and work-based learning may not exceed 30 semester hours. Students who do not have any applicable work experience may take internship courses (ETIS 2920, 3920, and 3930) or co-op courses (ETIS 2930, 2940, 3970, and 3980) and may apply these courses as part of this experiential learning. Students will be required to participate in a formal assessment process to qualify for experiential learning credit.

Students should consult their advisors each semester to plan their schedules.

Curriculum Requirements and Recommended Sequence*

| FRESHMAN | | SOPHOMORE | |
|-----------------------------------|-----------|--|-----------|
| ENGL 1010, 1020 (Comm) | 6 | ENGL 2020 or 2030 or HUM 2610 (Hum/FA) | 3 |
| BIOL 1030 (Nat Sci) | 4 | PHYS 2010/2011 (Nat Sci) | 4 |
| CHEM 1010 | 4 | HIST 2010, 2020, or 2030 | 6 |
| MATH 1730 (Math) | 4 | Social/Behavioral Sciences | 3 |
| MATH 1910 | 4 | MATH 1530, PSY 3020, or Q M 2610 | 3 |
| Humanities and/or Fine Arts | 3 | ACTG 3000 | 3 |
| CSCI 1150 | 3 | Humanities and/or Fine Arts | 3 |
| ET 1840 | 3 | ET 2310 | 3 |
| | 31 | COMM 2200 (Comm) | 3 |
| | | | 31 |
| JUNIOR | | SENIOR | |
| ET 3615, 3260, 3910 3950, 4420 | 16 | Directed electives* | 6 |
| ET 3210, 3810, 3830, 4600 | 11 | ET 3960, 4710, 4920, 4990, 4590, 4900, 4970 | 19 |
| Social/Behavioral Sciences | 3 | ETIS 4800 | 3 |
| | 30 | | 28 |

*Students should choose six credits of electives from the following courses: PSY 3320; ET 1210, 3360, 3860, 4280, 4370, 4850, 4910.

Students should consult their advisors each semester to plan their schedules.

Minor in Industrial Technology

The minor in Industrial Technology consists of 18 semester hours of courses as approved by the minor advisor. A minimum of 9 hours must be upper-division courses. The minor must include 8 semester hours in one of the following areas: drafting, electronics, engineering, industrial facilities and management, metals, or safety.

Minor in Construction Management

The minor in Construction Management consists of 18 semester hours in Engineering Technology and Industrial Studies courses including CMT 3150 and 3160 plus 12 semester hours as approved by the minor advisor.

Minor in Industrial Education

A minor in Industrial Education consists of 18 semester hours of Engineering Technology and Industrial Studies courses as approved by the minor advisor. A minimum of 9 hours must be at the upper-division level.

Occupational Education License

Individuals may obtain professional course work for renewal of the Occupational Education License. This license is required to teach health science technology and occupational education at the secondary level.

Students should consult their advisors each semester to plan their schedules.

Major in Environmental Science and Technology

Environmental Science and Technology is an interdisciplinary major offered in the College of Basic and Applied Sciences and administered by the Department of Engineering Technology and Industrial Studies. The broad-based curriculum offers coursework in the natural sciences, life sciences, mathematics, agriculture, technology, and the arts. Four concentrations in environmental areas—Energy Technology, Environmental Health and Safety, Planning and Site Analysis, and Water and Waste Management—are available to allow the student to pursue an area of interest. No minor is required but is encouraged for EST students. Courses that are part of a student's major cannot be used in a minor. The requirements for a major in Environmental Science and Technology are listed below with 36-41 semester hours in the EST core, 30 hours in General Education outside of the math and science areas, and 20 to 29 hours in an identified specialty or concentration.

Typical employment opportunities exist in the various levels of governmental agencies and as environmental consultants in manufacturing, construction, and agricultural industries in such areas as air and water quality control, recycling, hazardous and solid waste management, and noise.

The Department of Engineering Technology and Industrial Studies administers the interdisciplinary program. Courses are offered by Agribusiness and Agriscience, Biology, Chemistry, Geosciences, and Engineering Technology and Industrial Studies.

Students are encouraged to pursue opportunities offered through the Center for Energy Efficiency. The center promotes energy economics and environmental awareness and stewardship for students, faculty, administrators, and others in the community. Through interaction with local, state, and federal associations, the center offers certification seminars, educational and training opportunities, and leadership in achieving energy management and efficiency goals.

Core requirements (36-41 hours)

- ABAS 3370, 3 hours
- BIOL 1120, 4 hours
- CHEM 1120, 4 hours
- CHEM 2030 or 3010/3020, 4 or 8 hours
- GEOL 1040 or ABAS 3340, 3 or 4 hours
- EST 2810, 3 hours
- EST 4770 or 4780, 4 hours
- PHYS 2010/2011, 2020/2021, 8 hours
- MATH 2050, 3 hours

Concentration: Energy Technology

The Energy Technology concentration under the Environmental Science and Technology major includes course work in conservation and the environmental issues in the use of non-renewable energy sources. This program offers preparation for students seeking employment in the energy management, air pollution control, and resource management fields.

Curriculum Requirements and Recommended Sequence

| FRESHMAN | | SOPHOMORE | |
|-----------------------------|-----------|--|--------------|
| ENGL 1010, 1020 (Comm) | 6 | MATH 1910 (Math) | 4 |
| BIOL 1110 (Nat Sci) | 4 | MATH 2050 | 3 |
| BIOL 1120 | 4 | PHYS 2010/2011, 2020/2021 | 8 |
| CHEM 1110 (Nat Sci) | 4 | CHEM 2030 | 4 |
| CHEM 1120 | 4 | GEOL 1040 or ABAS 3340 | 3-4 |
| EST 2810 | 3 | Social/Behavioral Sciences | 3 |
| Humanities and/or Fine Arts | 3 | ET 3615 | 4 |
| HIST 2010, 2020, or 2030 | 3 | ENGL 2020 or 2030 or HUM 2610 (Hum/FA) | 3 |
| | 31 | | 32-33 |

| JUNIOR | | SENIOR | |
|----------------------------|-----------|-----------------------------|-----------|
| Social/Behavioral Sciences | 3 | EST 4770 or 4780 | 4 |
| ABAS 3370 | 3 | ET 4815, 3810, 4970 | 9 |
| HIST 2010, 2020, or 2030 | 3 | ET 4420 or BIOL 3220 | 3 |
| EST 4810, 4820, 4840 | 9 | Humanities and/or Fine Arts | 3 |
| COMM 2200 (Comm) | 3 | GEOL 4130 | 4 |
| ET 3610 | 4 | ETIS 3920 | 2 |
| GEOG 4530 | 3 | PHYS* | 4 |
| | 28 | | 29 |

*Consult advisor for course.

Concentration: Environmental Health and Safety

The Environmental Health and Safety concentration of the Environmental Science and Technology major includes course work in calculus-based courses in physics and engineering mechanics, engineering design, and safety. This course of study offers preparation for a variety of careers in environmental engineering technology, safety, design, and environmental consulting, as well as graduate degree programs in environmental engineering.

Curriculum Requirements and Recommended Sequence

| FRESHMAN | | SOPHOMORE | |
|-----------------------------|-----------|--|--------------|
| ENGL 1010, 1020 (Comm) | 6 | MATH 1910 (Math) | 4 |
| BIOL 1110 (Nat Sci) | 4 | MATH 2050 | 3 |
| BIOL 1120 | 4 | PHYS 2010/2011, 2020/2021 | 8 |
| CHEM 1110 (Nat Sci) | 4 | Social/Behavioral Sciences | 3 |
| CHEM 1120 | 4 | ENGL 2020 or 2030 or HUM 2610 (Hum/FA) | 3 |
| EST 2810 | 3 | GEOL 1040 or ABAS 3340 | 3-4 |
| Humanities and/or Fine Arts | 3 | CHEM 3010, 3020 | 8 |
| HIST 2010, 2020, or 2030 | 3 | | |
| | 31 | | 32-33 |

| JUNIOR | | SENIOR | |
|----------------------------|--------------|-----------------------------|-----------|
| Social/Behavioral Sciences | 3 | CHEM 4600 | 3 |
| HIST 2010, 2020, or 2030 | 3 | Humanities and/or Fine Arts | 3 |
| COMM 2200 (Comm) | 3 | BIOL 4240 | 4 |
| ABAS 3370 | 3 | HLTH 4460 | 3 |
| EST 4780 | 4 | ET 4450 | 3 |
| CHEM 2230, 3530 | 9 | EST 4770 | 4 |
| BIOL 3050 or 4080 | 3-4 | EST 4980 | 3 |
| | 28-29 | ET 4420 | 3 |
| | | BIOL 4570 | 3 |
| | | | 29 |

Students should consult their advisors each semester to plan their schedules.

Concentration: Planning and Site Analysis

The Planning and Site Analysis concentration under the Environmental Science and Technology major offers training in environmental planning, the collection and analysis of information on the natural environment to be completed before design and construction of a project. The goal of planning is to avoid natural hazards, conserve natural resources, and protect the environment through sound ecological principles. Effective environmental planning results in the efficient management of natural resources, insuring sound economic development while minimizing environmental degradation.

Curriculum Requirements and Recommended Sequence

| FRESHMAN | | SOPHOMORE | |
|-----------------------------|-----------|--|--------------|
| ENGL 1010, 1020 (Comm) | 6 | MATH 1910 (Math) | 4 |
| BIOL 1110 (Nat Sci) | 4 | MATH 2050 | 3 |
| BIOL 1120 | 4 | PHYS 2010/2011, 2020/2021 | 8 |
| CHEM 1110 (Nat Sci) | 4 | Social/Behavioral Sciences | 3 |
| CHEM 1120 | 4 | ENGL 2020 or 2030 or HUM 2610 (Hum/FA) | 3 |
| EST 2810 | 3 | GEOL 1040 or ABAS 3340 | 3-4 |
| Humanities and/or Fine Arts | 3 | CHEM 2030 | 4 |
| HIST 2010, 2020, or 2030 | 3 | BIOL 2230 | 4 |
| | 31 | | 32-33 |

| JUNIOR | | SENIOR | |
|----------------------------|-----------|-----------------------------|-----------|
| Social/Behavioral Sciences | 3 | Humanities and/or Fine Arts | 3 |
| HIST 2010, 2020, or 2030 | 3 | Approved electives* | 7 |
| COMM 2200 (Comm) | 3 | BIOL 4240, 4250 | 8 |
| ABAS 3370 | 3 | CHEM 4600, 4630 | 7 |
| EST 4770 or 4780 | 4 | GEOL 4090, 4130 | 5 |
| CHEM 2230 | 5 | | 30 |
| BIOL 3220 | 3 | | |
| GEOG 4530 | 3 | | |
| | 27 | | |

*Choose from ABAS 4340, 4350; BIOL 3210; CHEM 4610; EST 4810; GEOG 4490, 4570; GEOL 4150.

Students should consult their advisors each semester to plan their schedules.

Concentration: Water and Waste Management

The Water and Waste Management concentration under the Environmental Science and Technology major looks at solid waste which is deposited on land and in water, sometimes causing serious environmental problems. However, wastes may be handled as a resource. Major issues of waste management include problems and benefits associated with landfilling garbage and with the need to reduce the waste stream. Major concerns to be considered in assessing waste management problems and solutions are (1) environmental quality: wastes must be managed so they do not pollute air or soil water resources; nor should they be used in a way that might introduce a toxic or pathogen into the food chain; (2) organic waste as energy resources: incineration can be studied as an alternative to landfilling or application; organic wastes may also be a source of fertilizers.

Curriculum Requirements and Recommended Sequence

| FRESHMAN | | SOPHOMORE | |
|-----------------------------|-----------|----------------------------|-----------|
| ENGL 1010, 1020 (Comm) | 6 | MATH 1910 (Math) | 4 |
| BIOL 1110 (Nat Sci) | 4 | MATH 2050 | 3 |
| BIOL 1120 | 4 | PHYS 2010/2011, 2020/2021 | 8 |
| CHEM 1110 (Nat Sci) | 4 | Social/Behavioral Sciences | 3 |
| CHEM 1120 | 4 | ENGL 2020 or 2030 or | |
| EST 2810 | 3 | HUM 2610 (Hum/FA) | 3 |
| Humanities and/or Fine Arts | 3 | ABAS 3340 | 3 |
| HIST 2010, 2020, or 2030 | 3 | CHEM 2030 | 4 |
| | 31 | BIOL 2230 | 4 |
| | | | 32 |

| JUNIOR | | SENIOR | |
|--------------------------|-----------|-----------------------------|-----------|
| GEOL 1040 | 4 | Humanities and/or Fine Arts | 3 |
| EST 4770 or 4780 | 4 | GEOL 4130 | 4 |
| ABAS 3370 | 3 | BIOL 4250 | 4 |
| COMM 2200 (Comm) | 3 | CHEM 4600, 4630 | 7 |
| HIST 2010, 2020, or 2030 | 3 | Approved electives* | 7 |
| BIOL 3220, 4240 | 7 | Social/Behavioral Sciences | 3 |
| CHEM 2230 | 5 | | 28 |
| | 29 | | |

*Choose from ABAS 3700, 4370; BIOL 3210, 4590; CHEM 4610; GEOL 4150.

Students should consult their advisors each semester to plan their schedules.

Minor in Environmental Science and Technology

The minor in Environmental Science and Technology consists of 18 semester hours of courses as approved by the minor advisor with at least 6 hours at the upper-division level.

Pre-architectural and Pre-engineering Programs

Pre-architecture

The following program is recommended as the first year of a five-year program leading to the Bachelor of Architecture degree. After successful completion of the courses listed, students are eligible to apply for admission to the school of architecture of their choice. It should be understood that students who complete this year of work will not automatically be assured of admission to the remaining four years of work in a school of architecture. Those who wish to apply to a school of architecture should see their advisors no later than February 1 in order to have time to follow the proper procedure to be considered for admission for the fall term of the following year. The recommended program for the first year follows.

FRESHMAN

| | |
|--------------------------|-----------|
| ENGL 1010, 1020 | 6 |
| MATH 1910, 1920 | 8 |
| Science* | 8 |
| CMT 1300 | 3 |
| ET 1840 | 3 |
| Social Science Electives | 6 |
| | 34 |

*To be selected based on the transfer school requirements and the approval of the advisor. The student should have the catalog of the transfer school at the time of registration, if possible.

Students should consult their advisors each semester to plan their schedules.

Pre-engineering

The pre-engineering program that exists at MTSU requires additional study at an engineering school such as Tennessee State University, Tennessee Technological University, the University of Memphis, the University of Tennessee, or Vanderbilt University in order to obtain an engineering degree. Depending upon the program chosen, the student will complete two or three* years of the curricula shown below at MTSU. Students should consult their advisors and an advisor at the school to which they want to transfer concerning specific information on acceptance/transfer of the courses listed below to the engineering school of their choice. Information on the pre-engineering program in agricultural engineering can be found under the School of Agribusiness and Agriscience.

| FRESHMAN | | SOPHOMORE | |
|-----------------|-----------|---------------------------|-----------|
| ENGL 1010, 1020 | 6 | PHYS 2110/2111, 2120/2121 | 8 |
| CHEM 1110, 1120 | 8 | MATH 3110, 3120; | |
| MATH 1910, 1920 | 8 | STAT 3150 | 10 |
| ET 1840, 2310 | 6 | ET 3830, 3840, 3860 | 9 |
| CSCI 1170 | 4 | ET 3360, 4970 | 6 |
| | 32 | COMM 2200 | 3 |
| | | | 36 |

**Additional classes are available to juniors based on which school they are planning to attend. For example, MTSU offers a wide variety of engineering courses that may be available to third-year pre-engineering students. Students wanting to stay for a third year and take these courses may do so, but they must consult their advisors in advance.*

Students should consult their advisors each semester to plan their schedules.

Standard Four-Year Engineering Program

This program will require four years to complete. The student is required to take the freshman and sophomore years indicated above and then transfer to an engineering school. The engineering school would then require two years of additional study to complete requirements toward the degree. The pre-engineering program at MTSU has been closely coordinated with several engineering schools. A student who elects to transfer should confer with his or her faculty advisor two semesters prior to transfer.

Courses in Construction Management Technology [CMT]

- 1300 Drafting Fundamentals for Architecture and Construction.** Three credits. Not open to students who take ETIS 1310. Drafting theory and practice including orthographic projection, drafting conventions, lettering, descriptive geometry, and size descriptions employing architectural and construction sketching activities. Recommended for students of pre-architecture and construction management with less than one unit of high school drafting. Two hours lecture and four hours laboratory.
- 3150 Residential Building Construction and Materials I.** Three credits. Blueprint reading, terminology, building materials, methods and techniques, problems, and fundamentals essential for residential construction. Recommended for those desiring general knowledge of construction or work in the construction field. Two hours lecture and four hours laboratory.
- 3160 Residential Cost Estimating I.** Three credits. Prerequisite: CMT 3150. Principles and practices involved in the preparation of a cost estimate for a residential home. Topics include introduction to cost estimating, materials, and labor costs for residential building.
- 3180 Construction and Materials II.** Three credits. Prerequisite: CMT 3150. A continuation of CMT 3150 with emphasis on new building materials and various types of construction. Light commercial construction included.
- 3190 Construction Land Development Operations.** Three credits. Topics include contractor procedures in land development, land development infrastructure, and management methods used in small land development construction equipment.
- 3210 Residential Codes, Regulations, Specifications, and Plan Reading.** Three credits. Prerequisite: CMT 3150 or permission of instructor. The residential and subdivision infrastructure construction language for plan reading, codes, regulations, and specifications. Lectures and hands-on activities. Industry will provide guest lecturers and show examples of some of their work in the field. Students will be required to visit architects, city and county codes department representatives, and contractors during the semester.
- 3320 Architectural Computer-Aided Drafting and Design.** Four credits. Prerequisites: ET 2310 and CMT 3190 or consent of instructor. Using computers to draw and design residential architectural plans. Specifically geared toward the construction area of concentration. Two hours lecture and four hours laboratory.
- 3500 Land Surveying.** Three credits. Prerequisite: MATH 1720 or 1730. Basic surveying operations such as chaining, differential leveling, transverse methods and calculations, structural layout, topographic mapping, and slope staking for road and utilities in subdivisions. Basic surveying instruments used include the chain, automatic level, transit, and theodolite. Environmental issues relating to land and land development covered.
- 4010 Construction Law.** Three credits. Prerequisite: Junior standing. Practical approach to the legal system in construction. Topics include licensing requirements, business associations, hiring professionals, employment issues, insurance, worker's comp, tort liability, contracts, financing, sale of property, title issues, liens, land use, bankruptcy, and warranties.
- 4100 Mechanical and Electrical Systems.** Four credits. Prerequisites: CMT 3160, 3320; PHYS 2010-2011. Fundamentals and computer design of mechanical, electrical, and plumbing systems used in the residential and light commercial building construction industry. Three hours lecture and three hours laboratory.
- 4110 Cost Estimating II.** Three credits. Prerequisites: CMT 3190, 4120. Use of computer to estimate total cost of land development and housing costs for capstone project.
- 4120 Scheduling.** Three credits. Prerequisites: CMT 3190, 3320, and 4100. Flow of labor and material toward specified goal, weather, trade characteristics, and material availability in work scheduling shown by graphs.
- 4130 Construction Administration.** Three credits. Prerequisites: CMT 3160-3190. Management and administration of construction to include contracts, office, and field work.
- 4170 Capstone—LDRB Construction Management.** Three credits. Prerequisites: All construction courses through CMT 4130. Final preparation of development plans, etc., for subdivision. Basic principles of presentations. Presentation of capstone project to Building Construction Technical Committee.
- 4171 Construction Marathon.** Three credits. Prerequisite: Construction Management Technology majors beginning their fifth consecutive semester of marathon training. For students interested in advanced training to prepare for National Competition in Land Development/Residential Construction. Training will be year-round for a minimum of two years. Students will sign up for CMT 4171 at the beginning of the fifth and the sixth consecutive semesters of training for three hours credit each. Participants must attend the required number of sessions each semester as determined by the team coaches (not to exceed nine sessions). Students are required to sign a contract with the construction program advisor before becoming a Marathon Construction Team member.

Courses in Concrete Industry Management [CIM]

- 1010 Introduction to Concrete Industry.** One credit. Overview of the history, career opportunities, job functions, and professional organizations in the concrete industry. Introduction to the concrete industry management curriculum, instructional exceptions, and methodologies.
- 1050 Blueprint Reading.** One credit. Provides a broad-based background in interpreting blueprints. Typical plans for both residential and commercial building reviewed.
- 3000 Fundamentals of Concrete: Properties and Testing.** Four credits. Corequisite: CMT 3150. Concrete testing, admixtures, placing, and finishing. Effects of concrete-making materials on properties of fresh and hardened concrete materials.
- 3050 Concrete Construction Methods.** Three credits. Prerequisites: CIM 1010, 3000. Forming and shoring, placing and reinforcing; transporting, placing, consolidating, finishing, jointing, and curing concrete for cast-in-place foundations, pavements, slabs on ground, structural frames, and other structural members; erecting precast concrete members; waterproofing concrete foundations.
- 3060 Understanding the Concrete Construction System.** Three credits. Prerequisites: CIM 1010, 3000. Detailed look at how the concrete construction industry works. Includes review of model building codes, building officials and their function, concrete industry codes and standards, concrete construction processes, quality assurance systems, contract documents, and concrete construction markets.
- 3070 Site Planning, Layout, and Preparation.** Three credits. Prerequisites: CIM 1010, 3050. Activities required to successfully prepare a site for concrete work. Includes initial site investigation, surveying, groundwork, subbase preparation, and elevations. Exposes students to modern technological tools and methods such as the use of GPS, EDM, and lasers.
- 3080 Formwork Design and Computerized Drafting.** Three credits. Prerequisites: CIM 1010, 3050. Overview of costs and safety with regard to formwork selection, design, and construction. Reviews the various forming systems available and how they may be integrated for use in specific project circumstances. Includes a basic review of CAD drafting techniques and their applications.
- 3100 Applications of Concrete Construction.** Three credits. Prerequisites: CIM 1010, 3000, and 3050. Details many uses of concrete in the construction of buildings, pavements, and other facilities. Emphasis on the advantages, disadvantages, and unique problems faced by materials suppliers, contractors, and design professionals when concrete is chosen for specific applications.
- 3200 Concrete Project Estimating.** Three credits. Prerequisites: CIM 1010, 3100. Project drawings to prepare both basic and detailed estimates. Activities include practice implementing the printreading, estimating, and other skills acquired using actual sets of finished drawings. Projects will become more complicated as the semester progresses and will include below-grade, flatwork, and above-grade examples.
- 3300 Concrete Industry Internship.** Two credits. Prerequisite: CIM 1010. Opportunity for students to gain supervised, practical work experience in their particular field of interest within the concrete industry. The student will be evaluated by his/her supervisor, and a final report will be submitted by the student detailing the internship experience.
- 3600 Advanced Concrete Project Management.** Three credits. Prerequisites: CIM 1010, 3060. A continuation of the construction management concepts taught in CIM 3060. Emphasis on application of advanced project management concepts. A group activity involving management of a complex concrete construction project.
- 4010 Design and Construction Issues.** Three credits. Prerequisites: CIM 1010, 3200. A review of concrete construction materials and their physical and mechanical properties. Special emphasis placed on the concepts of mechanics of materials and resolving design/construction mismatches.
- 4030 Issues in the Concrete and Construction Industry: A Legal and Ethical Perspective.** Three credits. Prerequisite: CIM 1010. Involves a case study approach to critically analyzing historical and current events in the concrete and construction industry. Particular emphasis on developing a managerial decision-making process incorporating ethical, legal, financial, and other business perspectives.
- 4050 Management of Concrete Products: Ordering and Delivering.** Three credits. Prerequisites: ET 3910; CIM 1010, 3000, and 3050. Provides student with basic understanding on managing order and delivery processes common to all concrete products. Emphasis on planning, organizing, and controlling at both the first-line supervisory and managerial levels. Key differences in the order and delivery functions of ready mix concrete, concrete masonry, pre-cast concrete, pre-stress concrete, and concrete pipe supplemented by product-specific guest lectures and plant tours.
- 4060 Management of Concrete Products Production Facilities.** Three credits. Prerequisites: CIM 1010, 3000, and 3050; ET 3910. Provides student with basic understanding of managing the manufacturing process common to all concrete products production facilities. Emphasis on planning, organizing, and controlling at both the first-line supervisory and managerial levels. Review of key differences in manufacturing process of ready mix concrete, concrete masonry, precast concrete, pre-stress concrete, and concrete pipe explained through product-specific guest lectures and plant tours.
- 4070 Concrete Contracting Personnel Management.** Three credits. Prerequisite: Senior standing. Application of personnel management techniques in the contracting business. Emphasis on adapting management styles to various employee personality traits, training techniques, personal management, effective and efficient management of equipment and other resources, and leadership development.
- 4100 Field Management and Supervision.** Three credits. Prerequisite: Senior standing. Offers knowledge and skills to effectively manage concrete construction jobsite activities. Emphasis on safety, equipment identification and use, maintenance, contingency plans, and worksite productivity.
- 4150 Concrete Problems: Diagnosis, Prevention, and Dispute Resolution.** Three credits. Prerequisite: Senior standing. Diagnosing and preventing problems related to concrete production, testing, construction, and performance. Identifying causes of fresh and hardened concrete problems such as fast and slow setting, air content variations, low strength, cracking, and scaling. Pre-job conferences and dispute resolution methods.
- 4200 Senior Concrete Lab.** Two credits. Opportunity for students to gain in-depth knowledge of the technical aspects of concrete and cement chemistry in a laboratory environment. The student will be evaluated by his/her ability to investigate a concrete situ-

ation and resolve the issue with a laboratory project. Graded activities include in-class exercises, written reports, and oral presentations.

4800 Special Problems in Concrete Industry Management. One-three credits. Prerequisite: Permission of department. Opportunity to pursue projects of individual interest in concrete industry management. Projects may be technical and/or managerial in nature and may require any combination of literature reviews, lab work, field studies, and other research methods. A faculty member will approve a formally submitted proposal for the study, supervise progress, and grade a report and a presentation which are required upon completion of the project. May be repeated for up to 6 hours of undergraduate credit.

4910 Capstone. Three credits. Prerequisite: To be taken semester before graduation. Intensive study of a problem(s) appropriate to the major and the student's career interest. Solution(s) for problem(s) presented to a committee of concrete industry representatives. Presentation must emphasize depth of analysis, completeness and effectiveness of solution, and presentation skills.

Courses in Engineering Technology and Industrial Studies [ETIS]

1310 Basic Technical Drawing and Sketching. Three credits. Not open to students who take CMT 1300. Technical drawing and sketching theory and practice including orthographic projection, drafting conventions, lettering, descriptive geometry, sections, auxiliary views, and size descriptions employing mechanical drawing and sketching activities. Recommended for students with less than one unit of high school drawing. DOES NOT SATISFY REQUIREMENTS FOR MAJOR. Two hours lecture and four hours laboratory.

2920 Industrial Orientation Internship. One to three credits. Prerequisite: Consent of the instructor. Provides industrial exposure for students with little or no industrial work experience. Students will be placed in an acceptable company for introductory industrial experiences. Arrangement for this course must be made in advance.

2930 Cooperative Education Experience I. Three credits. Provides students with opportunity for on-the-job training in conjunction with on-campus academic experiences. Students will participate in professional growth seminars. Pass/Fail.

2940 Cooperative Education Experience II. Three credits. Prerequisite: ETIS 2930. Continuation of ETIS 2930. Pass/Fail.

3920 Industrial Internship I. Three credits. Prerequisite: Consent of instructor. Student is employed by an acceptable industry for industrial experience. Credit given for actual work with employer. Arrangement for this course must be made in advance. Pass/Fail.

3930 Industrial Internship II. Three credits. Prerequisite: ETIS 3920. A continuation of Internship I. Same stipulations apply. Pass/Fail.

3970 Cooperative Education Experience III. Three credits. Prerequisite: ETIS 2940. Continuation of ETIS 2940. Pass/Fail.

3980 Cooperative Education Experience IV. Three credits. Prerequisite: ETIS 3970. Continuation of ETIS 3970. Pass/Fail.

4490 Topics in Industrial Technology. One to six credits. Subject topics offered as required to meet the needs of the class.

4700 Industrial Topics. One to six credits. Problems in any one of a variety of areas to meet the needs of the class.

4790 Advanced Problems in Technology. Three credits. Prerequisite: Completion of all courses in a given area or approval of instructor. For the advanced student who wishes to work on a designated problem in a specific area. Works on an individual problem or project independently under the guidance of an instructor.

4800 Senior Problems in Industrial Technology. Three credits. Prerequisites: ET 4920, 4970. Capstone course requiring the solution and presentation of a broad technical problem which requires the application of previous course work.

Courses in Engineering Technology [ET]

1210 Introduction to Metals and Metallurgy. Three credits. Origin and behavior of metals. Extractive metallurgy—reduction of metallic ores, production of stock shapes, identification and selection of ferrous and nonferrous metals. Physical metallurgy—mechanical and physical properties, crystalline structure, phase diagrams, hardening and tempering, isothermal diagrams, metallurgy of welds, service problems, casting processes. Exercises in the use of basic welding, foundry, and metallurgical testing equipment. Two hours lecture and four hours laboratory.

1840 Engineering Fundamentals. Three credits. Broad introduction to basic laws of fluid mechanics, thermodynamics, materials science, and electricity, including topics on power production by conventional and developmental techniques and introduction to computer-aided problem solving. Employment in the engineering fields addressed.

2310 Computer-Assisted Drafting/Design I. Three credits. Prerequisite: ETIS 1310 or CMT 1300 or one year of high school drafting. Technical drafting concepts utilizing personal computers, plotters, and appropriate CAD software. Lecture and laboratory.

3210 Machine Tool Technology. Three credits. Prerequisite: ETIS 1310. Metals, their sources, manufacture, and properties; basic metalworking hand tools, measurements; layout; drawing and safety. Exercises in the use of the basic machine tools in machine shop work. Lecture and laboratory.

3220 Advanced Metalwork. Three credits. Techniques, equipment and procedures, advantages and disadvantages of current metal-casting processes used in industry. Laboratory exercises in sand molding and casting, the full mold process, investment casting, and permanent mold casting including pattern design and construction, mold making, metal melting and handling. Guest lecturer(s). Plant tour(s). Lecture and laboratory.

3240 Welding. Four credits. Prerequisite: ET 1210 or consent of instructor. Overview of basic welding, brazing, and cutting processes. Emphasis on operation and safe practice of oxyacetylene, shielded metal arc, tungsten inert gas, and metal inert gas welding and cutting processes. Exercises with welding symbols, selection of electrodes, and setup and operation of welding equipment. Two hours lecture and four hours laboratory.

3260 Manufacturing Processes and Materials. Three credits. An analysis of machines, tools, processes, and materials used in production.

- 3360 Computer-Assisted Drafting/Design II.** Three credits. Prerequisite: CMT 3320 or ET 2310. Utilizes IBM-compatible computer and CAD software to develop skills in the creation and analysis of mechanical solid models for design and production purposes. Includes the use of shading and rendering to enhance three-dimensional model display and the extraction of two-dimensional engineering drawings. Lecture and laboratory.
- 3601 Electrical Circuit Analysis I.** Three credits. Corequisite: MATH 1910. Fundamentals of electrical circuits. Addresses basic circuit components and quantities. Emphasis on DC circuit calculations and theorems. Uses lab equipment to build and test DC circuits. Two hours lecture and three hours laboratory.
- 3602 Electrical Circuit Analysis II.** Three credits. Prerequisite: ET 3601 and MATH 1910. Addresses basic circuit components and quantities of AC circuits. Introduces three-phase circuits and transformers. Emphasis on AC circuit calculations and theorems. Uses lab equipment to build and test AC circuits. Two hours lecture and three hours laboratory.
- 3610 Introduction to Electricity and Electronics.** Four credits. Prerequisite: MATH 1710 or 1730. Orientation to direct current, alternating current, magnetism, filters, and semiconductor devices. Rectifier-filters and basic transistor amplifiers are also examined as representative electronic circuits. Use of meters, oscilloscopes, and other test instruments are stressed in the laboratory. Three hours lecture and three hours laboratory.
- 3615 Principles of Electricity.** Four credits. Prerequisite: MATH 1710 or 1730. An overview of basic electrical circuits and systems, direct current circuits, alternating current circuits, and electrical devices and control schemes. Electrical motors, relays, solenoids, transformers, and power supplies examined. National Electric Code also examined. For students enrolled in Construction Management Technology or Concrete Industry Management. Laboratory exercises stress the use of test instruments and the construction of basic electrical circuits. Three hours lecture and three hours lab.
- 3620 Digital Circuits Fundamentals.** Three credits. Prerequisite: ET 3601 or permission of instructor. Provides thorough coverage of basic digital electronic circuits analysis and design. TTL and CMOS families examined. Number systems, mapping, and minimization techniques covered. Digital design using random logic and programmable logic devices (FPGAs and CPLDs). Three hours lecture and three hours laboratory.
- 3630 Electronics I.** Three credits. Prerequisite: ET 3602 or permission of instructor. Introduction to analog electronics. Defines basic parameters and theory of operation of discrete semiconductor devices. Introduces fundamentals of electronic circuits analysis and design. Applications illustrate use, and laboratory projects provide hands-on experience. Two hours lecture and three hours laboratory.
- 3640 Digital Circuits Design.** Three credits. Prerequisite: ET 3620; corequisite: ET 3630 or permission of instructor. In-depth study of sequential circuit analysis and design that includes state machine design. Emphasis on the use of available development boards using both FPGAs and CPLDs and their respective CAD tools. PLDs programmed using latest relative CAD systems. Two hours lecture and three hours laboratory.
- 3650 Introduction to Microprocessors.** Three credits. Prerequisites: CSCI 1170 and ET 3620. Covers architecture of microcontrollers and microprocessor-based systems and their related components. Machine language programming extensively used to solve problems and demonstrate the relationship of the microprocessor and its supporting peripherals. Basic microcomputer architecture also emphasized. Two hours lecture and three hours laboratory.
- 3660 Communication Electronics.** Three credits. Prerequisite: ET 3630 or permission of instructor. Theory of electronic circuits as applied to communication; special electronics circuits required in communications systems. Testing theory and procedures. Various methods of electronic communications. Testing and evaluation of electronic circuits. Three hours lecture and three hours laboratory.
- 3670 Computer-Assisted Printed Circuit Board Design.** Three credits. Prerequisites: ET 3620 and 3630 or permission of instructor. Utilizes computer software to develop skills in creating schematic and printed circuit board artwork for use in printed circuit board production. Includes plotting, printing, and generating all necessary documents required for fabrication. Three hours lecture and three hours laboratory.
- 3810 Engineering Thermodynamics and Heat Transfer.** Three credits. Prerequisites: PHYS 2010 or 2110; MATH 1910. Basic concepts of engineering thermodynamics, work, heat, first law, second law, ideal gases, power cycles, conduction, convection, and radiation heat transfer. Applications to power generation, aerospace, and electronics addressed.
- 3830 Statics.** Three credits. Corequisites: MATH 1910 and PHYS 2010. Fundamental concepts and conditions of static equilibrium; their application to systems of forces and couples acting on rigid bodies; and the calculation of centers of gravity, centroids, and moments of inertia.
- 3840 Dynamics.** Three credits. Prerequisite: ET 3830. Rectilinear curvilinear, and rotary motion of rigid objects both with and without consideration of the unbalanced force causing the motion. Application of the principles of work, energy, impulse, and momentum to the solution of engineering problems.
- 3860 Strength of Materials.** Three credits. Prerequisite: ET 3830. The mechanics of materials emphasizing the analysis and design of statically determinate beams, columns, and structural members in torsion and application of the three moment equation to statically indeterminate beams.
- 3910 Introduction to Operations Management.** Three credits. A foundation course in manufacturing and service operations management. Problem-solving applications emphasized.
- 3950 Metrology.** Three credits. Overview of methods and procedures of precision measuring and gauging as used in inspection and quality control by industry. Two hours lecture and four hours laboratory.
- 3960 Industrial Quality Technology.** Three credits. Covers breadth and some depth in quality technology. Explores history of quality, present techniques, and future predictions. Covers six-sigma methodology at the "greenbelt" level. Certification after industry project. Lecture.
- 4230 Advanced Machine Tool Technology.** Three credits. Prerequisite: ET 3210. Taper turning, boring and thread chasing, and calculations of screw threads and other operations. Gear terminology and calculations; practice gear cutting on the milling machine; use of index head. Lecture and laboratory.
- 4280 Computer-Aided Manufacturing: Numerical Control (NC).** Three credits. Prerequisites: ET 2310 and 3210 or consent of

instructor. The role of NC in today's manufacturing environment; machines and machine control systems of a typical installation. Justifying NC equipment. Emphasis on writing and debugging programs for a three-axis milling machine and a two-axis turning machine utilizing both computer numerical control and computer-aided part programming. For those with little experience or seeking to broaden their knowledge. Two hours lecture and four hours laboratory.

4330 Advanced Computer-Aided Drafting. Two credits. Prerequisite: ET 3360 or permission of instructor. Topics include customizing menus, 3-D concepts and surface modeling, AutoLisp, rendering, and slide shows. Interactive computer drafting and design using advanced AutoCAD software and add-ons. Primarily for students who want to increase their capabilities using CAD. Lecture and laboratory.

4340 Design of Machine Elements. Three credits. Prerequisite: ET 3860. Analytical design methods. Stress analysis, working stress, combined stresses, failure theories, fatigue failure. Design techniques for shafts, fasteners, gears, bearings, and belt and chain drives. Includes a design project.

4370 Tool Design. Three credits. Prerequisites: ET 3260 and 3360; MATH 1730. Basic concepts, to include design projects such as jigs and fixtures and simple dies. Students use CAD in conjunction with CAD catalogs of tooling components.

4420 Industrial Safety. Three credits. Safety and health in the manufacturing, construction, and utilities industries, including pertinent laws, codes, regulations, standards, and product liability considerations. Organizational and administrative principles and practices for safety management and safety engineering, accident investigation, safety education, and safety enforcement.

4440 Fire Safety. Three credits. Fundamental methods of fire protection, prevention, and suppression. Includes characteristics and behavior of fire, fire hazards of materials and buildings, codes and standards for fire prevention and protection, fire protection equipment and systems, and fire fighting forces and how they operate.

4450 Industrial Hygiene. Three credits. Corequisite: ET 4420 or permission of instructor. An introduction to industrial or occupational hygiene—that science and art devoted to the anticipation, recognition, evaluation, and control of those environmental factors or stresses, arising in or from the workplace, which may cause sickness, impaired health and well-being, or significant discomfort and inefficiency among workers or citizens of the community.

4590 Manufacturing Automation Systems. Three credits. Prerequisite: Junior status or consent of instructor. Technical, human, and business aspects of modern automation system. Includes automation controls, levels of control and major components/subsystems, object-based software components, intelligent actuators and sensors, emerging trends, flexible manufacturing systems (FMS), computer integrated manufacturing (CIM), industrial systems and supply chain applications, organizational approaches, and automation justification.

4600 Programmable Logic Controllers. Two credits. Prerequisite: ET 3630 or permission of instructor. Introduction to programmable logic controllers (PLCs). Selection, operation, and troubleshooting. Ladder diagrams and programming of PLC emphasized. One hour lecture and two hours laboratory.

4610 Instrumentation and Controls. Three credits. Prerequisites: ET 3620 and 3630. Devices and techniques used in the measure-



ment of physical parameters. Consideration of accuracies and sources of error, identification of typical measurements, sensors and transducers, control stability and response. Two hours lecture and three hours laboratory.

4630 Local Area Networks. Three credits. Provides the necessary foundation experience to understand the design, implementation, and management strategies of local and wide area networks (LAN/WAN). Data Communication Standards and protocol, fundamentals included. Will include lecture, laboratory activities, and a LAN design requirement. Two hours lecture and three hours laboratory.

4640 Industrial Electricity. Three credits. Prerequisite: ET 3602 or permission of instructor. AC power theory and circuits for industrial applications, polyphase systems, power factor correction, and transformers. Theory, applications, and selection of motors and generators. Industrial motor control and power transmission. Two hours lecture and three hours laboratory.

4660 Microprocessor Interfacing. Three credits. Prerequisites: ET 3640 and 3650 or permission of instructor. Emphasis on interfacing various analog and digital devices to a microcontroller/microprocessor-based system: memory expansion, A/D and D/A, display devices, keyboards and keypads, electromechanical devices, and sensors. PLDs (FPGAs/CPLDs) interfaced to facilitate rapid prototyping of digital system design. Three hours lecture and three hours laboratory.

4670 Microprocessor Design. Three credits. Prerequisite: ET 4660 or permission of instructor. Advanced microprocessor system design. Emphasis on the design of core CPUs and imbedded components using high-density FPGA/CPLD development boards. Industrial applications of microprocessor-based systems. Two hours lecture and three hours laboratory.

4700 Transform Circuit Analysis. Three credits. Prerequisites: ET 3602 and MATH 1920 or permission of the instructor. Advanced network analysis stressing network theorems and solutions of time and frequency-domain problems with the use of Laplace Transforms.

4710 Industrial Seminar. One credit. Prerequisite: Junior status. Orientation to industrial job opportunities, placement practices, interview techniques, and preparation of application materials (resume, cover letter). Guest lecturers, plant tours, films, student and faculty presentations arranged in seminar fashion. Recommended for junior year.

4801 - Senior Problem in Engineering Technology. One to three credits. All required freshman-, sophomore-, and junior-level courses in all disciplines have to be completed before registering for this course. Engineering situations are solved by experimental means. Student must have experimental approach, gather data, interpret results, and prepare a formal technical written and oral report.

4801 Computer Engineering Technology. Prerequisites: ET 4670; CSCI 3160.

4802 Electro/Mechanical Engineering Technology. Prerequisites: ET 3650, 3860, 4610, and 4860.

4803 Mechanical Engineering Technology. Prerequisites: ET 3860, 4340, and 4815.

4804 Design Engineering Technology. Prerequisites: ET 3840, 3860, and 4340.

4815 Heating, Ventilation, and Air Conditioning. Three credits. Prerequisite: ET 3810 or permission of instructor. Design and operation of heat and mass transfer systems which produce the needed environments for manufacturing operations, industrial

processes, and human comfort. Systems that use mechanical equipment such as pumps, blowers, fans, compressors, and heat exchanges found in fields such as air conditioning, low temperature metallurgy, food preservation, chemical processing, and industrial manufacturing covered. Lecture and laboratory.

4830 Vibration. Three credits. Provides a broad-based background in vibration analysis and introduces present practices. Topics include free, damped, and forced vibrations with one degree of freedom; vibration isolation; free vibration with two degrees of freedom; and introduction to matrix formulation. Lecture, laboratory, and problem solving.

4850 Fluid Power. Three credits. Prerequisites: ET 1840, 3810. Systems and the basic components that make up these systems, including hydraulic, pneumatic, and fluidic. Emphasis on understanding the language and graphic symbols associated with fluid power and the performance characteristics of system components. Lecture, laboratory, and problem solving.

4860 Robotics. Three credits. Prerequisites: ET 4850; MATH 1910; CSCI (3 hours). Fundamentals of robots. Types of robots, types of controls, the prime movers, and the application of robots in the industrial environment. Lecture, laboratory, and problem solving.

4900 Productivity Strategies. Three credits. Prerequisite: ET 3910 or equivalent. Analysis, design, and implementation of productivity strategies and productivity improvement programs for a wide variety of organizations. Touches a spectrum of disciplines such as work design, quality, design engineering, and employee involvement. Includes lean manufacturing with certification available after successful industry project.

4910 Maintenance Management. Three credits. Prerequisite: ET 3910. Overview of maintenance management in an organizational setting such as manufacturing, hospitals, airlines, or large maintenance shops. Application of work measurement and labor utilization controls with emphasis on preventative and predictive maintenance techniques. Computer applications highlighted.

4920 Plant Layout and Materials Handling. Three credits. Prerequisites: ET 2310 and 3910. An overview of facility planning including equipment selection, work flow analysis, activity relationship analysis, and plant layout for product, process, and JIT requirements. Teams assigned actual projects in industry. CAD layout presentations to industry management required.

4970 Engineering Economy. Three credits. Development of capital budgets. Justification of capital projects using time value of money concepts. Replacement analysis. Review of justification of actual capital projects and computer applications.

4980 Federal and State Safety Legislation. Three credits. Corequisite: ET 3910 or permission of instructor. The Federal Occupational Safety and Health Act (OSHA) and the Tennessee Occupational Safety and Health Act (TOSHA) Environmental Protection Agency; rules and regulations and how they apply to industry.

4990 Industrial Engineering Systems. Three credits. Prerequisite: ET 3910. System design of work tasks including establishing time standards by time and motion study and work sampling; ergonomic design for integration of the human into the work task environment. Scientific methods supplemented by quality considerations with emphasis on statistical quality control (SQC). Computer software used for design and analysis.

Courses in Industrial Education [IED]

- 3050 Occupational Teaching Internship I.** Three credits. A supervised teaching experience at a post secondary or secondary school offering occupational training, composed of teaching one half-day course for 15 weeks (or the equivalent). Students given opportunities to apply methods and principles learned in professional courses under the guidance of an experienced supervisor.
- 3060 Occupational Teaching Internship II.** Three credits. A continuation of IED 3050.
- 4000 Program Development and Modification for the Special Needs Learner.** Three credits. Basic strategies for identifying and working with special needs learners in occupational education.
- 4010 History and Philosophy of Industrial Education.** Three credits. Relation to the development of industrial education stressed.
- 4030 Course Development in Occupational and Technology Education.** Three credits. Basic techniques including occupational analysis, preparing objectives, planning a learning sequence, preparing learning activities, selecting and preparing learning resources, and evaluating student performance.
- 4040 Methods of Teaching Occupational and Technology Education.** Three credits. Understanding and skills required for individualizing instruction in occupational and technology education.
- 4060 Organization and Operation of Occupational Student Organizations.** Three credits. Orientation to incorporating student organizations in occupational education programs. Emphasis on establishing an organization, planning chapter activities, utilizing community resources, chapter business procedures and competitive activities.
- 4070 Laboratory Organization and Classroom Management.** Three credits. Laboratory planning and layout, supplies and equipment purchasing, inventory and record keeping, laboratory maintenance, class organization, and safety.
- 4480 Topics in Industrial Education.** One to six credits. Subject topics offered as required to meet the needs of the class.

Courses in Environmental Science and Technology [EST]

- 2810 Introduction to Environmental Science.** Three credits. The technical, economic, and political aspects of environmental science. Introduction to specific problems dealing with many pollution issues. Specific monitoring, abatement techniques, and equipment. An overview of energy production processes, industrial pollution problems, air, noise, solid and hazardous wastes, along with economic and environmental concerns. Field trips, lecture, and research projects and/or papers highlight specific topics of special interest to students.
- 4760-Seminar in Environmental Science and Technology.** One credit each. Four interdisciplinary seminars conducted jointly among Agribusiness and Agriscience, Biology, Chemistry, Physics and Astronomy, and Engineering Technology and Industrial Studies. Guest lecturers, agency and resource personnel, readings, reflective thought, films, and discussions on environmental problems and issues, new and proposed legislation, and the role of environmental science and technology in pollution control.

- 4770 Pollution Control Technology.** Three credits. Prerequisites: 8 hours each in biology, chemistry, and physics, or consent of instructor. Solid waste and water pollution control technology. Legislative regulations and quality standards, pollution types and sources, detection and analysis instruments, and treatment or abatement principles and practices.
- 4780 Air, Solids, and Noise Pollution Technology.** Three credits. Prerequisites: 8 hours each chemistry, biology, and physics or permission of instructor. Air, noise, solid and hazardous waste pollution technology, including legislative regulations and quality standards: sources, detection, and analysis instrumentation and practices, and treatment and abatement principles, equipment, and practices.
- 4810 Energy and the Environment.** Three credits. Prerequisites: 4 hours chemistry and 3 hours mathematics or consent of instructor. Sources and methods of energy production and classifications of energy usages, with emphasis on usage trends, energy conservation strategies, and alternate energy utilization.
- 4820 Solar Building Design.** Three credits. Prerequisites: 4 hours science and 3 hours mathematics or consent of instructor. Broad introduction to the environmental and economic impact of solar energy for residential and light industrial construction including day lighting, passive solar design, and hot water heating.
- 4840 Energy Auditing.** Three credits. Prerequisites: 4 hours chemistry and 3 hours mathematics or consent of instructor. Types of energy consumption and classifications of energy usages, with emphasis on conservation strategies and total management for residential and industrial plants.
- 4980 Environmental Public Health.** Three credits. Prerequisites: 8 hours college biology and 8 hours college chemistry. Applying the sciences of biology, chemistry, statistics, and environmental engineering to the field of public health. Public health epidemiology and disease control concepts related to the anticipation, recognition, assessment, and control of common public health disease problems.

Honors College

The Department of Engineering Technology and Industrial Studies offers periodically the following courses in Honors: ET 2310 Computer-Assisted Drafting/Design I
ET 3610 Introduction to Electricity/Electronics
ET 3910 Introduction to Industrial Management

Graduate Study

The Engineering Technology and Industrial Studies Department offers the Master of Science with thesis and non-thesis options. Requirements and a list of graduate courses offered may be found in the graduate catalog.