

Department of Engineering Technology and Industrial Studies

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The major purpose of the Engineering Technology and Industrial Studies Department is to prepare students for a broad range of industrial and vocational positions.

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 Engineering Technology, Environmental Science and Technology, Industrial Education, and Industrial Technology.

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

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

The Industrial Education major contains three concentrations: Technology Education for teaching in secondary schools, Industrial Training and Development for applications in manufacturing and construction industries, and the Occupational Education concentration for secondary education teachers in vocational-technical education areas.

The Industrial Technology major has three concentrations: Concrete Industry Management, Construction Management Technology, and Industrial Management Technology.

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.

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

In all curricular listings, (Area __) refers to the General Studies requirements as outlined on pages 59-61.

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 Manufacturing Engineering Technology.

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

1. completion of a core of 14 hours of Engineering Technology courses
 - ET 1840 Engineering Fundamentals, 3 hours
 - ET 3600 Electrical Circuit Analysis, 4 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, 62 hours
 - Electro-Mechanical Engineering Technology, 70 hours
 - Manufacturing Engineering Technology, 72 hours
3. completion of other specific courses as shown under the appropriate concentration.

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, telephone: (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, 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 (Area I-A)	6	ENGL 2030, 2--- (Area II-A)	6
MATH 1730, 1910 (Area IV-B)	8	PHYS 2010, 2011, 2020, 2021	
CSCI 1170	4	(Area IV-A)	8
ET 1840	3	ET 3600, 3620	8
BIOL 1030 (Area IV-A)	4	MATH 1920	4
PHED or M S (Area V)	2	CSCI 2170, 3160	7
Speech (Area I-B)	3	PHED or M S (Area V)	2
	30		35
JUNIOR		SENIOR	
HIST 2010, 2020 (Area III-A)	6	ET 4600, 4610	6
ENGL 3520	3	ET 4630, 4670, 4801	11
CSCI 3180	3	ET 4420, 4710, 4970	7
ET 3630, 3640, 3650	12	Technical Elective*	3
ET 4640, 4660	8	ET 3670	4
Humanities (Area II-B)	3	Social Science (Area III-B)	3
	35		34

*Technical elective is to be selected from upper-division ET courses or MATH 1530 as approved by the student advisor.

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

Digital Electronics (ET 3600, 3620, 3630, 3640)
 Microprocessor (ET 3620, 3640/3650, 4660, 4670)
 Instrumentation and Control (ET 3600, 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 18 semester hours including ET 3610 (or ET 3600 with a prerequisite of MATH 1910), 3620, and 3630 plus two courses from ET 3640, 3650, 3660, 3670, 4600, 4610, 4630, 4640, 4660, 4670, or ETIS 4790. All are four credit hours except ET 4600 which is two and ETIS 4790 which is three. Non-majors may minor in Electronics.

As a prerequisite, ET 3610 replaces ET 3600 for students minoring 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, telephone: (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 (Area I-A)	6	ENGL 2030, 2--- (Area II-A)	6
MATH 1730, 1910,		PHYS 2010, 2011, 2020,	
2110 (Area IV-B)	9	2021 (Area IV-A)	8
CHEM 1110	4	BIOL 1030 (Area IV-A)	4
ET 1210, 1840, 2310	11	ET 3210, 3600, 3830	11
CSCI 1170	4	MATH 1530	3
PHED or M S (Area V)	2	PHED or M S (Area V)	2
	36		34
JUNIOR		SENIOR	
HIST 2010, 2020 (Area III-A)	6	ET 3860, 4420, 4600, 4610	12
COMM 2200 (Area I-B)	3	ET 4640, 4850, 4860	10
ENGL 3520	3	ET 4710, 4970, 4802	7
ET 3360, 3620, 3630	12		29
ET 3650, 3810	7		
Humanities elective (Area II-B)	3		
Social Science elective			
(Area III-B)	3		
	37		

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

Robotics (ET 3810, 4850, 4860)
 Control Systems (ET 3600, 3630, 4610, 4600)
 Digital Circuits (ET 3600, 3620, 3650)
 Engineering Mechanics (ET 1840, 3830, 3860)
 Capstone course (ET 4802)

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

Concentration: Manufacturing Engineering Technology

The Manufacturing Engineering Technology (MET) program is accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET), 111 Market Place, Suite 1050, Baltimore, MD 21202, telephone: (410) 347-7700. The MET program is the applied arm of Manufacturing Engineering and provides a modern comprehensive education in elements of design (CAD, standards, tolerances, product/process/facilities), engineering management (Quality Assurance, engineering economics, human factors, safety), manufacturing planning and strategy (materials, strategic issues, processes), management (supervision, communication, organization), and computer applications/automation (simulation, lean manufacturing techniques, machine/robot/PLC programming, CAM, material handling/layout). This education provides the background to become a Certified Manufacturing Technologist (CMfgT). The Society of Manufacturing Engineers (SME) administers this examination on campus twice per year. An MET program graduate can expect opportunities for employment in engineering, product/process design, production or technical management, quality, process planning, facilities, CAD/CAM

design/programming, and other areas of the manufacturing organization.

Curriculum Requirements and Recommended Sequence

FRESHMAN		SOPHOMORE	
ENGL 1010, 1020 (Area I-A)	6	ENGL 2030, 2--- (Area II-A)	6
MATH 1730, 1910, 2110 (Area IV-B)	9	PHYS 2010, 2011, 2020, 2021 (Area IV-A)	8
CHEM 1110, 1111	4	BIOL 1030 (Area IV-A)	4
ET 1210, 1840, 2310	11	ET 3360, 3600, 3830, 3860	14
CSCI 1170	4	ENGL 3520	3
PHED or M S (Area V)	2	PHED or M S (Area V)	2
	36		37

JUNIOR		SENIOR	
HIST 2010, 2020 (Area III-A)	6	ET 3810	3
MATH 1530	3	ET 4850, 4950, 4970	9
ET 3260, 4920	6	ET 4803	3
ET 3210, 3910, 4710	8	ET 3950, 4940	7
ET 4280, 4370	8	PSY 1410 (Area III-B)	3
COMM 2200 (Area I-B)	3	Upper-division/technical electives	3
Humanities elective (Area II-B)	3		28
	37		

Recommended electives: See Upper-Division Form

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

Materials/Processing (ET 1210, 3260, 4280)
CADD (ET 2310, 3360, 4370)
Manufacturing Analysis (ET 3910, 4950, 4970)
Engineering Mechanics (ET 1840, 3830, 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 Concrete Industry Management, Construction Management, and Industrial Management for manufacturing and service industries.

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

1. completion of a minimum of 40-49 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 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: Concrete Industry Management

The concentration in Concrete Industry Management is designed to produce broadly educated, articulate graduates

grounded in basic science and mathematics who are knowledgeable of 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; production management of a ready mix plant; sales and marketing of production, construction, and finishing equipment; product distribution management; construction specialist in an architectural/engineering firm or a governmental entity; and support positions such as a writer or editor for a technical magazine.

All students in the program complete a basic set of business-related courses including ECON 2410 or 2420, CSCI 1150, BLAW 3400, ACTG 3000, FIN 3000 or 3010, MGMT 3610 and 3940, MKT 3820. However, no more than 25 percent of the total hours can be taken in the Jennings A. Jones College of Business. Additionally, only juniors and seniors will be allowed to enroll in 3000- and 4000-level courses.

Students must select one of the following minors:

Business Administration (to be satisfied by the business courses listed above and three of the following five courses: MKT 3840, 3850, or 4800 or MGMT 3620 or 4680).

Management (to be satisfied by the business courses listed above and MGMT 3620, 4680, and an approved management elective).

Marketing (to be satisfied by the business courses listed above and MKT 3840, 3850, 4800, and an approved marketing elective).

Curriculum Requirements and Recommended Sequence

FRESHMAN		SOPHOMORE	
ENGL 1010, 1020 (Area I-A)	6	ENGL 2030, 2--- (Area II-A)	6
CHEM 1110, 1111; GEOL 1040 (Area IV-A)	8	PHYS 2010, 2011; BIOL 1030 (or BIOL 1110 and 1120)	8
MATH 1710, 1720 or 1730 (Area IV-B)	4-6	ECON 2410 or 2420	3
COMM 2200 (Area I-B)	3	ENGL 3520 or BMOM 3510	3
CSCI 1150	3	Humanities elective (Area II-B)	3
PSY 3020, Q M 2610, or MATH 1530	3	ET 2310	4
PSY 1410 (Area III-B)	3	CM 3000, 3050	7
PHED or M S	2		34
CM 1010	1		
	33-35		

JUNIOR		SENIOR	
HIST 2010, 2020 (Area III-A)	6	ET 4420, 3610, 4710	8
ACTG 3000; BLAW 3400	6	CM 4060, 4150, 4910	9
MGMT 3610; MKT 3820	6	MGMT 3940	3
FIN 3000 or 3010	3	Minor and electives	9-12
CM 3060, 3100, 4050	9	PHED (Area V)	1
ET 3910	3		30-33
PHED or M S (Area V)	1		
	34		

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

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 wide 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.

Suggested areas for the required minor are Business Administration, Economics, or Marketing.

Curriculum Requirements and Recommended Sequence

FRESHMAN		SOPHOMORE	
ENGL 1010, 1020 (Area I-A)	6	ENGL 2030, 2--- (Area II-A)	6
BIOL 1030 (Area IV-A)	4	PHYS 2010, 2011, 2020,	
CHEM 1110, 1111	4	2021 (Area IV-A)	8
MATH 1710 (Area IV-B)	3	HIST 2010, 2020 (Area III-A)	6
COMM 2200 (Area I-B)	3	MATH 1720	3
CM 3150	4	CM 3320; ET 3610	8
INFS 2200	3	Gen. Studies (Area III-B)	3
ET 4420, 2310	7	PHED or M S (Area V)	2
	34		36
JUNIOR		SENIOR	
ACTG 3000	3	CM 4110, 4120	6
BLAW 3400	3	CM 4130, 4170	6
CM 3160, 3170, 3180, 3190	12	ET 4710	1
CM 3000, 4100	8	Minor/electives	15
ET 3910	3	Gen. Studies (Area II-B)	3
Minor/electives	2		31
PHED or M S (Area V)	2		
	33		

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



Concentration: Industrial Management Technology

This program, accredited by the National Association of Industrial Technology (NAIT), is designed to prepare students for positions and careers in both the manufacturing and service sectors. Typical positions include first-level management, safety/ergonomics coordinator, production scheduler, inventory analyst, junior industrial engineer, work team facilitator, and other related positions.

Traditional Track

The traditional track is designed for students with fewer than five years of current relevant industrial experience. Students pursuing this track must complete either nine hours of internship, nine hours of cooperative education, or a combination of the two in an appropriate industrial setting. Students may transfer to the industry-based track if they accumulate five years of current relevant industrial experience prior to graduation.

Up to 18 semester hours may be granted for approved work-based training.

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

Curriculum Requirements and Recommended Sequence

FRESHMAN		SOPHOMORE	
ENGL 1010, 1020 (Area I-A)	6	ENGL 2030, 2--- (Area II-A)	6
BIOL 1030 (Area IV-A)	4	PHYS 1300, 2010, 2011	
CHEM 1010, 1011	4	(Area IV-A)	7
MATH 1710, 1720 (Area IV-B)	6	Gen. Studies (Area II-B)	3
ET 2310	4	ET 3610, 3950	8
ET 3260	3	ET 3910	3
INFS 2200	3	ETIS 2920 or 2930	3
PHED or M S (Area V)	2	PHED or M S (Area V)	2
	32	Gen. Studies (Area III-B)	3
			35
JUNIOR		SENIOR	
COMM 2200 (Area I-B)	3	ET 3960, 4710	4
HIST 2010, 2020 (Area III-A)	6	ET 4970	3
ET 4940, 4960	6	ET 4910, 4920	6
ACTG 3000	3	ET 4900	3
ET 4420	3	ETIS 4800	3
MATH 1530 or PSY 3020		PSY 3320	3
or Q M 2610	3	ETIS 3930 or 3970	3
ET 4930	3	Upper-division electives	7
ETIS 3920 or 2940	3		32
Elective	3		
	33		

Recommended electives: ET 1210, 3210, 3360, 4280, 4590, 4950; PSY 4360, 4380; FIN 3010; MKT 3820; ENGL 3520

Industry-based Track

Students must have documented a minimum of five years of current relevant full-time industrial work experience approved by a departmental committee prior to graduation to qualify for the industry-based track. The heart of this program is the following 60-hour technical core which combines credit for work-based learning with traditional coursework.

Work-based 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 number of hours for both work experience and work-based learning may not exceed 30 semester hours. Students will be required to go through a formal assessment process to qualify for work-based learning credit.

Technical Courses: Minimum 30 semester hours. Selected from the following with the consent of the advisor and based upon individual's background: ET 1210, 2310, 3210, 3260, 3360, 3610, 3910, 3960, 4280, 4420, 4590, 4900, 4910, 4920, 4930, 4940, 4950, 4960, 4970; ETIS 3920, 3930, 4490, 4700, 4790, 4800.

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

Curriculum Requirements and Recommended Sequence

FRESHMAN		SOPHOMORE	
ENGL 1010, 1020 (Area I-A)	6	ENGL 2030, 2--- (Area II-A)	6
BIOL 1030 (Area IV-A)	4	PHYS 1300, 2010, 2011 (Area IV-A)	7
CHEM 1010, 1011	4	Gen. Studies (Area II-B)	3
MATH 1710, 1720 (Area IV-B)	6	ET courses and/or work-based learning	14
ET courses and/or work-based learning	7	PHED or M S (Area V)	2
INFS 2200	3	Gen. Studies (Area III-B)	3
PHED or M S (Area V)	2		
	32		35
JUNIOR		SENIOR	
COMM 2200 (Area I-B)	3	ET courses and/or work-based learning	22
HIST 2010, 2020 (Area III-A)	6	PSY 3320	3
ET courses and/or work-based learning	17	Upper-division electives	8
ACTG 3000	3		33
MATH 1530 or PSY 3020 or Q M 2610	3		
	32		

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 CM 3150 and 3160 plus 11 semester hours as approved by the minor advisor.

Major in Industrial Education

Three degree concentrations are offered under the Industrial Education major: (1) Technology Education, for those who seek secondary teacher licensure; (2) Industrial Training and Development for those planning to design and conduct train-

ing for adult learners in industrial settings; and (3) Occupational Education, for those who are teaching or plan to teach in vocational-technical programs. Also, courses required for an Occupational Education license and a minor in Industrial Education are offered.

Concentration: Technology Education

The concentration in Technology Education is designed to prepare the student to teach industrial technology in grades 5-12. Included is the study of the evolving philosophy, objectives, and methodology of technology education, as well as the historical development of technology and its impact on people, society, and environment.

Experiences are provided in technical areas to promote an understanding of industrial organization, materials, processes, products, occupations, problems, and environment. This includes provisions to make independent investigations into these various aspects of industry.

Students seeking a license to teach industrial technology in secondary schools (grades 5-12) must complete (1) a major in technology education, (2) a minor in professional education, (3) courses in addition to the General Studies requirements, and (4) professional vocational education courses.

Enhanced General Education Requirements

In addition to the General Studies requirements (see pages 59-61), the following courses are required:

MATH 1710 College Algebra, 3 hours
 MATH 1720 Plane Trigonometry, 3 hours
 JOUR 1020 or RATV 1020 Understanding Mass Media, 3 hours
 PHOT 2050 Basic Black and White Photography, 3 hours
 ET 4710 Industrial Seminar, 1 hour
 Electives to complete a total of 60 hours to include the General Studies requirements

Professional Education Requirements

Students must contact their minor advisor in professional education for approval of appropriate courses. (For specific procedures and additional requirements for teacher licensure, see page 184.)

Technology Education Teacher Endorsement

Individuals who have already earned a bachelor's degree in another field of education may seek to add an endorsement in technology education with the completion of a maximum of 21 additional hours of technical course offerings. Any deficiencies in professional education hours will also have to be removed. The Office of Teacher Licensure at MTSU must be contacted prior to the pursuit of an endorsement. Individuals must also take and pass the national Praxis subject area assessment tests for teachers before licenses are issued.

Professional Occupational Education Requirements

IED 4040 Methods of Teaching Occupational and Technology Education, 3 hours
 IED 4060 Organization and Operation of Occupational Student Organizations, 3 hours

Major Requirements (39 hours)

CM 3150 Construction and Materials I, 4 hours
CM 3320 Architectural Computer-Aided Drafting and Design, 4 hours
IED 4070 Laboratory Organization and Classroom Management, 3 hours
EST 4810 Energy and the Environment, 3 hours
ET 1210 Introduction to Metals and Metallurgy, 4 hours
ET 2310 Computer-Assisted Drafting/Design I, 4 hours
ET 3210 Machine Tool Technology, 4 hours
ET 3260 Manufacturing Processes and Materials, 3 hours
ET 3360 Computer-Assisted Drafting/Design II, 3 hours
ET 3610 Introduction to Electricity and Electronics, 4 hours
ET 4280 Computer-Aided Manufacturing: Numerical Control (NC), 4 hours

Curriculum Requirements and Recommended Sequence

FRESHMAN		SOPHOMORE	
ENGL 1010, 1020 (Area I-A)	6	ENGL 2030, 2--- (Area II-A)	6
BIOL 1030 (Area IV-A)	4	Gen. Studies (Area III-B)	3
PSCI 1030 (Area IV-A)	4	PHED (Area V)	2
PHED (Area V)	1	Professional Education Req.	3
Professional Education Req.	3	HIST 2010, 2020 (Area III-A)	6
MATH 1710, 1720 (Area IV-B)	6	CM 3150	4
ET 1210, 2310	8	ET 3210, 3260, 3610	11
CSCI 1000 or equivalent	1		35
	33		

JUNIOR

COMM 2200 (Area I-B)	3
Gen. Studies (Area II-B) (2 courses)	6
Professional Education Req.	6
PHOT 2050	3
PHED (Area V)	1
ET 3360, 4280	8
CM 3320	4
JOUR/RATV 1020	3
	34

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

**Concentration: Industrial Training and Development**

The concentration in Industrial Training and Development is designed to prepare individuals to design and conduct training for adult learners in industrial settings. A major in Industrial Education with Industrial Training and Development concentration requires

- the following courses:

Manufacturing

ET 1210 Introduction to Metals and Metallurgy
ET 3210 Machine Tool Technology
ET 3260 Manufacturing Processes and Materials
ET 4910 Maintenance Management
ET 4940 Methods and Work Measurement

Engineering Graphics

ET 2310 Computer-Assisted Drafting/Design I
ET 3360 Computer-Assisted Drafting/Design II

Electronics

ET 3610 Introduction to Electricity and Electronics

Internship

ETIS 3920 Industrial Internship I
ETIS 3930 Industrial Internship II

Professional

H SC 3020 Presentation Techniques
IED 4030 Course Development in Occupational and Technology Education
IED 4040 Methods of Teaching Occupational and Technology Education
ET 3910 Introduction to Operations Management
ET 4420 Industrial Safety
ET 4710 Industrial Seminar
PSY 4330 Industrial/Organizational Training and Development
SPSE 3220 Technology in Teaching

- completion of an approved minor of 18 or more semester hours;
- completion of specific courses as listed below.

Curriculum Requirements and Recommended Sequence

FRESHMAN		SOPHOMORE	
ENGL 1010, 1020 (Area I-A)	6	ENGL 2030, 2--- (Area II-A)	6
BIOL 1030 (Area IV-A)	4	COMM 2200 (Area I-B)	3
PSCI 1030 (Area IV-A)	4	Gen. Studies (Area II-B)	3
PHED or M S (Area V)	2	Gen. Studies (Area III-B)	3
MATH 1710, 1720 (Area IV-B)	6	PHED activity or	
ET 1210, 2310, 3360	11	PHED 2100 (Area V)	2
	33	HIST 2010, 2020 (Area III-A)	6
		ET 3210, 3260	7
		Lower-division electives	5
			35

JUNIOR

ETIS 3920; IED 4030	6
ET 3610, 3910, 4910	11
Minor	6
Upper-division electives	4
H SC 3020	2
SPSE 3220	3
	32

SENIOR

IED 4040	3
ETIS 3930	3
PSY 4330	3
Upper-division electives	3
Upper-division minor	12
CSCI 1000 or equivalent	1
ET 4420, 4710, 4940	7
	32

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

Concentration: Occupational Education

The Occupational Education concentration is designed to provide a baccalaureate degree option for individuals who are teaching or planning to teach in secondary and/or postsecondary schools offering occupational education courses.

In addition to the General Studies requirements, the minimum recommendations for all majors in the Occupational Education concentration are

1. completion of a minimum of 18 semester hours of professional course work;
2. completion of a minimum of 27 semester hours in technical areas which may be met by specializing in a single occupational area or by combining technical courses from two or more occupational areas. ETIS 3920 and 3930 may be applied toward this requirement. Up to 18 semester hours may be granted for appropriate work experience;
3. completion of 6 semester hours of occupational education teaching internship; three years of successful teaching may be substituted for this requirement;
4. completion of an approved minor.

Curriculum Requirements and Recommended Sequence

FRESHMAN		SOPHOMORE	
ENGL 1010, 1020, (Area I-A)	6	ENGL 2030, 2--- (Area II-A)	6
Science (Area IV-A)	8	Gen. Studies (Areas I-B	9
Math (Area IV-B)	3	II-B, III-B)	6
PHED (Area V)	2	HIST 2010, 2020 (Area III-A)	2
Area of technical		PHED (Area V)	3
specialization	12	IED 4030	3
IED 4000	3	Area of technical	6
	34	specialization	3
		SPSE 3220	35
JUNIOR		SENIOR	
IED 4040, 4070	6	IED 4060	3
IED 3050	3	IED 3060	3
Minor	9	Upper-division minor	9
ETIS area of technical		Upper-division electives	15
specialization	9	CSCI 1000 or equivalent	1
Upper-division electives	5		31
	32		

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. Six concentrations in environmental areas—Energy Resource Management, Engineering Technology and Safety, Planning, Site Analysis, Waste Management, and Water Resources—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 67 semester hours in the EST core, 30 hours in General Studies 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, Physics and Astronomy, Geography and Geology, 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 (67 hours)

ABAS 3340, 3370, 6 hours
 BIOL 1110, 1120, 3220, 4240, 15 hours
 CHEM 1110, 1111, 1120, 1121, 2030, 2230, 17 hours
 CSCI 1150, 3 hours
 GEOL 1040, 4 hours
 EST 4760, 4761, 4762, 4763, 4 hours
 EST 4770, 4 hours
 MATH 1710, 1720 (or 1730), 6 hours
 PHYS 2010, 2011, 2020, 2021, 8 hours

Concentration: Energy Resource Management

The Energy Resource Management concentration under the Environmental Science and Technology major includes course work in conservation and the environmental issues in the use of nonrenewable 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 (Area I-A)	6	ENGL 2030, 2--- (Area II-A)	6
BIOL 1110, 1120 (Area IV-A)	8	PHYS 2010, 2011, 2020, 2021	8
CHEM 1110, 1111, 1120, 1121	8	CHEM 2230	5
MATH 1730 or MATH 1710 and 1720 (Area IV-B)	4-6	GEOL 1040	4
EST 4760	1	HIST 2010, 2020 (Area III-A)	6
CSCI 1150	3	EST 4761	1
PHED or M S (Area V)	2	Gen. Studies (Area II-B)	3
		PHED or M S (Area V)	2
	32-34		35

JUNIOR		SENIOR	
CHEM 2030	4	ABAS 3370	3
BIOL 3220, 4240	7	EST 4770	4
PHYS 3700	4	GEOL 4050	3
EST 4810	3	EST 4840 or 4870	3
ABAS 4620 or 4370	3	EST 4820	3
EST 4762	1	EST 4763	1
ABAS 3340	3	Gen. Studies (Area III-B)	3
GEOG 4310	3	Electives	14
COMM 2200	3		34
	31		

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

Concentration: Engineering Technology and Safety

The Engineering Technology 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 (Area I-A)	6	ENGL 2030, 2--- (Area II-A)	6
BIOL 1110, 1120 (Area IV-A)	8	CHEM 2230	5
CHEM 1110, 1111, 1120, 1121	8	GEOL 1040	4
CSCI 1150	3	ET 3830	3
MATH 1910 (Area IV-B)	4	MATH 1920	4
EST 4760	1	PHED or M S (Area V)	2
ET 1840	3	EST 4761	1
	33	PHYS 2110, 2111, 2120, 2121	8
			33

JUNIOR		SENIOR	
ABAS 3340	3	ET 4420	3
CHEM 2030	4	ABAS 3370	3
HIST 2010, 2020 (Area III-A)	6	COMM 2200 (Area I-B)	3
ET 4450	3	Gen. Studies (Areas II-B, III-B)	6
EST 4762	1	EST 4770	4
ET 2310	4	EST 4763	1
ET 3860	3	BIOL 3220, 4240	7
PHED or M S (Area V)	2	EST 4810 or PHYS 3700	3
Elective	4	Elective	3
	30		33

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

Concentration: Planning

The Planning 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 (Area I-A)	6	ENGL 2030, 2--- (Area II-A)	6
BIOL 1110, 1120 (Area IV-A)	8	PHYS 2010, 2011, 2020, 2021	8
CHEM 1110, 1111, 1120, 1121	8	CHEM 2230	5
MATH 1710, 1720 or MATH 1730 (Area IV-B)	4-6	ET 2310	4
EST 4760	1	COMM 2200 (Area I-B)	3
CSCI 1150	3	Gen. Studies (Area II-B)	3
PHED or M S (Area V)	2	PHED or M S (Area V)	2
		EST 4761	1
	32-34	Elective	2
			34

JUNIOR		SENIOR	
GEOL 1040	4	ABAS 3370	3
GEOG 4490 or 4520	4	EST 4770	4
CHEM 2030	4	Gen. Studies (Area III-B)	3
BIOL 3220, 4240	7	BIOL 4250	4
ABAS 3340	3	EST 4810	3
EST 4762	1	EST 4763	1
HIST 2010, 2020 (Area III-A)	6	GEOG 4310 or 4530	3-4
Elective	3	GEOL 4120	4
	32	ABAS 4350 or 4370	3
		Elective	5
			33-34

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

Concentration: Site Analysis

The Site Analysis concentration under the Environmental Science and Technology major is designed to train students to examine an area of perceived pollutants, to obtain and analyze the necessary samples to characterize any contaminants present, and to provide the necessary data for site reclamation or other engineering projects. The required courses for this program are selected from those areas of biology, chemistry, agriculture, and geography/geology which build skills in obtaining accurate data describing the identity, quantity, and location of polluting substances.

Curriculum Requirements and Recommended Sequence

FRESHMAN		SOPHOMORE	
ENGL 1010, 1020 (Area I-A)	6	ENGL 2030, 2--- (Area II-A)	6
BIOL 1110, 1120 (Area IV-A)	8	BIOL 2230, 3220	7
CHEM 1110, 1111, 1120, 1121	8	CHEM 2230, 2030	9
MATH 1710, 1720 or MATH 1730 (Area IV-B)	4-6	PHYS 2010, 2011, 2020, 2021	8
COMM 2200 (Area I-B)	3	CSCI 1150	3
PHED or M S (Area V)	2	PHED or M S (Area V)	2
		EST 4761	1
		EST 4760	1
	32-34		36

JUNIOR		SENIOR	
ABAS 3340, 3370	6	ABAS 4340 or 4350	3
EST 4770, 4810	7	BIOL 4240, 4250	8
GEOL 1040	4	Gen. Studies (Area III-B)	3
EST 4762	1	CHEM 4600, 4630	7
HIST 2010, 2020 (Area III-A)	6	GEOG 4490 or 4520	4
Gen. Studies (Area II-B)	3	EST 4763	1
Electives	6	Elective	3
	33		29

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

Concentration: Waste Management

The 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 (Area I-A)	6	ENGL 2030, 2--- (Area II-A)	6
BIOL 1110, 1120 (Area IV-A)	8	PHYS 2010, 2011, 2020, 2021	8
CHEM 1110, 1111, 1120, 1121	8	CHEM 2230	5
MATH 1710, 1720, or MATH 1730 (Area IV-B)	4-6	GEOL 1040	4
EST 4760	1	BIOL 2230	4
CSCI 1150	3	EST 4761	1
PHED or M S (Area V)	2	Gen. Studies (Area II-B)	3
	32-34	PHED or M S (Area V)	2
			33

JUNIOR		SENIOR	
CHEM 2030	4	ABAS 3370, 4620	6
BIOL 3220, 4240	7	EST 4770	4
ABAS 3340	3	EST 4763	1
EST 4762	1	Gen. Studies (Area III-B)	3
HIST 2010, 2020 (Area III-A)	6	GEOL 4130	4
ABAS 3700 or 4350	3	CHEM 4360	4
COMM 2200 (Area I-B)	3	BIOL 3210 or 4250	3-4
Elective	5	CHEM 4600	3
	32	GEOL 4120	4
		Elective	2
			34-35

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

Concentration: Water Resources

The Water Resources concentration under the Environmental Science and Technology major is designed to give the student a detailed background of water sources in the environ-

ment as well as the nature of human impacts on those resources. The student will develop a working knowledge of the chemical, physical, and biological characteristics of both surface and subsurface waters and will be trained in the major methodologies used for sampling these resources. This concentration is highly compatible with the Waste Management, Site Analysis, and Energy Resources Management concentrations.

Curriculum Requirements and Recommended Sequence

FRESHMAN		SOPHOMORE	
ENGL 1010, 1020 (Area I-A)	6	ENGL 2030, 2--- (Area II-A)	6
BIOL 1110, 1120 (Area IV-A)	8	PHYS 2010, 2011, 2020, 2021	8
CHEM 1110, 1111, 1120, 1121	8	CHEM 2230	5
MATH 1710 or MATH 1720 and 1730 (Area IV-B)	4-6	GEOL 1040	4
EST 4760	1	EST 4761	1
CSCI 1150	3	COMM 2200 (Area I-B)	3
PHED or M S (Area V)	2	Gen. Studies (Area II-B)	3
	32-34	PHED or M S (Area V)	2
			32

JUNIOR		SENIOR	
CHEM 2030	4	ABAS 3700, 4370	6
BIOL 3220, 4240	7	EST 4770	4
ABAS 3340	3	BIOL 4250	4
BIOL 2230	4	EST 4763	1
ABAS 3370	3	Gen. Studies (Area III-B)	3
EST 4762	1	CHEM 4600	3
HIST 2010, 2020 (Area III-A)	6	CHEM 4360	4
Electives	6	GEOL 4130	4
	34	Electives	5
			34

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-professional 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
CM 1300	4
ET 1840	3
Social Science Electives	6
35	

*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

Three pre-engineering programs exist at MTSU. All of the programs require 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 one, two, or three years of the curricula shown below at MTSU. Students should consult their advisors 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,	
CHEM 1110, 1111, 1120,		2121	8
1121	8	MATH 3110, 3120;	10
MATH 1910, 1920	8	STAT 3150	
ET 1840, 2310	7	ET 3830, 3840, 3860	9
CSCI 1170	4	ET 3360, 4970	7
PHED or MS	2	COMM 2200	3
35		37	

JUNIOR: HIST 2010 and 2020; and 23 hours of electives to be chosen from the fields of science, mathematics, English, social science, and business. Students who wish to study chemical engineering should take a second year of chemistry; those who wish to study industrial engineering should take ET 3910. Students must have 24 hours of upper-division credit and 6 of those upper-division semester hours must be in the major area.

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

Five-Year Engineering Program—Binary Program

Two Bachelor of Science degrees—one from MTSU and one from an engineering school—are awarded to each student who completes the MTSU three-year pre-engineering program and also finishes the final two years in an engineering discipline.

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

The specific requirements for the MTSU degree are to

1. complete the pre-engineering curriculum as outlined in this catalog;

2. earn 99 semester hours at MTSU, with 24 at the upper-division level;
3. earn 24 semester hours in Engineering Technology and Industrial Studies;
4. meet all of the MTSU General Studies requirements;
5. enroll in and successfully complete (average grade of C) one year (33 semester hours) of an engineering program;
6. be admitted unconditionally to senior status at an engineering school in a recognized engineering discipline;
7. be admitted to upper division using Upper-Division Form.

This program, when taken in cooperation with the University of Tennessee, Tennessee State University, or Tennessee Technological University, requires two years of study at that school for the completion of requirements for a Bachelor of Engineering degree in chemical, civil, electrical, industrial, mechanical, nuclear, agricultural engineering, or others as they are made available. Other cooperating schools have similar requirements and offer various degrees. Specific details can be obtained by contacting the Department of Engineering Technology and Industrial Studies.

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 above program 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.

Engineering Cooperative Program

Superior students may be selected during the spring semester of their freshman year for the cooperative engineering program at Middle Tennessee State University, Tennessee Technological University, or the University of Tennessee. This program is designed to provide actual industrial experience interspersed with academic study on an alternating semester basis. The student would complete the freshman year indicated above and then transfer. A student desiring to be included in this program should confer with his/her advisor before the end of the first semester.

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

Courses in Construction Management [CM]

1010 (101) 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.

1300 (130) Drafting Fundamentals for Architecture and Construction. Four 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.

- 3000 (300) Fundamentals of Concrete—Properties and Testing.** Four credits. Corequisite: CM 3150 or 1010. Concrete testing, admixtures, placing, and finishing. Effects of concrete-making materials on properties of fresh and hardened concrete materials.
- 3050 (305) Concrete Construction Methods.** Three credits. Prerequisite: CM 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 (306) Understanding the Concrete Construction System.** Three credits. Prerequisite: CM 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.
- 3100 (310) Applications of Concrete Construction.** Three credits. Prerequisites: CM 3000, 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.
- 3150 (315) Construction and Materials I.** Four 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 (316) Cost Estimating I.** Three credits. Prerequisite: CM 3150 or consent of instructor. Introduction to the 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.
- 3170 (317) Construction Measurement.** Three credits. Prerequisites: CM 3150; ET 2310; MATH 1720 or 1730. Reading of topo maps used in the construction field. Measurement and calculations involved in surveying, road and utilities layout for subdivisions.
- 3180 (318) Construction and Materials II.** Three credits. Prerequisite: CM 3150. A continuation of CM 3150 with emphasis on new building materials and various types of construction. Light commercial construction included.
- 3190 (319) Construction Operations.** Three credits. Prerequisite: CM 3150. Topics Include contractor organization in land development and infrastructure. Management methods used in construction equipment.
- 3320 (332) Architectural Computer-Aided Drafting and Design.** Four credits. Prerequisites: ET 2310 and CM 3150 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.
- 4050 (405) Management of Concrete Products—Ordering and Delivering.** Three credits. Prerequisites: ET 3910; CM 3000, 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 (406) Management of Concrete Products Production Facilities.** Three credits. Prerequisites: CM 3000, 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.
- 4100 (410) Mechanical and Electrical Systems.** Four credits. Prerequisites: CM 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 (411) Cost Estimating II.** Three credits. Prerequisites: CM 3190, 4120. Use of computer to estimate total cost of land development and housing costs for capstone project.
- 4120 (412) Specifications and Scheduling.** Three credits. Prerequisites: CM 3170-4100, 3320. Basic methods of writing about characteristics of materials used in the assembling of construction as specified. Flow of labor and material toward specified goal, weather, trade characteristics, and material availability in work scheduling.
- 4130 (413) Construction Administration.** Three credits. Prerequisites: CM 3160-3190. Management and administration of construction to include contracts, office, and field work.
- 4150 (415) Concrete Problems: Diagnosis, Prevention, and Dispute Resolution.** Three credits. Prerequisite: Senior course only. 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.
- 4170 (417) Capstone—Construction Management.** Three credits. Prerequisites: All construction courses through CM 4130. Final preparation of development plans, etc., for subdivision. Basic principles of presentations. Presentation of capstone project to Building Construction Technical Committee.
- 4910 (491) 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 (131) Basic Technical Drawing and Sketching.** Four credits. Not open to students who take CM 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 (292) 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 (293) 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 (294) Cooperative Education Experience II.** Three credits. Prerequisite: ETIS 2930. Continuation of ETIS 2930. Pass/Fail.
- 3680 (368) Navigation Avionics.** Three credits. Prerequisite: ET 3660. Theory of operation of all common types of electronic navigation systems for aircraft and the principles of testing for proper operation and alignment. Use of special purpose test equipment to check operation and alignment.
- 3920 (392) 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 (393) Industrial Internship II.** Three credits. Prerequisite: ETIS 3920. A continuation of Internship I. Same stipulations apply. Pass/Fail.
- 3970 (397) Cooperative Education Experience III.** Three credits. Prerequisite: ETIS 2940. Continuation of ETIS 2940. Pass/Fail.
- 3980 (398) Cooperative Education Experience IV.** Three credits. Prerequisite: ETIS 3970. Continuation of ETIS 3970. Pass/Fail.
- 4490 (449 A-Z) Topics in Industrial Technology.** One to six credits. Subject topics offered as required to meet the needs of the class.
- 4700 (470) Industrial Topics.** One to six credits. Problems in any one of a variety of areas to meet the needs of the class.
- 4790 (479) 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 (480I) Senior Problems in Industrial Technology.** Three credits. Prerequisites: ET 4920, 4930, 4940, 4960, and 4970. Capstone course requiring the solution and presentation of a broad technical problem which requires the application of previous course work.

- 4990 (499) Introduction to Operations Research.** Three credits. Prerequisites: ET 3910 and MATH 1530 or equivalent. Problem solving in research and development involving operations research models, computer applications, and industrial problems.

Courses in Engineering Technology [ET]

- 1210 (121) Introduction to Metals and Metallurgy.** Four 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 (184) 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 (231) Computer-Assisted Drafting/Design I.** Four credits. Prerequisite: ETIS 1310 or CM 1300 or one year of high school drafting. Technical drafting concepts utilizing personal computers, plotters, and appropriate software. Two hours lecture and four hours laboratory.
- 3210 (321) Machine Tool Technology.** Four 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. Two hours lecture and four hours laboratory.
- 3220 (322) Advanced Metalwork.** Four 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). Two hours lecture and four hours laboratory.
- 3240 (324) 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 (326) Manufacturing Processes and Materials.** Three credits. An analysis of machines, tools, processes, and materials used in production.
- 3360 (336) Computer-Assisted Drafting/Design II.** Four credits. Prerequisite: CM 3320 or ET 2310. Utilizes IBM-compatible computer and AutoCAD 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. Two hours lecture and four hours laboratory.

- 3600 (360) Electrical Circuit Analysis.** Four credits. Prerequisite: MATH 1910. Direct current and alternating current circuits. Serves as prerequisite for advanced electricity and electronics courses. Concepts, circuit performance and analysis, and problem-solving techniques using rigorous application of mathematics through calculus. Three hours lecture and three hours laboratory.
- 3610 (361) 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.
- 3620 (362) Digital Circuits Fundamentals.** Four credits. Prerequisite: ET 3600 or permission of instructor. Provides thorough coverage of basic digital electronic circuits analysis and design. Both TTL and CMOS families examined. Number systems, mapping methods, and combinational logic circuits design for digital control strongly emphasized. Three hours lecture and three hours laboratory.
- 3630 (363) Electronics I.** Four credits. Prerequisite: ET 3600 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. Three hours lecture and three hours laboratory.
- 3640 (364) Digital Circuits Design.** Four credits. Prerequisite: ET 3620; corequisite: ET 3630. In-depth study of sequential logic circuits analysis and design including counters, shift registers, and programmable logic devices. Introduction to multi-input system controllers and state machine design using SSI, MSI, and LSI devices. Three hours lecture and three hours laboratory.
- 3650 (365) Introduction to Microprocessors.** Four credits. Prerequisite: ET 3620. 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. Three hours lecture and three hours laboratory.
- 3660 (366) Communication Electronics.** Four 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 (367) Computer-Assisted Printed Circuit Board Design.** Four 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 (381) 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 (383) 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 (384) 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 (386) 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 (391) Introduction to Operations Management.** Three credits. A foundation course in manufacturing and service operations management. Problem-solving applications emphasized.
- 3950 (395) Metrology.** Four credits. Overview of methods and procedures of precision measuring and gaging as used in inspection and quality control by industry. Two hours lecture and four hours laboratory.
- 3960 (396) Industrial Quality Technology.** Three credits. Covers breadth and some depth in quality technology. Explores history of quality, present techniques, and future predictions. Lecture.
- 4230 (423) Advanced Machine Tool Technology.** Four 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. Two hours lecture and four hours laboratory.
- 4280 (428) Computer-Aided Manufacturing: Numerical Control (NC).** Four 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 (433) Advanced Computer-Aided Drafting.** Four 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. Two hours lecture and four hours laboratory.
- 4340 (434) 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. Lecture.
- 4370 (437) Tool Design.** Four 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 (442) 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 (444) 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 (445) 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 (459) Fundamentals of Computer-Integrated Manufacturing.** Three credits. Prerequisite: Junior status or consent of instructor. A beginning course to aid in identifying the terms, applications, and requirements for using computer-integrated manufacturing. An overall view of the design, drafting, manufacturing, and integration aspects of using computers for manufacturing. Includes manufacturing, human, and business elements.
- 4600 (460) 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 (461) Instrumentation and Controls.** Four credits. Prerequisites: ET 3620 and 3630. Devices and techniques used in the measurement of physical parameters. Consideration of accuracies and sources of error, identification of typical measurements, sensors and transducers, control stability and response. Three hours lecture and three hours laboratory.
- 4630 (463) Local Area Networks.** Four credits. Provides the necessary foundation experience to understand the design, implementation, and management strategies of Local Area Networks (LAN). Data Communication Standards and protocol, fundamentals included. Will include lecture, laboratory activities, and a LAN design requirement. Three hours lecture and three hours laboratory.
- 4640 (464) Industrial Electricity.** Four credits. Prerequisite: ET 3600 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. Three hours lecture and three hours laboratory.
- 4660 (466) Microprocessor Interfacing.** Four credits. Prerequisites: ET 3640 and 3650. Analog and digital conversion devices and their related systems. Introduction to individual subsystems; A/D and D/A data conversion. Organization and design of individual digital systems emphasized. Includes data transfer, conversion, storage, input and output. Focuses on systems which are typically external to microprocessor-based systems. Three hours lecture and three hours laboratory.
- 4670 (467) Microprocessor Design.** Four credits. Prerequisite: ET 4660. Advanced course in design and application of microprocessor-based measurement and control systems. Includes an in-depth analysis of hardware design process. Three hours lecture and three hours laboratory.
- 4680 (468) Electronic Fabrication.** Four credits. Prerequisite: ET 3610 or equivalent. Planning and designing electronic packaging, including printed circuit board design, component selection criteria, construction techniques, soldering techniques, and assembly techniques. Conventional and computer-aided printed circuit board design techniques used. Three hours lecture and three hours laboratory.
- 4690 (469) Electronic System Analysis.** Four credits. Prerequisite: ET 3640 or 4670. Theory of electronic troubleshooting and proper repair techniques of electronic devices. Three hours lecture and three hours laboratory.
- 4700 (470) Transform Circuit Analysis.** Three credits. Prerequisites: ET 3600 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 (471) 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.
- 4801-4804 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 (480C) Computer Engineering Technology.** Prerequisites: ET 4670; CSCI 3160.
- 4802 (480E) Electro/Mechanical Engineering Technology.** Prerequisites: ET 3650, 3860, 4610, and 4860.
- 4803 (480M) Manufacturing Engineering Technology.** Prerequisites: ET 4280, 4370, 4920, and 4970.
- 4804 (480D) Design Engineering Technology.** Prerequisites: ET 3840, 3860, and 4340.
- 4850 (485) 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 (486) 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 (490) 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.

- 4910 (491) 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 (492) 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.
- 4930 (493) Production Planning and Control.** Three credits. Prerequisite: ET 3910. Concepts of manufacturing planning, forecasting, material requirements, planning and control of inventories. Emphasis on computer systems for planning, scheduling, and control. Plant tours and special presentations are supplementary.
- 4940 (494) Methods and Work Measurement.** Three credits. Prerequisite: ET 3910. Design of work tasks including analysis and improvement of existing tasks. Establishing engineered time standards by stop-watch, pre-determined times, and work sampling. Application of computer systems in work measurement.
- 4950 (495) Statistical Quality Control.** Three credits. Statistical quality analysis of manufacturing processes including product sampling and design of overall quality system, study of various systems in use by industry.
- 4960 (496) Human Factors Engineering (Ergonomics).** Three credits. Integration of the human into the work task environment. Emphasis on practical applications of ergonomics to task design and analysis. Design teams apply concepts to real world problems. Presentations of projects. Computer applications reviewed.
- 4970 (497) 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 (498) 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.

Courses in Industrial Education [IED]

- 3050 (305) 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 (306) Occupational Teaching Internship II.** Three credits. A continuation of IED 3050.
- 4000 (400) 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 (401) History and Philosophy of Industrial Education.** Three credits. Relation to the development of industrial education stressed.
- 4030 (403) 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 (404) Methods of Teaching Occupational and Technology Education.** Three credits. Understanding and skills required for individualizing instruction in occupational and technology education.
- 4060 (406) 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 (407) 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 (448) 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 (281) 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.
- 4760-4763 (476 A, B, C, D) Seminar in Environmental Science and Technology.** One credit each. NOTE: These courses are required for a major in Environmental Science and Technology. 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 (477) Pollution Control Technology.** Four credits. NOTE: This course is required for a major in Environmental Science and Technology. 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 (478) Air, Solids, and Noise Pollution Technology.** Four 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 qual-

ity standards: sources, detection, and analysis instrumentation and practices, and treatment and abatement principles, equipment, and practices.

4810 (481) Energy and the Environment. Three credits. NOTE: This course is required for a major in Environmental Science and Technology. 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 (482) 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 (484) 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.

4870 (487) Passive Solar Design. Three credits. Prerequisite: EST 4820 or 4 hours science and 3 hours mathematics. Introduces use of passive solar techniques on the construction of residential and light industrial structures including topics such as day lighting, passive solar design, methods, and system integration.

Honors College

The Department of Engineering Technology and Industrial Studies offers periodically the following courses in Honors:
 ET 2310 (231H) Computer-Assisted Drafting/Design I
 ET 3610 (361H) Introduction to Electricity/Electronics
 ET 3910 (391H) Introduction to Industrial Management

Graduate Study

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

