Technological Studies

Faculty: Karsnitz, *Chair;* Edelbach, S. O'Brien, D. Sullivan; *TIES Magazine:* R. Todd, *Publisher and Senior Research Professor;* P. Hutchinson, *Editor-in-Chief;* K. Maskell, *Editor*

We live in a technological age and the impacts of technology on the individual, society, and environment are great. Technology is the study of the human quest for solutions to problems involving the design and production of artifacts, systems, and environments. Society needs professionals who understand technological forces and are prepared to help people manage those forces. Students in either the technology education (technology and pre-engineering education) or Mathematics/Science/Technology—M/S/T (NJDOE approved academic major for education) major study a variety of themes including historical and contemporary influence of designed objects on end users and society, design style, product development, human factors engineering, product modeling, problem-solving techniques, communication, computers, and robotics. Emphasis is placed on understanding and applying core technological/pre-engineering/ mathematical/and scientific principles to develop design and problem-solving skills. Courses are conducted in modern classroom/laboratories housed in the School of Engineering.

"Technology Education" is a broad term used in the United States to describe a curriculum that addresses the need to educate students about the many ways that technology affects their lives. At The College of New Jersey's School of Engineering, this area of certification has been redesigned to include K-12 technological and pre-engineering principles. The goal of the program is to prepare teachers who can explain to students how objects that they interact with on a daily basis have been conceived of, designed, and fabricated by another person or group of people—an engineer, architect, graphic/fashion or industrial designer. These objects run the gamut from the design of the package that contains their cereal to the fabrication and fashion design of their clothing, to the water supply system that allows them to wash in the morning, to the myriad of engineering advances that allow them to play MP3s on their PC and instant message friends from their mobile phones while sitting comfortably in their climate-controlled houses.

New "Standards for Technological Literacy: Content for the Study of Technology" were published in 2000. The National Science Foundation (NSF), the American Association for the Advancement of Science (AAAS), and most recently the National Academy of Engineering (NAE) have recognized technology education/pre-engineering as a new field of study and as an important element of school reform. Continuing its commitment to providing New Jersey's children with an education that enables them to succeed in the new economy, the New Jersey Department of Education established a new Core Content Standard #8 for "Technological Literacy." Students in the Department of Technological Studies with a teacher-education specialty in either Technology Education or M/S/T receive provisional certification to teach in New Jersey schools. Most states recognize teacher candidates from these NCATE nationally accredited program. Students graduating from the program also take positions in business and industry such as manufacturing design and prototyping, industrial sales, training and development, or become entrepreneurs. Some students choose to pursue this program to prepare for positions in higher education, commerce, media, or government service. Graduates from both the Technology Education and M/S/T majors can become pre-certified to teach PLTW courses and are in high demand.

Entrance, Retention, and Graduation Standards

Every major program at the College has set standards for allowing students to remain in that program, to transfer within the College from one program to another, and to graduate from a program. The following are the standards for programs in technological studies. Minimum grades are noted in parentheses:

- Retention in the technology education major is based on the following performance standards in these "critical content courses": ETE 261/Multimedia Design (C+); and TED 280/Introduction to Teaching Technology Education (C+).
- Transfer to the technology education major from another program within the College is based upon the following performance standards in these "foundation courses": ETE 261/Multimedia Design (C+); and TED 280/Introduction to Teaching Technology Education (C+).
- Retention in the M/S/T major is based on the following performance standards in these "critical content courses": ETE 261/Multimedia Design (C+); and
    - ELST and DHST—ELE 201/RAL221 (C+) or
    - ECST—ECE 102/202 (C+) or
    - SEST—WRI 102/SPE 103/FSP (B)
- Transfer to the M/S/T major from another program within the College is based upon the following performance standards in these "foundation courses": ETE 261/Multimedia Design (C+); and
    - ELST and DHST—ELE 201/RAL221 (C+) or
    - ECST—ECE 102/202 (C+) or
    - SEST—WRI 102/SPE 103/FSP (B)

Technology Education (ETTC) or M/S/T (ELST/ECST/DHST/SEST) Majors

Candidates for a teacher-education certificate must have a 2.75 cumulative grade point average to successfully complete their teacher education program. They also must meet the state hygiene/physiology requirement and pass the appropriate PRAXIS examination before the New Jersey State Department of Education will issue the appropriate certificate. MST graduates will be able to qualify for a middle school endorsement. Teacher-education candidates will receive a "certificate of eligibility with advanced standing" which requires a candidate to be provisionally certified for his or her first year of teaching. After one year of successful teaching, the candidate is eligible for a permanent certificate. Students should consult with their departmental advisers in planning their academic program. These plans should take into account requirements for the major, general education, professional courses, and state certification.

Suggested Course Sequence

Technology Education—First Year (by advisement)

FSP	First Seminar	1 course unit
MAT	127/Calculus A	1 course unit
TST	161/Creative Design	1 course unit
ETE	261/Multimedia Design	1 course unit
PHY	201/General Physics I	1 course unit
ETE	111/Engineering Design	1 course unit
ETE	131/Engineering Math	1 course unit
WRI	102/Academic Writing (if not exempt)*	1 course unit

Total for year 8 course units

**It is recommended that students exempted from this course take other liberal learning courses.*

Elementary Education M/S/T (ELST) or Early Childhood Education M/S/T (ECST) or Deaf and Hard of Hearing M/S/T (DHST) or Special Education M/S/T (SEST) with a Technology Specialization

This interdisciplinary major integrates formal study in mathematics, science, and technology and consists of a common "core" with a "specialization" in one of the M/S/T disciplines. Students electing a technology specialization will complete 10 units of common core requirements including MAT 127/Calculus A, Math Option, Science Option#1, two other approved science courses, ETE 261/Multimedia Design, ETE 271/Structures and Mechanics, MAT 105/Mathematical Structures and Algorithms for Education I (or MAT 200 by advisement), TED 460/Integrated M/S/T for the Child/Adolescent Learner, and one M/S/T elective (by advisement). The technology specialization consists of a minimum of three additional units with one at the 300 level or higher selected from the following courses: ETE 111/Engineering Design, ETE 281/Analog Circuits and Devices, ETE 361 Architectural and Civil Engineering Design, ETE 461/Manufacturing Systems, or two laboratory courses (ETE 275/Mechanics and Materials Laboratory, or ETE 285/Robotics and Controls Laboratory, or ETE 365/Prototyping Laboratory), and one approved elective in support of the middle school endorsement.

Suggested Course Sequence
M/S/T-Freshman Year (by advisement)

FSP	First Seminar	1 course unit
MAT	127/Calculus A	1 course unit
TST	161/Creative Design	1 course unit
ETE	261/Multimedia Design	1 course unit
Science Option #1 (by advisement)		1 course unit
Math or Science Option (by advisement)		1 course unit
MAT	105/Mathematical Structures and Algorithms for Education I	1 course unit
WRI	102/Academic Writing (if not exempt)*	1 course unit

**It is recommended that students exempted from this course take another liberal learning course.*

Total for year 8 course units

Technology Minor

The minor consists of five units:

TST 161/Creative Design
ETE 261/Multimedia Design

Select three of the following courses (at least one 300-level course)

ETE 111/Engineering Design
ETE 271/Structures and Mechanics
ETE 281/Analog Circuits and Devices
ETE 361 Architectural and Civil Engineering Design, or
Two laboratory courses (ETE 275/Mechanics and Materials Laboratory, or ETE 285/Robotics or Controls Laboratory, ETE 365/Prototyping Laboratory)

COURSES

TST 161/Creative Design **1 course unit**
(fall and spring)
This is a foundational course that looks at the elements and principles of design as related to practical products, systems, and environments. It introduces students to the creative process practiced by artists, designers, and engineers, valuable to them as both future producers and consumers. Content includes thinking, drawing, and modeling skills commonly used by designers; development of a design vocabulary; the nature and evolution of technological design; the impacts of design on the individual, society, and the environment; patents and intellectual property; human factors; team design; and appropriate technology, risk analysis, and futuring techniques. Design problems are presented within real-world contexts, using field trips and outside speakers. Students complete a major design project, document their work through a design portfolio, and present their solutions before the class. Weekly critiques of class projects build fluency, confidence, and creativity.

ETE 111/Engineering Design **1 course unit**
(annually-spring)
Introduces the student to the concepts of mechanical design through the use of solid modeling of machine and product elements, exercises in reverse engineering, and the design of a simple machine. The course endeavors to provide the student the experience of learning a concept by analysis (reverse engineering), giving form to this concept through 3-D modeling, and finally applying the concept(s) in a simple mechanical design.

ETE 131/Engineering Math **1 course unit**
(annually-spring)
Prerequisite: MAT 127
Includes a brief review of algebra, trigonometry, geometry, and Calculus A (differentiation and integration). The course will introduce the use of computational methods as a tool for engineering analysis. Computational methods will include Mathematica and MS Excel. Mathematical concepts to be covered include: numerical integration, multiple integrals, vector algebra, and differential equations. All mathematical topics will be tied to the solution of physical problems (the rocket equation, the RC circuit, spring-damper system, etc.). The course will also cover the analysis of experimental data and include the concepts of error analysis and standard deviation.

ETE 261/Multimedia Design **1 course unit**
(annually-fall)
This course is intended to build upon skills and experiences introduced in the TST 161/Creative Design. Students will gain a perspective on the historical and contemporary influence of the information age on the individual and society. Main emphasis will be placed on understanding 2-D visual elements, compositional operations and associated human factors principles. Students will be given design problems in page layout, photography, video production, web-based media using current equipment and software, and prepare an ethical case study.

ETE 271/Structures and Mechanics **1 course unit**
(annually-fall)
Prerequisites: Calculus A, PHY 201
This course is a synthesis of the primary concepts that are covered in the traditional ME courses of Statics, Strength of Materials and Machine Design. The lecture portion of the class contains ample real-world examples to illustrate the applicability of the concepts being discussed. The course will also contain a substantial hands-on component where students will be instructed in the safe use of woodworking machines. Students will fabricate a model from print that illustrates

some basic machine concept. The students will make practical use of the course instruction by participating in a design competition where teams of students build a machine to solve a "real world" problem.

ETE 275/Mechanics and Materials Laboratory **.5 course units**
(annually-fall)
Co-requisite: ETE 271
This course builds upon the laboratory experience students gained in ETE 271 and the material covered in ETE 131/Engineering Math. Students get further instruction in the use of woodworking tools and learn the theory of cutting tools. The course moves on to machining techniques (lathe and mill) and includes projects that investigate optimal cutting speeds and feed speeds for various engineering materials. Additional projects cover tensile testing, the use of strain gages, sheet metal fabrication, plastics, composite materials and environmental effects.

ETE 279/Thermo and Fluid Systems **1 course unit**
(annually-spring)
Prerequisite: ETE 271
Students will study the design requirements of an engineered system such as a modern passenger jet or other major modern engineering accomplishment. Students will then apply these learned concepts and principles to a student selected problem and will design/engineer and make/model a selected solution.

ETE 281/Analog Circuits and Devices **1 course unit**
(annually-spring)
Prerequisites: MAT127
This introductory course provides the student with an overview of the fundamental concepts of electrical circuits. The course is lecture-based but requires the student to build and test a wide range of electrical circuits. The course will cover the use of the digital multimeter, variable power supply, function generator, and oscilloscope. Topics covered include Ohm's law, resistor networks, Kirchhoff's Laws, RC circuits, LEDs and diodes, transformers and rectifiers, transistors, op-amps, 555 timers, dc motors.

ETE 283/Digital Electronics **1 course unit**
(annually-fall)
Prerequisite: ETE 281
This course introduces the student to digital electronics as they are designed and used in modern electrical devices. Basic logic circuit concepts are briefly introduced, and the course then moves on to applications of digital circuits such as digital signal processing and digital process control. This course will also cover programming fundamentals using the C programming language and Mathematica.

ETE 285/Robotics and Controls Laboratory **.5 course unit**
(annually-spring)
Prerequisites: ETE 283
This course extends the scope of the hands-on components of ETE 281 and ETE 283. Students are given the opportunity to build and test various electrical systems that introduce a wide range of electrical and electro/mechanical components such as optical encoders, sensors and actuators.

ETE 361/Architectural and Civil Engineering Design **1 course unit**
(annually-spring)
Prerequisite: ETE 261, ETE 271
This is an advanced course in the design of structures with an emphasis on understanding the historical and contemporary influence of designed objects on end users and society. Content includes key design themes from the Industrial Revolution to the present, architectural style, product development, civil engineering and structural analysis, and human factors. A Design (Style) Case Study is used to better understand the influence of human design on the individual, society, and the environment. A thematic approach is used to select some problems for this course.

ETE 365/Prototyping Laboratory **.5 course unit**
(annually-fall)
Co-requisite: ETE 111, ETE 271
This is an advanced laboratory course designed to give students hands-on experiences with a variety of modeling techniques, tools, and machines. Students will make a variety of products including a mockup model, appearance model and prototype model. The experience is designed to develop the student's fabrication skills with advanced techniques to produce high quality models for product development.

ETE 371/Mechanical Systems Design **1 course unit**
(annually-fall)
Prerequisite: ETE 275
This course combines the knowledge of the previous mechanical oriented courses and considers applications where the only possible engineering solution requires a combination of these mechanical engineering concepts. Some examples are HVAC systems, internal combustion engines, fuel cells, power plants, space vehicles, and automobiles. Examples of mechanical systems will be covered by means of case studies. Students will work in teams to solve a series of design problems. These design problems will require that the student teams apply the methodology of engineering analysis to iterate an optimal solution that satisfies multiple criteria (e.g., weight, size, cost, ease of assembly, recyclability, etc.)

ETE 381/Mechatronics **1 course unit**
(annually-spring)
Prerequisite: ETE 285
This course is to be a directed design class with an emphasis on the concepts of mechatronics. Various topics will be introduced using real-world examples such as engine control units (ECUs), autonomous vehicles (e.g., Mars rovers), and smart houses.

TST 391/Independent Study in Technological Studies **1 course unit**
(fall and spring)
Prerequisites: Permission of instructor and department chair
Independent Study is for advanced students wishing to pursue a special area of interest. Topic developed in consultation with a faculty advisor.

ETE 461/Manufacturing Systems **1 course unit**
(annually-spring)
Prerequisite: ETE 365
This course challenges advanced students to design multi-step, automated production systems, including related elements of coordination, management, evaluation and continuous

improvement. It documents the effects of mass production on individuals and society, and engages students with issues of economics, ethics and globalization.

ETE 470/Topics in Technological Studies **1 course unit**
(occasionally)
Prerequisites: Recommendation of faculty adviser, approval of department chair
Topics is an advanced course dealing with an emerging issue in technological studies.

ETE 495 Senior Design Project **1 course unit**
(annually-spring)
Senior Design Project is a culminating experience that provides the structure for students to further develop their design, problem solving and technical skills. Intended to come at the end of the program, students draw from their experiences to solve a major technical problem, including research, solution planning and development, testing and evaluation.

Professional Education Courses

TED 280/Introduction to Teaching Technology Education **1 course unit**
(with clinical hours)
(annually-fall)
The course is an initial professional experience for technology teacher education candidates. Technology Education (the study of the designed world) as a subject is a dynamic new teaching field reflecting the need for students to better understand their technological world through a design-based learning environment. New "Standards for Technological Literacy: Content for the Study of Technology" were published in 2000. The National Science Foundation (NSF), the American Association for the Advancement of Science (AAAS), and most recently the Technology for All Americans (TfAA) project have recognized Technology Education as a new field of study and as an important element of school reform. This introduction will include observations of classroom activities and school administrative functions, teaching small groups of students, studying about selecting content for instruction and historical developments in the field. Student membership in ITEA and TEANJ is required.

TED 380/Junior Professional Experience in Technology Education **1 course unit**
(with clinical hours)
(annually-spring)
Prerequisites: TED 280, junior status, 2.5 GPA
This course is a systematic professional experience designed to develop knowledge and skills necessary for teaching Technology Education in secondary schools. Experiences in the schools will include formal observation of teaching, planning for teaching, modes of instruction, presenting lessons, teacher-pupil interaction analysis and, planning, management and control of a Technology Education classroom/laboratory. The weekly seminars will address these and other related issues including defining the role of and performing as a professional educator. Continued membership in ITEA and TEANJ is required.

TED 391/Independent Study in Technology Education **1 course unit**
(fall and spring)
Prerequisites: Permission of instructor and department chair
TED 391 is restricted to advanced students wishing to pursue a special area of interest. The topic will be developed in consultation with a faculty adviser.

TED 460/Integrated M/S/T for Child/Adolescent Learner **1 course unit**
(annually-spring)
Prerequisites: TST 161, ETE 271
This course is an introduction to research and contemporary issues concerning the national focus on technological literacy. The course will deal with concepts of design-based inquiry, history, principles and processes of technology including engineering and the impact of technological activity on the individual, society and the environment. The setting for the study of technological literacy and design-based inquiry will focus on initiating technological literacy starting at the elementary school level. The Children Designing and Engineering™ project serves as the model for the course (CD&E™ was a NSF funded project, see designed world learning website for more information)

TED 480/Content and Methods in Technology Education **1 course unit**
(annually-fall)
Prerequisite: TED 380
This course encompasses a general overview of curriculum and methodology in technology education. The course will emphasize development of instructional programs and materials, methodology, evaluation and facilities organization, and management in technology education based on the Standards for Technological Literacy: Content for the Study of Technology (ITEA, 2000). TED 480 also includes a Red Cross First Aid course. Continued membership in ITEA and TEANJ is required

TED 481/Seminar in Technology Education **1 course unit**
(annually-fall)
Co-requisite: TED 490
The course includes planning for and analysis of student teacher's role in school and community; assistance in preparing for postgraduate activities; and individual and group assignments to strengthen student teacher's preparation. This course runs concurrently with Student Teaching. Continued membership in ITEA and TEANJ is required.

TED 490/Student Teaching in Technology Education **2 course units**
(field experience)
(annually-fall)
Prerequisites: TED 380, 2.75 GPA
Co-requisites: TED 480, TED 481
Student teaching during the senior year is carried out under direct supervision of public or private school teachers and a college supervisor. Experience includes observation, participation, and responsible teaching within the school along with familiarization with both the school management system and community makeup.

TED 492/Facilities Design and Management **1 course unit**
(annually-spring)
Prerequisite: ETE 261
The course involves the design of technological facilities, selecting and specifying equipment, and planning for the management of that facility. Safety and working with students in a materials/tool/equipment environment is a key component of the course (New Jersey requires technology education certification for any teacher working with students in a materials laboratory setting). Using real-world design constraints from a selected school district, students design a facility to support a technological/pre-engineering studies program.