Integrative STEM Education

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We live in a highly technological age and the impacts of technology and engineering on the individual, society, and environment are great. Design, a fundamental aspect of technology and engineering, is central to our department's teacher preparation methods. The K–12 educational system, as well as society in general, can benefit from professionals who understand the impacts and value of developing the habits of mind of designers. Our department coordinates two undergraduate teacher preparation programs: Technology, Engineering, and Computing Education (TEC Ed), a K-12 certification program with a focus on preparing educators for the middle school and high school grade levels, and Integrative Science, Technology, Engineering, and Mathematics Education (iSTEM), with a focus on preparing educators for the PreK-8 grades.

Both undergraduate teacher preparation programs are integrative STEM-based programs, studying a variety of STEM content areas and problem-based learning educational methods. STEM content areas include science and math applied in design processes (for K–12 environment), historical and contemporary influence of designed objects, creativity, product development, human factors engineering, product modeling, problem-solving techniques, environmental and biotechnical systems, communications, electronics and computers, structures, mechanisms, and robotics. Emphasis is placed on understanding and applying core STEM principles and applying design-centric, problem-based pedagogies. Courses are conducted in modern classrooms and laboratories housed in the School of Engineering.

New Jersey recognizes the importance of technology and engineering through the establishment of standards for K-12 students (NJ Core Content Standard 8.2 Design Thinking). These standards outline the framework for teaching technological and engineering literacy, engineering design, ethics and culture, and the effects of technology on the natural world. In addition, the Next Generation Science Standards (NGSS) require engineering content in science courses. Graduates of our programs receive provisional certification to teach in New Jersey schools, and most states recognize teacher candidates from the Association for Advancing Quality in Educator Preparation (AAQEP) nationally accredited programs, such as TCNJ's education programs. Graduates from both the TEC Education and iSTEM programs are in high demand.

Program Entrance, Retention, and Exit Standards for the Integrative STEM Education Programs

1. Technology, Engineering, and Computing Education (Undergraduate)

Retention in this program is based on the following performance standards in these critical content courses: ETE 131 (C-), PHY 121 (C-), ETE 271 (C-), TED 280 (B-). A student who does not achieve these minimum performance standards and/or earns a grade of F in any other in-major course will be placed on the School of Engineering Academic Warning List.

The State of New Jersey currently requires at least a 3.00 cumulative GPA for students to be recommended for certification, and a department requirement is that students in this major must maintain a GPA of at least 2.33 for any single academic semester. Students who do not achieve these minimum GPA milestones will be placed on the School of Engineering Academic Warning List. Placement on the Academic Warning List for two consecutive semesters or any three

non-consecutive semesters will result in dismissal from the major. Students dismissed from the major may appeal for re-entry into the major. Students dismissed from the major may not enroll in School of Engineering offerings with the exception of offerings that meet College Core program requirements.

Entrance (internal transfer) into this program from another program within the College is based upon meeting or exceeding the following performance standards: TED 280 (B-) and overall cumulative GPA ≥ 2.75. Internal transfer within engineering programs will be permitted as long as enrollment limits are not exceeded.

2. Integrative STEM Education (Undergraduate)
Retention in this program is based on the following performance standards in these critical content courses: ETE 131 (C-) and ETE 271 (C-). A student who does not achieve these minimum performance standards and/or earns a grade of F in any other in-major course will be placed on the School of Engineering Academic Warning List. In-major courses for this major are any professional (education/methods) or content (STEM) course required for the iSTEM major.

A cumulative GPA of 3.00 is required for TCNJ to recommend the student for certification to the New Jersey Department of Education. The department's requirement is that students in this major must maintain a GPA of at least 2.33 for any single academic semester. Students who do not achieve this minimum GPA milestone will be placed on the School of Engineering Academic Warning List. Placement on the Academic Warning List for two consecutive semesters or three non-consecutive semesters will result in dismissal from the major. Students dismissed from the major may appeal for re-entry into the major.

Entrance (internal transfer) into this program from another program within the College is based upon meeting or exceeding the following performance standards: MAT 105 or MAT 106 (C) and overall cumulative GPA ≥ 3.00. Internal transfer within engineering programs will be permitted as long as enrollment limits are not exceeded.

Program Course Sequences

1. **Technology, Engineering, and Computing Education (undergraduate degree program)** Candidates for a teacher education certificate must have a cumulative grade point average of at least 3.00 to complete the teaching preparation program, and should have a 3.00 cumulative GPA to enroll in Clinical 1. They also must meet the state hygiene/physiology requirement; the state Harassment, Intimidation, and Bullying Prevention (HIB) training certificate requirement, and pass the appropriate Praxis examination before the New Jersey State Department of Education will issue the corresponding certificate. Candidates will receive a "certificate of eligibility with advanced standing" (CEAS), which requires a candidate to be provisionally certified for his or her first year of teaching. After two effective or highly effective summative evaluations of teaching, which usually takes two years, 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. All teacher candidates who have a cumulative GPA of 3.0 are

officially accepted into the teacher education program as rising juniors. In order to be eligible for *institutional recommendation* for teacher certification, all candidates must successfully complete program requirements, attain a 3.00 cumulative GPA, and earn minimum SED 399 Clinical 1 and TED 490 Clinical 2 grades of B. The department also requires a minimum grade of a B− in TED 280 and SED 224.

Required Major Courses (fulfill College Core requirements)

FYS 16X: First Year Seminar (1 unit)
CSC 120: Foundations of Computational Thinking (1 unit)
CSC 220: Computer Science I: Computational Problem Solving (1 unit)
PHY 121: Principles of Physics (1 unit)
SPE 103: Social and Legal Foundations of Special Education (1 unit)
TST 161: Creative Design (1 unit)
IDS 252: Society, Ethics, and Technology (1 unit)
SED 224: Adolescent Learning and Development (1 unit)
US History Course (1 unit)
College Core Elective (1 unit)

Required Major Content Courses (TEC Education Core)

ETE 99: TEC Education Seminar (0 unit)
ETE 131: Engineering Math for Educators (1 unit)
ENG 144: Fundamentals of Engineering Design (0.5 unit)
ETE 145: Introduction to Engineering Design for Educators (0.5 unit)
ETE 245: Design and Fabrication Lab (0.5 unit)
ETE 261: Multimedia and Communication Technology (1 unit)
ETE 271: Structures and Mechanisms (1 unit)
ETE 275: Mechanics and Materials (1 unit)
ETE 341: Environmental and Biotechnology Systems (1 unit)
ETE 361: Architectural Design (1 unit)
ETE 382: Innovation through Electrical Systems (1 unit)
ETE 395: TEC Design Proposal (0.5 unit)
ETE 461: Manufacturing Systems (1 unit)
ETE 482: Automation and Robotic Systems (1 unit)
ETE 492: Facilities Design and Management (1 unit)
ETE 495: TEC Design Project (1 unit)

Required Major Pedagogical Courses (Professional Education)

TED 280: Introduction to TEC Ed (1 unit)
RAL 328: Reading in Secondary Education (0.5 unit)
TED 360: Methods in Computational Thinking (1 unit)
SED 399: Pedagogy in Secondary Schools (Clinical I) (1.5 unit)
TED 460: Integrative STEM for Young Learners (1 unit)
TED 480: Content & Methods in TED Ed (1 unit)
TED 481: Seminar in TEC Ed (1 unit)
TED 490: Student Teaching in TEC Ed (Clinical II) (2 units)

First Year Suggested Course Sequence for Technology, Engineering, and Computing Education Major

First Year - Fall	Units	First Year - Spring	Units
ETE 99: TEC Education Seminar	0	ETE 131: Engineering Math for Educators	1.0
FYS 16X: First Year Seminar	1.0	PHY 121: Principles of Physics	1.0
TST 161: Creative Design	1.0	ETE 261: Multimedia and Communication Technology	1.0
CSC 120: Foundations of Comp. Thinking	1.0	ETE 145: Intro to Engineering Design	0.5
SPE 103: Social and Legal Foundations of Special Ed.	1.0	ETE 245: Design and Fabrication Lab	0.5
ENG 144: Fundamentals of Eng Design	0.5		
Semester Units	4.5	Semester Units	4.0

Total for year 8.5 course units

Technology Minor

The minor consists of five units:

Required: TST 161: Creative Design

Complete 4 units of content courses (with at least one 300-level course):

ETE 131: Engineering Math for Educators (1 unit)
ETE 145: Introduction to Engineering Design for Educators (0.5 unit)
ETE 245: Design and Fabrication Lab (0.5 unit)
ETE 261: Multimedia and Communication Technology (1 unit)
ETE 271: Structures and Mechanisms (1 unit)
ETE 275: Mechanics and Materials (1 unit)
ETE 341: Environmental and Biotechnology Systems (1 unit)
ETE 361: Architectural Design (1 unit)
ETE 382: Innovation through Electrical Systems (1 unit)
ETE 461: Manufacturing Systems (1 unit)
ETE 482: Automation and Robotic Systems (1 unit)

2. <u>Integrative STEM Education (undergraduate degree program)</u>

This disciplinary content major is open to students in the following education majors: Inclusive Elementary Education, Early Childhood Education, Special Education, or Deaf and Hard of Hearing Education. The iSTEM disciplinary content major cannot be taken as a stand-alone major, and must be coupled with one of the above listed School of Education majors.

Required College Core Courses

TST 161: Creative Design (1 unit)

Required Major Courses (Content)

ETE 131: Engineering Math for Educators (1 unit)
ETE 145: Introduction to Engineering Design for Educators (0.5 unit)
ETE 245: Design and Fabrication Lab (0.5 unit)
ETE 271: Structures and Mechanisms (1 unit)
ETE Tech Content I (ETE 261 or ETE 275)
ETE Tech Content II (300 or 400 level)
ETE Content III (300 or 400 level)
ETE Content IV (300 or 400 level)
TED 360 or TED 460 (1 unit)

Note 1: Integrative STEM Education students in the major receive careful course advisement so that they may add endorsements to qualify to teach middle school mathematics and/or middle school science in addition to their K-6 certification. Students seeking either or both of these endorsements must complete at least 15 credits of coursework in mathematics and/or science, and must also pass the pertinent Praxis exam(s).
Note 2: Integrative STEM Education students can also become eligible for K-12 certification in Technology Education by completing 30 credits of Technology Education Content courses (ETE and TST courses) and completing the Praxis Technology Education Exam (5051).

First Year Suggested Course Sequence for Integrative STEM Education Major

First Year - Fall	Units	First Year - Spring	Units
ELE 99: Elementary Education Seminar	0	ETE 131: Engineering Math for Educators	1.0
FYS 16X: First Year Seminar	1.0	PHY 103: Physical, Earth & Space Science	1.0
TST 161: Creative Design	1.0	SLP 102: Speech & Language	1.0
ELE 203: Foundations of Inclusive Ed	1.0	Development	0.5
MAT 105: Structures & Algorithms for Education	1.0	ETE 145: Intro to Engineering Design ETE 245: Design and Fabrication Lab	0.5
Semester Units	4.0	Semester Units	4.0

Total for year 8.0 course units