Technological Design Curriculum Standards and Policy Addition

The Background:

Curriculum frameworks are mandated by Rules, Regulations, and Minimum Standards of the State Board of Education (Section 0520-01-03-.05, State Curriculum, Requirement D).

Technological Design is developed to be a tenth grade level course for students who have an interest in careers pertaining to Engineering and Technology, an aspect of Science, Technology, Engineering, and Math (STEM) education. This course provides students with a foundation in such areas as systems thinking; design, sketching, and drawing; and solving problems. The addition of this course will align this program of study with updated national/international standards.

Within this course students will apply technology, science, and math concepts and skills to solve authentic engineering design problems and invent or innovate designs using engineering systems approach along with technical drawing and computer aided design.

Following approval of this course, the course title will be added to State Board of Education Policy 3.205, the list of Approved High School Courses, in the Technology Engineering Education section.

Changes since first reading include:

- Cosmetic formatting changes to reflect new course description document format. This new format includes additional information about the course to assist school leadership in implementing the course, including pre-requisites, as requested by the Board on first reading. This format has been reviewed by division and department leadership.

- Learning expectations and performance indicators have been combined with duplicate performance indicators (competencies) removed.

- Specific performance indicators that were possible but not necessary demonstrations of professional skills competencies have been removed (i.e. recitation of the TSA creed), as requested by the Board on first reading.

The Recommendation:

The Department of Education recommends adoption of the standards on final reading. The SBE staff concurs with this recommendation.

Technological Design

Primary Career Cluster:	Science, Technology, Engineering, and Mathematics (STEM)
Consultant:	Marty Willis, (615) 741-8836, Marty.Willis@tn.gov
Course Code(s):	Awaiting approval
Prerequisite(s):	Algebra I and Foundations of Technology (or similar)
Credit:	One
Grade Level:	10th – 12th
Graduation Requirement Substitution:	None
Programs of Study and Sequence:	
Necessary Equipment:	None
Aligned Student Organization(s):	TSA http://www.tntsa.org/
Coordinating Work-Based Learning:	Instructors are encouraged to become certified in work-based learning for mentorship and job shadowing opportunities. http://www.state.tn.us/education/cte/wb/index.shtml
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	None
Teacher Endorsement(s):	Any TEE endorsement OR 007, 013, 014, 015, 016, 017, 018, 105, 210, 211, 212, 213, 214, 407, 413, 414, 415, 416, 417, 418, 460, 461, 480, 481, 482, and 483 OR Any T&I teacher who holds a Bachelor's.
Additional Required Teacher Certifications/Training:	State approved STEM training session
Teacher Resources:	http://www.state.tn.us/education/cte/index.shtml

Course Description

In Technological Design, engineering scope, content, and professional practices are presented through practical applications. Students in engineering teams apply technology, science, and mathematics concepts and skills to solve engineering design problems and innovate designs.

Students research, develop, test, and analyze engineering designs using criteria such as design effectiveness, public safety, human factors, and ethics. This course is an essential experience for students who are interested in technology, innovation, design, and engineering.

Program of Study Application

Technological Design prepares students for the capstone Engineering Design course that is used as a bridge course for post-secondary study.

Course Standards

Standard 1.0
Demonstrate leadership, citizenship, and teamwork skills required for success in the school, community and workplace.

Learning Expectations and Performance Indicators:
1.1   Cultivate positive leadership skills. Take part in opportunities to practice and demonstrate personal leadership skills. For example, taking advantage of opportunities provided by a career and technical student organization (CTSO), such as the Technology Student Association (TSA).
1.2   Assess situations, apply problem-solving techniques and decision-making skills within the school, community, and workplace.
1.3   Participate as a team member in a learning environment.
1.4   Respect the opinions, customs, and individual differences of others.
1.5   Build personal career development by identifying career interests, strengths, and opportunities.

Standard 2.0
Safely use tools, materials, equipment and other technology resources.

Learning Expectations and Performance Indicators:
2.1   Understand general laboratory safety rules and regulations when using tools, equipment and performing processes.
2.2   Successfully pass a test on general laboratory safety and regulations with 100% accuracy.
2.3   Successfully pass a safety test on power tools used in the classroom with 100% accuracy.
2.4   Successfully pass a written or oral test on the chemical, electrical and fire safety hazards that exist in a Technology Engineering classroom and their school.
2.5   Demonstrate continuous awareness of potential hazards to self and others and respond appropriately.

Standard 3.0
Students will understand how introduction to technological design in the designed world is the product of a design process that provides ways to turn resources and materials, tools and machines, people, information, energy, capital, and time into products and systems.

Learning Expectations and Performance Indicators:
- 3.1 Understand and identify the relationship between the technological design process and selected attributes of the designed world.
- 3.2 Understand, use, and apply the technological design process, sketching and drawing techniques, and prototyping to design a product or process following the steps of the technological design process.
- 3.3 Define and describe principles of design and analyze technological systems based on these principles.
- 3.4 To document the technological design processes and communicate them to audiences using appropriate oral and written techniques, such as a design proposal, models and prototypes, process and results communications, and a design portfolio.

Standard 4.0
Students will apply technological design skills to the solution of practical problems. They will develop sketching and modeling skills, and communicate observations, processes and results of the technological design process using verbal, graphic, quantitative, virtual, and written means as well as three-dimensional models.

Learning Expectations and Performance Indicators:
- 4.1 Prepare students to apply the technological design process including problem identification, development of constraints, design and prototyping, conceptual, physical, and mathematical modeling, and final development.
- 4.2 To enable students to convey design ideas through sketches.
- 4.3 To enable students to fabricate physical models or prototypes that will be used to test systems or components.
- 4.4 To enable students to document the technological designs processes and communicate them to audiences using appropriate oral and written techniques.

Standard 5.0
Technological design is a distinctive process with a number of defining characteristics: It is purposeful; it is based on certain requirements; it is iterative; it is creative; and it is systematic.

Learning Expectations and Performance Indicators:
- 5.1 Understand the relationship between systems and resources and the technological design process including measurable attributes of objects and the units; systems and processes of measurement; and appropriate techniques, tools, and formulas to determine measurements.
- 5.2 Understand that optimization is a process used to make a design as effective or functional as possible within the given criteria and constraints.

5.3 Understand that controls are mechanisms or activities that use information to cause a system to change; demonstrate by designing, fabricating, and testing a feedback-controlled system.

5.4 To apply the principles of human factors engineering to product design and use.

5.5 To familiarize students with the relationship between the protections of intellectual property through the patent process and technology transfer.

5.6 To familiarize students with fundamental concepts of project management (process of planning, organizing, and controlling work) through use of tools such as flow charts, graphs, technical vocabulary and symbols.

5.7 To familiarize students with the career pathways related to technological design.

Standard 6.0
Engineering resources, sometimes referred to as the core technologies, are the "basic building blocks" from which all technology systems are created.

Learning Expectations and Performance Indicators:

6.1 Understand the fundamentals of mechanical technology, the technology of putting mechanical parts together to produce, control, and transmit motion which is critical to the technological design process; analyze simple machines and calculate their mechanical advantage.

6.2 Understand the fundamentals of fluid technology, including common components, basic system design, controls, system performance evaluation, science concepts applied, mathematics applications, and safety practices for interacting with technology systems.

6.3 Understand the fundamentals of thermal technology including common components, basic system design, controls, system performance evaluation, science concepts applied, mathematics applications, and safety practices.

6.4 Understand the fundamentals of electrical technology including common components, basic system design, controls, system performance evaluation, science concepts applied, mathematics applications, and safety practices.

Standard 7.0
Students to analyze technology systems that are associated with selected areas of the designed world and to apply technological design skills in problem solving.

Learning Expectations and Performance Indicators:

7.1 Apply, use, manage, analyze and research the functioning and applications of power and energy technology systems.

7.2 Apply, use, manage, analyze and research the functioning and applications of Information and communication technology systems, including the inputs, processes, and outputs associated with sending and receiving information from human to human, human to machine, and machine to human.

7.3 Apply, use, manage, analyze and research the functioning and applications of transportation technologies; describe how transportation impacts the operation of other technologies, such as manufacturing, construction, communication, health and safety, and agriculture.

7.4 Apply, use, manage, analyze and research the functioning and applications of manufacturing technologies.

7.5 Apply, use, manage, analyze and research the functioning and applications of construction technologies.