Energy and Power: Generation, Transmission, and Distribution is the second year course in the Energy Systems pathway. In this course, students will continue to learn about energy and power industry fundamentals by furthering their knowledge about electric power generation, transmission and distribution. The student will gain knowledge about business models, regulations, and safety within the energy industry.

ENGR-EPGTD-1. Students will identify electric power generation equipment and systems.

a. Describe the major parts of an electric energy generation and conversion system.
b. Explain how a furnace operates including the exhaust, ignition, and combustion.
c. Demonstrate knowledge of how power generation equipment and systems work including: a boiler, superheater, turbine, and a reheater by creating a diagramed image.

ENGR-EPGTD-2. Students will explain the conventional electric power generation systems and process (coal, gas, hydroelectric, and nuclear).

a. Compare and contrast the process of formation of oil, coal, and natural gas.
b. Describes the advantages or disadvantages of using oil, coal, or natural gas in the process of generating electricity
c. Explain the process of generating hydroelectric electricity and describe its advantages or disadvantages over other forms for generating electricity.

ACADEMIC STANDARDS:

SEV1. Students will investigate the flow of energy and cycling of matter within an ecosystem and relate these phenomena to human society.

SEV4. Students will understand and describe availability, allocation and conservation of energy and other resources.

SCSh4. Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.
SCSh5. Students will demonstrate the computation and estimation skills data and developing reasonable scientific explanations.

MM3P1. Students will solve problems (using appropriate technology).

MM3P2. Students will reason and evaluate mathematical arguments.

MM3P3. Students will communicate mathematically.

MM3P4. Students will make connections among mathematical ideas and to other disciplines.

MM3P5. Students will represent mathematics in multiple ways.

ELAALRC2. The student participates in discussions related to curricular learning in all subject areas.

ELAALRC3. The student acquires new vocabulary in each content area and uses it correctly.

**ENGR-EPGTD-3. Students will define nuclear power and discuss it in terms of its positive and negative impacts as well as its relevancy to various situations in today’s society.**

a. Define terms relating to nuclear energy, including but not limited to, the following: fission, fusion, breeder reacting, boiling water reactors, pressurized water reactors, plutonium and plutonium 239, proliferation, isotope, electron, plasma, Nuclear Waste Policy Act, Kyoto Protocol, control rod, half-life, uranium 235 and uranium 238, Nucleus, Proton, Neutron, plasma, radioactivity and shipping cask.

c. Discuss supply and demand for nuclear power.

d. Create a technical report that includes international use, restrictions, and regulations of nuclear power including inequities of regulations and policies throughout the world.

e. Develop an outline that provides information regarding present and future uses of nuclear power in the world.

**ENGR-EPGTD-3. Students will explain how nuclear power is generated.**

a. Explain how nuclear power is created and how the atom uranium is utilized.

b. Create a flow chart that details the Nuclear Fuel Cycle.
c. Compare and contrast the two types of nuclear power reactors used in the United States including Boiling Water Reactors and Pressurized Water Reactors.

d. Explain the U.S. Nuclear Regulatory Commission (NRC) safeguards and regulations including inspection, performance assessment and enforcement, operational experience evaluation.

ENGR-EPGTD-4. Students will identify alternative sources for generation of electric power (i.e., solar, wind, geothermal, biomass, and ocean/tidal motion) and describe the advantages and disadvantages of their use for the consumer, industry, and the environment.

a. Explain how solar, wind, biomass, and wave energy are used to produce electricity and steam and the advantages and disadvantages of each.

b.

ENGR-EPGTD-5. Students will explain the conditions necessary to build a functional electric power distribution and transmission grid.

a. Compare and contrast the electric power transmission and distribution.

b. Discuss the application of different electric power transmission principles (including AC vs. DC).

c. Describe electric power transmission equipment and systems how each element functions together to transfer power.

d. Discuss the implications (economical, environmental, social) of emerging technologies in electric power transmission and distribution (including the Smart Grid).

e. Discuss the need for electric distribution systems and how they are designed to operate.

f. Describe different electric power distribution systems and compare its advantages as it relates to implementation (i.e. substations, distribution feeder circuits, switches, primary circuits, secondary circuits, and services).

ENGR-EPGTD-7. Students will explain the transmission and distribution of natural gas.

a. Explain the natural gas transmission and distribution process.

b. Describe how the parts of a natural gas distribution system relate to each other and to the operation of the system as a whole.
c. Discuss the emerging technologies in natural gas distribution; compare its advantages and disadvantages respect to each other and their (economical, environmental, and social) impact.

ENGR-EPGTD-8. Students will explain different process use to conserve energy resources and increase its efficient distribution and use.

a. Define energy efficiency.
   b. Explain how to reduce the carbon footprint by identifying energy conservation techniques.
   c. Examine different systems of energy distribution as it relates to its implication in energy conservation with both residential and commercial settings energy use.

ENGR-EPGTD-9. Students will explain the ownership of the transmission and distribution systems.

a. Compare and contrast the types of ownership including: fully-integrated investor-owned utilities, transmission/distribution owners, transmission owners, distribution owners, and miscellaneous owners.
   b. Discuss the application of current state, city, or local community regulations that guide energy usage

ENGR-EPGTD-10. Students will understand and be able to implement safety practices and procedures within the energy industry.

a. Describe the roles of federal, state, and local agencies in workplace safety and health.
   b. Explain the importance of compliance with standards, regulations, and established procedures to ensure safe and healthful work environment.
   c. Create an OSHA job safety plan that demonstrates knowledge of basic regulatory requirements that promote safe and effective operations for protection of people, data, property, and institutions.
   d. Demonstrate through lab activities basic procedural guidelines that promote safe and effective operations for the protection of people, data, property, and institutions.
   e. Explain the roles and responsibilities of employers, employees, and the general public in creating and maintaining workplace, personal, and community safety cultures.
ENGR-EPGTD-11. Students will demonstrate the importance of following safety practices for utility workers.

a. Identify potential threats and consequences from deviation of safety procedures and improper use of tools.

b. Explain the importance of using personal protective equipment (PPE) including safety glasses, hearing protection, gloves, work boots, and hard hats and the potential dangers of failing to do so.

c. Describe the processes and policies of companies to maintain personal safety equipment (PPE) to ensure working order.

d. Demonstrate through lab activities the use tools and equipment in compliance with user manuals and safety training.

e. Describe the appropriate first aid practices and first response procedures for electrical and nonelectrical emergencies including: cuts, insect stings, dog bites, broken bones, spinal injury, thermal burns, electrical burns, chemical burns, electric shock, shock, heart attack, stroke, and unconsciousness.

STEM Standards (Common to all Engineering & Technology Courses)

**Nature of Technology**

ENGR-STEM-1. Students will recognize the systems, components, and processes of a technological system.

a. Describe the core concepts of technology.

b. Identify the relationships among technologies along with connections to contemporary issues.

c. Apply lifelong learning strategies necessary to understand the characteristics and scope of technology.

**Academic Standards:**

SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.

SCSh7. Students analyze how scientific knowledge is developed.

MM3P4. Students will make connections among mathematical ideas and to other disciplines.
Technology and Society

ENGR-STEM-2. Students will identify the impact of engineering and technology within global, economic, environmental, and societal contexts.

  a. Describe the social, economic, and environmental impacts of a technological process, product, or system.
  b. Demonstrate ethical and professional behavior in the development and use of technology.
  c. Explain the influence of technology on history and the shaping of contemporary issues.

Academic Standards:

SCSh7. Students analyze how scientific knowledge is developed.

MM3P4. Students will make connections among mathematical ideas and to other disciplines.

Design

ENGR-STEM-3. Students will design technological problem solutions using scientific investigation, analysis and interpretation of data, innovation, invention, and fabrication while considering economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability constraints.

  a. Demonstrate fundamental principles of design.
  b. Design and conduct experiments along with analysis and interpretation of data.
  c. Identify and consider realistic constraints relevant to the design of a system, component, or process.

Academic Standards:

SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.

SCSh3. Students will identify and investigate problems scientifically.

SCSh4. Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.
SCSh5. Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.

SCSh8. Students will understand important features of the process of scientific inquiry.

MM3P1. Students will solve problems (using appropriate technology).

MM3P2. Students will reason and evaluate mathematical arguments.

**Abilities for a Technological World**

**ENGR-STEM-4.** Students will apply principles of science, technology, engineering, mathematics, interpersonal communication, and teamwork to the solution of technological problems.

a. Work cooperatively in multi-disciplinary teams.
b. Apply knowledge of mathematics, science, and engineering design.
c. Demonstrate strategies for identifying, formulating, and solving technological problems.
d. Demonstrate techniques, skills, and knowledge necessary to use and maintain technological products and systems.

**Academic Standards:**

SCSh3. Students will identify and investigate problems scientifically.

SCSh4. Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

SCSh5. Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.

SCSh6. Students will communicate scientific investigations and information clearly.

SCSh8. Students will understand important features of the process of scientific inquiry.

MM3P4. Students will make connections among mathematical ideas and to other disciplines.
ENGR-STEM-5. Students will select and demonstrate techniques, skills, tools, and understanding related to energy and power, bio-related, communication, transportation, manufacturing, and construction technologies.

a. Use common tools correctly and safely.
b. Describe strategies for selecting materials and processes necessary for developing a technological system or artifact.
c. Demonstrate fundamental materials processing and assembly techniques.
d. Evaluate the interdependence of components in a technological system and identify those elements that are critical to correct functioning.
e. Apply analytical tools to the development of optimal solutions for technological problems.

Academic Standards:

SCSh2. Students will use standard safety practices for all classroom laboratory and field investigations.

SCSh3. Students will identify and investigate problems scientifically.

SCSh4. Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

CTAE Foundation Skills

The Foundation Skills for Career, Technical and Agricultural Education (CTAE) are critical competencies that students pursuing any career pathway should exhibit to be successful. As core standards for all career pathways in all program concentrations, these skills link career, technical and agricultural education to the state’s academic performance standards.

The CTAE Foundation Skills are aligned to the foundation of the U. S. Department of Education’s 16 Career Clusters. Endorsed by the National Career Technical Education Foundation (NCTEF) and the National Association of State Directors of Career Technical Education Consortium (NASDCTEc), the foundation skills were developed from an analysis of all pathways in the sixteen occupational areas. These standards were identified and validated by a national advisory group of employers, secondary and postsecondary educators, labor associations, and other stakeholders. The Knowledge
Implementation date
Fall 2013

and Skills provide learners a broad foundation for managing lifelong learning and career transitions in a rapidly changing economy.

**CTAE-FS-1 Technical Skills:** Learners achieve technical content skills necessary to pursue the full range of careers for all pathways in the program concentration.

**CTAE-FS-2 Academic Foundations:** Learners achieve state academic standards at or above grade level.

**CTAE-FS-3 Communications:** Learners use various communication skills in expressing and interpreting information.

**CTAE-FS-4 Problem Solving and Critical Thinking:** Learners define and solve problems, and use problem-solving and improvement methods and tools.

**CTAE-FS-5 Information Technology Applications:** Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.

**CTAE-FS-6 Systems:** Learners understand a variety of organizational structures and functions.

**CTAE-FS-7 Safety, Health and Environment:** Learners employ safety, health and environmental management systems in corporations and comprehend their importance to organizational performance and regulatory compliance.

**CTAE-FS-8 Leadership and Teamwork:** Learners apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.

**CTAE-FS-9 Ethics and Legal Responsibilities:** Learners commit to work ethics, behavior, and legal responsibilities in the workplace.

**CTAE-FS-10 Career Development:** Learners plan and manage academic-career plans and employment relations.

**CTAE-FS-11 Entrepreneurship:** Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.