Georgia CTAE

Energy (2021)

Adopted 2021

Energy and Power Technology (21.451)

ENRG-EPT-1. Demonstrate employability skills required by business and industry. ENRG-EPT-1

1. Communicate effectively through writing, speaking, listening, reading, and interpersonal abilities. ENRG-EPT-1.1
2. Demonstrate creativity by asking challenging questions and applying innovative procedures and methods. ENRG-EPT-1.2
3. Exhibit critical thinking and problem solving skills to locate, analyze and apply information in career planning and employment situations. ENRG-EPT-1.3
4. Model work readiness traits required for success in the workplace including integrity, honesty, accountability, punctuality, time management, and respect for diversity. ENRG-EPT-1.4
5. Apply the appropriate skill sets to be productive in a changing, technological, diverse workplace to be able to work independently and apply team work skills. ENRG-EPT-1.5
6. Present a professional image through appearance, behavior and language. ENRG-EPT-1.6

ENRG-EPT-2. Students will investigate energy, work, power, and force and analyze the relations of each. ENRG-EPT-2

1. Research terms that describe the use and measurement of energy. ENRG-EPT-2.1
2. State and explain the significance of the fundamental scientific laws governing energy and power. ENRG-EPT-2.2
3. Propose how energy is measured and determine the amount of work that can be accomplished with that particular energy in a given situation. ENRG-EPT-2.3
4. Outline the differences between energy and power. ENRG-EPT-2.4
5. Create a project that states the advantages and disadvantages of the various forms of energy. ENRG-EPT-2.5

ENRG-EPT-3. **Identify the six simple machines and explain how each is able to change the value for force and distance in the work relation.** ENRG-EPT-3

1. Investigate what is meant by mechanical advantage and explain how it is determined by using force and distance in the work equation. ENRG-EPT-3.1
2. Identify the six simple machines (Lever, Wheel and Axel, Pulley, Inclined Plane, Wedge, and Screw) and create scenarios for use. ENRG-EPT-3.2
3. Investigate two ways of determining the mechanical advantage of a machine. ENRG-EPT-3.3
4. Solve problems involving simple machines, input and output forces, and mechanical advantage. ENRG-EPT-3.4
5. Describe the relationship of force and speed when either is changed by the advantage of a mechanical device. ENRG-EPT-3.5

ENRG-EPT-4. **Differentiate between electrical and mechanical power systems and apply the various scientific laws that govern each.** ENRG-EPT-4

1. Apply concepts of fluid power transfer. ENRG-EPT-4.1
2. Explain how the volume of a gas varies with changes in pressure and temperature. ENRG-EPT-4.2
3. Connect how a fluid is able to transfer force, as well as, change relationship between force and distance or speed. ENRG-EPT-4.3
4. Solve mathematical problems involving changes in pressure, temperature, and volume in fluid power transfer systems. ENRG-EPT-4.4

ENRG-EPT-5. **Differentiate between AC and DC circuits and apply Ohm's Law to series, parallel, and series/parallel circuits as well as state Kirchoff's Laws.** ENRG-EPT-5

1. Differentiate between alternating current and direct current. ENRG-EPT-5.1
2. Explain differences between series, parallel, and series-parallel circuits. ENRG-EPT-5.2
3. Define voltage, current, and resistance. ENRG-EPT-5.3
4. Calculate current, voltage, and resistance in a circuit by using Ohm's Law. ENRG-EPT-5.4
5. Define Kirchoff's Laws. ENRG-EPT-5.5

ENRG-EPT-6. **Describe the basic components of a small engine and explain the difference between a 4-cycle and 2-cycle engine.** ENRG-EPT-6

1. Describe the four-cycle engine operation and explain the purpose of each. ENRG-EPT-6.1
2. Explain valve timing and its parts. ENRG-EPT-6.2
3. Compare the lubrication system in a four-cycle engine to the system of a two-cycle engine. ENRG-EPT-6.3
4. Investigate the two-cycle engine operation and explain its principles. ENRG-EPT-6.4
5. Compare and contrast the advantages and disadvantages of two-cycle and four-cycle engines. ENRG-EPT-6.5
6. Disassemble and reassemble a basic small engine. ENRG-EPT-6.6

ENRG-EPT-7. **Demonstrate the importance of following safety practices for energy and power.** ENRG-EPT-7

1. Identify potential threats and consequences from deviation of safety procedures and improper use of tools. ENRG-EPT-7.1
2. 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. ENRG-EPT-7.2
3. Describe the processes and policies of companies to maintain personal safety equipment (PPE) to ensure working order. ENRG-EPT-7.3
4. Demonstrate through lab activities the use of tools and equipment in compliance with user manuals and safety training. ENRG-EPT-7.4
5. Describe the appropriate first aid practices and first response procedures for electrical and nonelectrical emergencies in the workplace including: cuts, insect stings, dog bites, broken bones, spinal injury, thermal burns, chemical burns, electric shock, shock, heart attack, stroke, and unconsciousness. ENRG-EPT-7.5

Appropriate and Alternative Energy Technologies (21.457)

ENRG-AAET-1. Demonstrate employability skills required by business and industry. ENRG-AAET-1

1. Communicate effectively through writing, speaking, listening, reading, and interpersonal abilities. ENRG-AAET-1.1
2. Demonstrate creativity by asking challenging questions and applying innovative procedures and methods. ENRG-AAET-1.2
3. Exhibit critical thinking and problem solving skills to locate, analyze and apply information in career planning and employment situations. ENRG-AAET-1.3
4. Model work readiness traits required for success in the workplace including integrity, honesty, accountability, punctuality, time management, and respect for diversity. ENRG-AAET-1.4
5. Apply the appropriate skill sets to be productive in a changing, technological, diverse workplace to be able to work independently and apply team work skills. ENRG-AAET-1.5
6. Present a professional image through appearance, behavior and language. ENRG-AAET-1.6

ENRG-AAET-2. Analyze current and potential careers in energy. ENRG-AAET-2

1. Analyze careers related to the development of innovative power, energy, and transportation technologies. ENRG-AAET-2.1
2. Predict which careers will be required in fifty years. ENRG-AAET-2.2
3. Identify education requirements for energy occupations and locations where programs of study are available. ENRG-AAET-2.3
4. Participate in activities related to energy occupations. ENRG-AAET-2.4
5. Explain how energy occupations relate to a green environment and sustainability. ENRG-AAET-2.5

ENRG-AAET-3. Understand the differences between nonrenewable and renewable types of energy sources and how each affects their world. ENRG-AAET-3

1. Research and create a project presenting non-renewable and renewable energy sources. ENRG-AAET-3.1
2. Categorize in a chart examples of nonrenewable and renewable energy sources. ENRG-AAET-3.2
3. Propose appropriate uses of each of these forms of energy in specific geographical locations through a written artifact. ENRG-AAET-3.3
4. Differentiate the positive and negative impacts of non-renewable and renewable energy sources on the global environment, society, and the individual through an oral presentation. ENRG-AAET-3.4

ENRG-AAET-4. **Define alternative energy and list several alternative sources and discuss the regional implications of each, including, but not limited to, economic, environmental, and sustainability issues.** ENRG-AAET-4

1. Explain the existing and future need to develop alternatives to fossil fuels as our primary source of energy. ENRG-AAET-4.1
2. State how renewable energy sources (wind, earth, oceans, biomass and waste) can be used to supply energy. ENRG-AAET-4.2
3. Discuss how alternative energies that utilize wind, earth, oceans, biomass, and waste were developed. ENRG-AAET-4.3
4. Compare and contrast various locations throughout the world which would be best suited for utilization of renewable energies as alternative energy sources. ENRG-AAET-4.4
5. Develop a spreadsheet that details the economic, environmental, and sustainability issues of at least five alternative energies in Georgia. ENRG-AAET-4.5

ENRG-AAET-5. **Define nuclear power and discuss it in terms of its positive and negative impacts and explain its relevancy to various situations in today's society.** ENRG-AAET-5

1. Define terms relating to nuclear energy, including but not limited to, the following: fission, fusion, reactor, Kyoto Protocol, control rod, half-life, uranium 235 and uranium 238, nucleus, proton, neutron, and radioactivity, hydrogen isotope deuterium. ENRG-AAET-5.1
2. Create and explain a flow chart that details the U.S. Nuclear Fuel Cycle. ENRG-AAET-5.2
3. Construct an outline that provides information regarding present and future uses of nuclear power in the world. ENRG-AAET-5.3
4. Conduct a research review and record data in a chart or table that compares the positive and negative impacts of nuclear power. ENRG-AAET-5.4
5. Create a letter that either supports or refutes the need for nuclear power in the student's community. ENRG-AAET-5.5

ENRG-AAET-6. **Discuss and provide research support for the future trends of energy and power and their impact on modes of transportation in developed and underdeveloped economies.** ENRG-AAET-6

1. Cite evidence on how power and transportation systems will be impacted by alternative energy sources. ENRG-AAET-6.1
2. Outline the relationship between present and future trends in terms of energy, power, and transportation systems and their environmental impact. ENRG-AAET-6.2
3. Research the impact of organizations committed to the development of new sources of energy, power, and transportation. ENRG-AAET-6.3
4. Explain future land, water, air, and space transportation technologies with a project. ENRG-AAET-6.4
5. Define nanotechnology and summarize its implications in relationship to the future of energy, power, and transportation technology. ENRG-AAET-6.5

ENRG-AAET-7. **Create a culminating project that demonstrates an understanding of alternative energy systems by incorporating a unique, as well as appropriate, approach to energy generation.** ENRG-AAET-7

1. Develop through research, an original paper that lists innovative alternative energies. ENRG-AAET-7.1
2. Design a system, either via computer model or prototype, which will produce power for a specific need. ENRG-AAET-7.2
3. Apply concepts and submit engineering documentation such as but not limited to, daily journal, spreadsheet, images, and calculations that show the development of this product. ENRG-AAET-7.3
4. Document the need for this product within the community. ENRG-AAET-7.4
5. Synthesize data and computer model or prototype to a group of peers and/or school staff/community members. ENRG-AAET-7.5

Foundations of Energy Technologies (49.537)

ENGR-FET-1. Demonstrate employability skills required by business and industry. ENGR-FET-1

1. Communicate effectively through writing, speaking, listening, reading, and interpersonal abilities. ENGR-FET-1.1
2. Demonstrate creativity by asking challenging questions and applying innovative procedures and methods ENGR-FET-1.2
3. Exhibit critical thinking and problem solving skills to locate, analyze and apply information in career planning and employment situations. ENGR-FET-1.3
4. Model work readiness traits required for success in the workplace including integrity, honesty, accountability, punctuality, time management and respect for diversity. ENGR-FET-1.4
5. Apply the appropriate skills sets to be productive in a changing, technological, diverse workplace to be able to work independently and apply teamwork skills. ENGR-FET-1.5
6. Present a professional image through appearance, behavior and language. ENGR-FET-1.6

ENGR-FET-2. Students will determine and analyze the relationships between energy, work, power, and force. ENGR-FET-2

ENGR-FET-2a. Define terms that describe the use and measurement of energy. ENGR-FET-2A

ENGR-FET-2b. State and explain the significance of Newton's Law. ENGR-FET-2B

ENGR-FET-2c. Describe how energy is measured and determine the amount of work that can be accomplished with that particular energy in a given situation. ENGR-FET-2C

ENGR-FET-2d. Outline the difference between energy and power. ENGR-FET-2D

ENGR-FET-2e. Identify the three common forms of power. ENGR-FET-2E

ENGR-FET-3. **Students will identify the six simple machines and explain how each machine changes the value for force and distance during work.** ENGR-FET-3

- ENGR-FET-3a. Identify the six simple machines. ENGR-FET-3A
- ENGR-FET-3b. Describe what is meant by mechanical advantage and explain how it is determined by using force and distance in the work equation. ENGR-FET-3B
- ENGR-FET-3c. Identify two ways of determining the mechanical advantage of a machine. ENGR-FET-3C
- ENGR-FET-3d. Solve problems involving simple machines, input and output forces, and mechanical advantage. ENGR-FET-3D
- ENGR-FET-3e. Describe the relationship of force and speed when either is changed by the advantage of a mechanical device. ENGR-FET-3E

ENGR-FET-4. **Students will differentiate between fluid power systems and apply the laws that govern.** ENGR-FET-4

- ENGR-FET-4a. Apply characteristics of Boyle's Law, Charles Law, and Archimedes principle. ENGR-FET-4A
- ENGR-FET-4b. Explain what is meant by fluid power. ENGR-FET-4B
- ENGR-FET-4c. Explain how the volume of a gas varies with the changes in pressure and temperature. ENGR-FET-4C
- ENGR-FET-4d. Describe how a fluid is able to transfer force as well as change the relationship between force and distance or speed. ENGR-FET-4D
- ENGR-FET-4e. Solve mathematical problems involving changes in pressure, temperature, and volume in fluid power systems. ENGR-FET-4E

ENGR-FET-5. **Students will differentiate between AC and DC circuits and apply Ohm's Law to Series, Parallel, and Series/Parallel circuits as well as discuss Kirchhoff's Law.** ENGR-FET-5

- ENGR-FET-5a. Differentiate between accelerating current and direct current. ENGR-FET-5A
- ENGR-FET-5b. Explain differences between series, parallel, and series/parallel circuits. ENGR-FET-5B
- ENGR-FET-5c. Define voltage, current, and resistance. ENGR-FET-5C
- ENGR-FET-5d. Calculate current, voltage, and resistance in a circuit by using Ohm's Law. ENGR-FET-5D
- ENGR-FET-5e. Recognize and apply when Kirchhoff's Law is demonstrated. ENGR-FET-5E

ENGR-FET-6. **Students will describe and demonstrate the basic components of a small engine and explain the difference between a four-stroke and a two-stroke engine.** ENGR-FET-6

- ENGR-FET-6a. Describe the four-stroke engine operation and explain the purpose of each stroke. ENGR-FET-6A
- ENGR-FET-6b. Explain the concept of valve timing. ENGR-FET-6B
- ENGR-FET-6c. Compare the lubrication system in a four-cycle engine to the system of a two-cycle engine. ENGR-FET-6C
- ENGR-FET-6d. Describe the two-stroke engine operation and explain the principles of two-cycle operation. ENGR-FET-6D
- ENGR-FET-6e. List the advantages and disadvantages of two-cycle and four-cycle engines. ENGR-FET-6E
- ENGR-FET-6f. Disassemble and reassemble a basic small engine. ENGR-FET-6F

ENGR-FET-7. **Identify and describe careers and the entry requirements for occupations in the Energy industry.** ENGR-FET-7

- ENGR-FET-7a. Describe entry-level careers available in energy generation, transmission, distribution and the education/experience requirements for entry into those positions, along with career development and advancement opportunities from those positions. ENGR-FET-7A
- ENGR-FET-7b. Identify entry-level careers available in business and corporate support functions of the energy industry; describe the education/experience requirements for entry into those positions, and career advancement opportunities from those positions. ENGR-FET-7B
- ENGR-FET-7c. Describe general wage/salary, benefits, and other advantages of careers in the energy industry. ENGR-FET-7C
- ENGR-FET-7d. Explain the educational pathways available to gain training necessary for entry into energy careers at the post-secondary level. ENGR-FET-7D

ENGR-FET-8. Students explore how related career and technology student organizations are integral parts of career and technology education courses. Students will develop leadership, interpersonal, and problem-solving skills through participation in co-curricular activities associated with the Technology Student Association. ENGR-FET-8

ENGR-FET-8a. Explain the goals, mission and objectives of CTSO organizations. ENGR-FET-8A

ENGR-FET-8b. Explore the impact and opportunities a student organization (TSA) can develop to bring business and education together in a positive working relationship through innovative leadership and career development programs. ENGR-FET-8B

ENGR-FET-8c. Explore the local, state and national opportunities available to students through participation in related student organization (TSA) including but not limited to conferences, competitions, community service, philanthropy, and other TSA activities. ENGR-FET-8C

ENGR-FET-8d. Explain how participation in career and technology education student organizations can promote lifelong responsibility for community service, professional development. ENGR-FET-8D

ENGR-FET-8e. Demonstrate teamwork, leadership, interpersonal relations, and project management. ENGR-FET-8E

ENGR-FET-8f. Through teamwork, apply the skills and abilities in requirements analysis and configuration control while working with plans, processes, and projects as assigned. ENGR-FET-8F

ENGR-FET-8g. Through teamwork, use the skills required in project management to track and assess the progress of a plan, process, or project as assigned. ENGR-FET-8G

ENGR-FET-8h. Through teamwork, apply the skills in quality assurance as well as those in process management and development for appropriate applications of systems integration techniques to an assigned project. ENGR-FET-8H

ENGR-FET-8i. Effectively use project management techniques (e.g. teamwork, appropriate time management practices, effective organizational skills, conduct analysis of cost, resources, and production capacity, and quality practices with continuous improvement). ENGR-FET-8I

ENGR-FET-8j. Understand and demonstrate proper work ethics when working with plans, processes, and projects as assigned. ENGR-FET-8J

Energy and Power: Generation, Transmission, Distribution (49.538)

ENRG-EPGTD-1. Demonstrate employability skills required by business and industry. ENRG-EPGTD-1

1. Communicate effectively through writing, speaking, listening, reading, and interpersonal abilities. ENRG-EPGTD-1.1
2. Demonstrate creativity by asking challenging questions and applying innovative procedures and methods. ENRG-EPGTD-1.2
3. Exhibit critical thinking and problem solving skills to locate, analyze and apply information in career planning and employment situations. ENRG-EPGTD-1.3
4. Model work readiness traits required for success in the workplace including integrity, honesty, accountability, punctuality, time management, and respect for diversity. ENRG-EPGTD-1.4
5. Apply the appropriate skill sets to be productive in a changing, technological, diverse workplace to be able to work independently and apply team work skills. ENRG-EPGTD-1.5
6. Present a professional image through appearance, behavior and language. ENRG-EPGTD-1.6

ENRG-EPGTD-2. Students will describe the history of the energy industry. ENRG-EPGTD-2

ENRG-EPGTD-2a. Describe the history of the United States energy industry/infrastructures. ENRG-EPGTD-2A

ENRG-EPGTD-2b. Identify the various laws and regulations that impact the energy industry. ENRG-EPGTD-2B

ENRG-EPGTD-2c. Explain the role of regulatory bodies in the energy and power industry. ENRG-EPGTD-2C

ENRG-EPGTD-2d. Explain the elements of the Clean Air Act of 1970 and 1990 and regulations necessary to protect the environment. ENRG-EPGTD-2D

ENRG-EPGTD-3. Students will analyze the differing processes of generation and distribution of power and energy. ENRG-EPGTD-3

ENRG-EPGTD-3a. Explain the flow of power and energy from generation through distribution. ENRG-EPGTD-3A

ENRG-EPGTD-3b. Explain the parts of an electric power system and its interrelations. ENRG-EPGTD-3B

ENRG-EPGTD-3c. Compare the different mechanisms of energy generation and its advantages. ENRG-EPGTD-3C

ENRG-EPGTD-3d. Contrast different forms of energy distribution and its advantages. ENRG-EPGTD-3D

ENRG-EPGTD-4. **Students will explain the differences between nonrenewable, renewable, and inexhaustible types of energy sources and their impact regionally and globally.** ENRG-EPGTD-4

- ENRG-EPGTD-4a. Define nonrenewable, renewable, and inexhaustible energy sources. ENRG-EPGTD-4A
- ENRG-EPGTD-4b. Provide examples of nonrenewable, renewable, and inexhaustible energy sources. ENRG-EPGTD-4B
- ENRG-EPGTD-4c. List appropriate uses of each of these forms of energy in specific geographical locations. ENRG-EPGTD-4C
- ENRG-EPGTD-4d. Detail the positive and negative impacts of nonrenewable, renewable, and inexhaustible energy sources on the global environment, society, and the individual. ENRG-EPGTD-4D

ENRG-EPGTD-5. **Students will define alternative power and energy and list several alternative sources as well as discuss the regional implications of each, including, but not limited to, economic, environmental, and sustainability issues.** ENRG-EPGTD-5

- ENRG-EPGTD-5a. Explain the existing and future needs to develop alternatives to fossil fuels as our primary source of energy. ENRG-EPGTD-5A
- ENRG-EPGTD-5b. State how the wind, the earth, oceans, and waste (biomass) products can be used to supply energy. ENRG-EPGTD-5B
- ENRG-EPGTD-5c. Discuss how alternative energies that utilize the wind, the earth, the oceans, and waste (biomass) were developed. ENRG-EPGTD-5C
- ENRG-EPGTD-5d. Compare and contrast various locations throughout the world that would be best suited for utilization of the wind, the earth, the oceans, and waste as alternative energy sources. ENRG-EPGTD-5D
- ENRG-EPGTD-5e. Develop a spreadsheet that details the economic, environmental, and sustainability issues of at least five alternative energies. ENRG-EPGTD-5E

ENRG-EPGTD-6. **Students will discuss the future trends of power and energy.** ENRG-EPGTD-6

- ENRG-EPGTD-6a. Define energy, power, and transportation systems. ENRG-EPGTD-6A
- ENRG-EPGTD-6b. Outline the relationship between present and future trends in terms of energy, power, and transportation systems. ENRG-EPGTD-6B
- ENRG-EPGTD-6c. List current organizations committed to the development of new sources of energy, power, and transportation. ENRG-EPGTD-6C
- ENRG-EPGTD-6d. Define nanotechnology and state the implications in relationship to the future of energy, power, and transportation technology. ENRG-EPGTD-6D
- ENRG-EPGTD-6e. Identify careers related to the development of innovative power, energy, and transportation technologies. ENRG-EPGTD-6E

ENRG-EPGTD-7. **Students will develop, through research, an alternative energy system that demonstrates their understanding of a unique, as well as an appropriate, approach to energy and power generation.** ENRG-EPGTD-7

- ENRG-EPGTD-7a. Provide a research paper that lists innovative alternative energies. ENRG-EPGTD-7A
- ENRG-EPGTD-7b. Design a system, either via computer model or prototype, which will produce power for a specific need. ENRG-EPGTD-7B
- ENRG-EPGTD-7c. Submit an engineering notebook which includes a daily journal, spreadsheet, and photos that show the development of this product. ENRG-EPGTD-7C
- ENRG-EPGTD-7d. Document the need for this product within the community. ENRG-EPGTD-7D
- ENRG-EPGTD-7e. Present data and prototype, or computer model, to a group of peers and/or school staff/community members. ENRG-EPGTD-7E

ENRG-EPGTD-8. Students explore how related career and technology student organizations are integral parts of career and technology education courses. Students will develop leadership, interpersonal, and problem-solving skills through participation in co-curricular activities associated with the Technology Student Association. ENRG-EPGTD-8

ENRG-EPGTD-8a. Explain the goals, mission and objectives of CTSO organizations. ENRG-EPGTD-8A

ENRG-EPGTD-8b. Explore the impact and opportunities a student organization (TSA) can develop to bring business and education together in a positive working relationship through innovative leadership and career development programs. ENRG-EPGTD-8B

ENRG-EPGTD-8c. Explore the local, state, and national opportunities available to students through participation in related student organization (TSA) including but not limited to conferences, competitions, community service, philanthropy, and other (TSA) activities. ENRG-EPGTD-8C

ENRG-EPGTD-8d. Explain how participation in career and technology education student organizations can promote lifelong responsibility for community service and professional development. ENRG-EPGTD-8D

ENRG-EPGTD-8e. Demonstrate teamwork, leadership, interpersonal relations, and project management. ENRG-EPGTD-8E

ENRG-EPGTD-8f. Through teamwork, apply the skills and abilities in requirements analysis and configuration control while working with plans, processes, and projects as assigned. ENRG-EPGTD-8F

ENRG-EPGTD-8g. Through teamwork, use the skills required in project management to track and assess the progress of a plan, process, or project as assigned. ENRG-EPGTD-8G

ENRG-EPGTD-8h. Through teamwork, apply the skills in quality assurance as well as those in process management and development for appropriate applications of systems integration techniques to an assigned project 8i. Effectively use project management techniques (e.g., teamwork, appropriate time management practices, effective organizational skills, conduct analysis of cost, resources, and production capacity, and quality practices with continuous improvement). ENRG-EPGTD-8H

ENRG-EPGTD-8j. Understand and demonstrate proper work ethics when working with plans, processes, and projects as assigned. ENRG-EPGTD-8J

Energy Systems Applications (49.539)

ENGR-ESA-1. Demonstrate employability skills required by business and industry. ENGR-ESA-1

1. Communicate effectively through writing, speaking, listening, reading, and interpersonal abilities. ENGR-ESA-1.1
2. Demonstrate creativity by asking challenging questions and applying innovative procedures and methods. ENGR-ESA-1.2
3. Exhibit critical thinking and problem solving skills to locate, analyze and apply information in career planning and employment situations. ENGR-ESA-1.3
4. Model work readiness traits required for success in the workplace including integrity, honesty, accountability, punctuality, time management, and respect for diversity. ENGR-ESA-1.4
5. Apply the appropriate skill sets to be productive in a changing, technological, diverse workplace to be able to work independently and apply teamwork skills. ENGR-ESA-1.5
6. Present a professional image through appearance, behavior and language. ENGR-ESA-1.6

ENGR-ESA-2. Students will identify electric power generation equipment and systems. ENGR-ESA-2

1. Describe the major parts of an electric energy generation and conversion system. ENGR-ESA-2.1
2. Describe the major parts of an electric energy generation and conversion system. ENGR-ESA-2.2
3. Demonstrate knowledge of how power generation equipment and systems work including: a boiler, superheater, turbine, and a reheater by creating a diagramed image. ENGR-ESA-2.3

ENGR-ESA-3. Students will explain the conventional electric power generation systems and process (coal, gas, hydroelectric, and nuclear). ENGR-ESA-3

1. Compare and contrast the process of the formation of oil, coal, and natural gas. ENGR-ESA-3.1
2. Describe the advantages or disadvantages of using oil, coal, or natural gas in the process of generating electricity ENGR-ESA-3.2
3. Explain the process of generating hydroelectric electricity and describe its advantages or disadvantages over other forms for generating electricity. ENGR-ESA-3.3

ENGR-ESA-4. **Students will define nuclear power and discuss in terms of positive and negative impacts, as well as relevance to various situations in today's society.** ENGR-ESA-4

1. 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. ENGR-ESA-4.1
2. Discuss supply and demand for nuclear power. ENGR-ESA-4.2
3. Create a technical report that includes international use, restrictions, and regulations of nuclear power including inequities of regulations and policies throughout the world. ENGR-ESA-4.3
4. Develop an outline that provides information regarding present and future uses of nuclear power in the world. ENGR-ESA-4.4

ENGR-ESA-5. **Students will explain how nuclear power is generated.** ENGR-ESA-5

1. Explain how nuclear power is created and how the atom uranium is utilized. ENGR-ESA-5.1
2. Create a flow chart that details the Nuclear Fuel Cycle. ENGR-ESA-5.2
3. Compare and contrast the two types of nuclear power reactors used in the United States including Boiling Water Reactors and Pressurized Water Reactors. ENGR-ESA-5.3
4. Explain the U.S. Nuclear Regulatory Commission (NRC) safeguards and regulations including inspection, performance assessment and enforcement, and operational experience evaluation. ENGR-ESA-5.4

ENGR-ESA-6. **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.** ENGR-ESA-6

1. Explain how solar, wind, biomass, and wave energy are used to produce electricity and steam. ENGR-ESA-6.1
2. Compare and contrast the advantages and disadvantages of solar, wind, biomass, and wave energy. ENGR-ESA-6.2

ENGR-ESA-7. **Students will explain the conditions necessary to build a functional electric power distribution and transmission grid.** ENGR-ESA-7

1. Compare and contrast the electric power transmission and distribution. ENGR-ESA-7.1
2. Discuss the application of different electric power transmission principles (including AC vs. DC). ENGR-ESA-7.2
3. Describe electric power transmission equipment and systems and how each element functions together to transfer power. ENGR-ESA-7.3
4. Discuss the implications (economical, environmental, and social) of emerging technologies in electric power transmission and distribution (including the Smart Grid). ENGR-ESA-7.4
5. Discuss the need for electric distribution systems and how they are designed to operate. ENGR-ESA-7.5
6. Describe different electric power distribution systems and compare their advantages as it relates to implementation (i.e. substations, distribution feeder circuits, switches, primary circuits, secondary circuits, and services). ENGR-ESA-7.6

ENGR-ESA-8. **Students will explain the transmission and distribution of natural gas.** ENGR-ESA-8

1. Explain the natural gas transmission and distribution process. ENGR-ESA-8.1
2. Describe how the parts of a natural gas distribution system relate to each other and to the operation of the system as a whole. ENGR-ESA-8.2
3. Discuss the emerging technologies in natural gas distribution; compare the advantages and disadvantages respect to each other and their (economical, environmental, and social) impact. ENGR-ESA-8.3

ENGR-ESA-9. **Students will explain the different processes used to conserve energy resources and increase efficient distribution and use.** ENGR-ESA-9

1. Define energy efficiency. ENGR-ESA-9.1
2. Explain how to reduce the carbon footprint by identifying energy conservation techniques. ENGR-ESA-9.2
3. Examine different systems of energy distribution relating to its implication in energy conservation with both residential and commercial settings energy use. ENGR-ESA-9.3

ENGR-ESA-10. **Students will explain the ownership of the transmission and distribution systems.** ENGR-ESA-10

1. Compare and contrast the types of ownership including: fully-integrated investorowned utilities, transmission/distribution owners, transmission owners, distribution owners, and miscellaneous owners. ENGR-ESA-10.1
2. Discuss the application of current state, city, or local community regulations that guide energy usage. ENGR-ESA-10.2

ENGR-ESA-11. **Students will understand and be able to implement safety practices and procedures within the energy industry.** ENGR-ESA-11

1. Describe the roles of federal, state, and local agencies in workplace safety and health ENGR-ESA-11.1
2. Explain the importance of compliance with standards, regulations, and established procedures to ensure safe and healthful work environment. ENGR-ESA-11.2
3. 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. ENGR-ESA-11.3
4. Demonstrate through lab activities basic procedural guidelines that promote safe and effective operations for the protection of people, data, property, and institutions. ENGR-ESA-11.4
5. Explain the roles and responsibilities of employers, employees, and the general public in creating and maintaining workplace, personal, and community safety cultures. ENGR-ESA-11.5

ENGR-ESA-12. **Students will demonstrate the importance of following safety practices for utility workers.** ENGR-ESA-12

1. Identify potential threats and consequences from deviation of safety procedures and improper use of tools. ENGR-ESA-12.1
2. 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. ENGR-ESA-12.2
3. Describe the processes and policies of companies to maintain personal safety equipment (PPE) to ensure working order. ENGR-ESA-12.3
4. Demonstrate through lab activities the use tools and equipment in compliance with user manuals and safety training. ENGR-ESA-12.4
5. Describe the appropriate first aid practices and first response procedures for electrical and non-electrical 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. ENGR-ESA-12.5

ENGR-ESA-13. **Students will demonstrate knowledge of the basic and emerging principles and concepts that impact the energy industry.** ENGR-ESA-13

1. Explain the flow of energy from generation through distribution to the customer. ENGR-ESA-13.1
2. Identify the role and function of generation, transmission and distribution organizations. ENGR-ESA-13.2
3. Explain the role of regulatory bodies in the energy industry ENGR-ESA-13.3
4. Discuss environmental laws and regulations that impact the energy industry and explain importance of proper documentation to ensure compliance. ENGR-ESA-13.4
5. Explain the different structures of energy companies, including investor-owned utilities, municipalities, electric cooperatives, independent power producers and can explain the different lines of energy business, including electric and gas. ENGR-ESA-13.5
6. Describe the process of electric metering and billing for energy consumption. ENGR-ESA-13.6
7. Discuss the importance and role of unions in the industry. ENGR-ESA-13.7

ENGR-ESA-14. Students explore how related career and technology student organizations are integral parts of career and technology education courses. Students will develop leadership, interpersonal, and problem-solving skills through participation in co-curricular activities associated with the Technology Student Association. ENGR-ESA-14

1. Explain the goals, mission and objectives of CTSO organizations. ENGR-ESA-14.1
2. Explore the impact and opportunities a student organization (TSA) can develop to bring business and education together in a positive working relationship through innovative leadership and career development programs. ENGR-ESA-14.2
3. Explore the local, state, and national opportunities available to students through participation in related student organization (TSA) including but not limited to conferences, competitions, community service, philanthropy, and other (TSA) activities. ENGR-ESA-14.3
4. Explain how participation in career and technology education student organizations can promote lifelong responsibility for community service and professional development. ENGR-ESA-14.4
5. Demonstrate teamwork, leadership, interpersonal relations, and project management. ENGR-ESA-14.5
6. Through teamwork, apply the skills and abilities in requirements analysis and configuration control while working with plans, processes, and projects as assigned. ENGR-ESA-14.6
7. Through teamwork, use the skills required in project management to track and assess the progress of a plan, process, or project as assigned. ENGR-ESA-14.7
8. Through teamwork, apply the skills in quality assurance as well as those in process management and development for appropriate applications of systems integration techniques to an assigned project ENGR-ESA-14.8
9. Effectively use project management techniques (e.g., teamwork, appropriate time management practices, effective organizational skills, conduct analysis of cost, resources, and production capacity, and quality practices with continuous improvement). ENGR-ESA-14.9
10. Understand and demonstrate proper work ethics when working with plans, processes, and projects as assigned. ENGR-ESA-14.10