Georgia CTAE

Manufacturing (2021)

Adopted 2021

Foundations of Engineering and Technology (21.425)

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

1. Communicate effectively through writing, speaking, listening, reading, and interpersonal abilities. STEM-FET-1.1
2. Demonstrate creativity by asking challenging questions and applying innovative procedures and methods. STEM-FET-1.2
3. Exhibit critical thinking and problem solving skills to locate, analyze and apply information in career planning and employment situations. STEM-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. STEM-FET-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. STEM-FET-1.5
6. Present a professional image through appearance, behavior and language. STEM-FET-1.6

STEM-FET-2. Develop an understanding of engineering and technology and describe the principal fields of engineering specializations (ex. aeronautical, automotive, chemical, civil, industrial, mechanical, computer software, electrical, and biomedical) and identify associated career tracks. STEM-FET-2

1. Explain a contemporary definition of engineering. STEM-FET-2.1
2. Identify education requirements for engineering occupations and locations where programs of study are available. STEM-FET-2.2
3. Match engineering job titles with qualifications and responsibilities. STEM-FET-2.3
4. Participate in activities related to career interests. STEM-FET-2.4
5. Explain how each engineering discipline will relate to a green environment and sustainability. STEM-FET-2.5

STEM-FET-3. **Identify the history of technology and engineering and its impact on society in the past, present, and future.** STEM-FET-3

1. Describe the history and development of engineering. STEM-FET-3.1
2. Describe the social, economic, and environmental impacts of a technological process, product, or system. STEM-FET-3.2
3. Explain the influence of technology on history and the shaping of contemporary issues. STEM-FET-3.3
4. Describe the relationship between the STEM cluster and society. STEM-FET-3.4
5. Evaluate the impact of science and society based on products and processes used in the real world for technological development. STEM-FET-3.5
6. Understand STEM knowledge and skills to analyze and suggest solutions to human societal problems. STEM-FET-3.6
7. Apply STEM knowledge and skills through hands-on research and lab experiments that are focused upon recreating the inventions and social solutions that were realized in the past, present, and possible future. STEM-FET-3.7
8. Identify key people who have influenced technological change. STEM-FET-3.8
9. Describe the impact of governmental and political systems on technological innovations. STEM-FET-3.9
10. Demonstrate ethical and professional engineering behavior in the development and use of technology. STEM-FET-3.10

STEM-FET-4. **Demonstrate and follow safety, health, and environmental standards related to the Science, Technology, Engineering, and Math (STEM) workplaces.** STEM-FET-4

1. Implement workplace and product safety standards such as OSHA, EPA, ISO, GMP, and UL. (STEM-ST3). STEM-FET-4.1
2. Accurately interpret safety signs, symbols, and labels (Hazardous Communications). STEM-FET-4.2
3. Demonstrate and incorporate safe laboratory procedures in lab, shop, and field environments. STEM-FET-4.3
4. Explain how the incorporation or lack of safety practices impact the economy and costs of safety in business and industry. STEM-FET-4.4
5. Identify, select, and use appropriate Personal Protective Equipment (PPE), follow work area organization procedures and follow Standard Operating Procedures (SOP) when performing work. STEM-FET-4.5

STEM-FET-5. Identify criteria of usage, care, and maintenance for tools and machines. STEM-FET-5

1. Identify, select, and use appropriate tools and machines for specific tasks. STEM-FET-5.1
2. Demonstrate safe use of tools and machines. STEM-FET-5.2
3. Use precision tools and instruments to measure and convert units. STEM-FET-5.3
4. Utilize appropriate computer hardware and software to compose, analyze and synthesize data to document the design process. STEM-FET-5.4
5. Apply proper maintenance techniques for tools, machines, and hardware. STEM-FET-5.5

STEM-FET-6. Apply fundamental principles of the engineering design process. STEM-FET-6

1. Understand and apply the engineering design process through project based learning activities. STEM-FET-6.1
2. Conduct technical research to develop possible solutions to a stated engineering problem. STEM-FET-6.2
3. Refine a design by using technical sketches, prototypes and modeling to ensure quality, efficiency, and productivity of the final product. STEM-FET-6.3
4. Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process (optimization and iterations) in order to check for proper design and note areas where improvements are needed. STEM-FET-6.4
5. Apply engineering economics and optimal design techniques to a design solution. STEM-FET-6.5
6. Record and organize observations and test data during design evaluation. STEM-FET-6.6
7. Finalize solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, qualitative, virtual, and physical means. STEM-FET-6.7

STEM-FET-7. **Use appropriate technology to collect, record, manipulate, analyze, and report data.** STEM-FET-7

1. Demonstrate the ability to recognize cause and effect when faced with projects or issues. STEM-FET-7.1
2. Recognize measurable attributes in units, objects, systems, and processes in assigned activities. STEM-FET-7.2
3. Organize data and the consequences of the problems or issues, and research the material placing it in manageable formats. STEM-FET-7.3
4. Attempt to predict the outcomes based on data collected in a project or experiment. STEM-FET-7.4
5. Defend one's position based on quality collection of facts and data supporting plans, processes, and/or projects. STEM-FET-7.5
6. Draw a conclusion when confronted with data or observations that focus on the observed plans, processes, or projects at hand. STEM-FET-7.6
7. Analyze change as a result of data differences and changing environmental values. STEM-FET-7.7
8. Use qualitative and quantitative skills to conduct a simple scientific inquiry and economic analysis; use the data to draw a conclusion based on the analysis. STEM-FET-7.8
9. Recognize the value of the reiterative process to improve date and to improve the design process. STEM-FET-7.9

Foundation of Electronics (21.452)

STEM-FE-1. **Demonstrate employability skills required by business and industry.** STEM-FE-1

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

STEM-FE-2. **Develop an understanding of engineering and electronics and describe the principal fields of engineering and electronic specializations (ex. aeronautical, automotive, chemical, civil, industrial, and mechanical, computer software, electrical, and biomedical) and identify associated career tracks.** STEM-FE-2

1. Explain a contemporary definition of engineering and electronics. STEM-FE-2.1
2. Identify education requirements for engineering and electronics occupations and locations where programs of study are available. STEM-FE-2.2
3. Match engineering and electronics job titles with qualifications and responsibilities. STEM-FE-2.3
4. Participate in activities related to career interests. STEM-FE-2.4
5. Explain how each engineering and electronic discipline will relate to a green environment and sustainability. STEM-FE-2.5

STEM-FE-3. **Describe and follow safety, health and environmental standards related to Science, Technology, Engineering, and Math (STEM) workplaces.** STEM-FE-3

1. Implement workplace and product safety standards such as OSHA, EPA, ISO, GMP, and UL. (STEM-ST3). STEM-FE-3.1
2. Accurately interpret safety signs, symbols, and labels (Hazardous Communications). STEM-FE-3.2
3. Demonstrate and incorporate safe laboratory procedures in lab, shop, and field environments. STEM-FE-3.3
4. Explain how the incorporation or lack of safety practices impact the economy and costs of safety in business and industry. STEM-FE-3.4
5. Identify, select, and use appropriate Personal Protective Equipment (PPE), follow work area organization procedures and follow Standard Operating Procedures (SOP) when preforming work. STEM-FE-3.5

STEM-FE-4. Identify criteria of usage, care, and maintenance for tools and machines. STEM-FE-4

1. Identify, select and use appropriate tools and machines for specific tasks. STEM-FE-4.1
2. Demonstrate safe use of tools and machines. STEM-FE-4.2
3. Use precision tools and instruments to measure and convert units. STEM-FE-4.3
4. Utilize appropriate computer hardware and software to compose, analyze and synthesize data to document the design process. STEM-FE-4.4
5. Apply proper maintenance techniques for tools, machines, and hardware. STEM-FE-4.5

STEM-FE-5. Introduce the history and development of electron theory. STEM-FE-5

1. Discuss the history of electron theory. STEM-FE-5.1
2. Identify the atom: protons, neutrons, and electrons. STEM-FE-5.2
3. Identify material conductivity/insulators. STEM-FE-5.3

STEM-FE-6. Identify electronic theories applicable to electronic processes. STEM-FE-6

1. Define Ohm's law and formula component parts. STEM-FE-6.1
2. Define Kirchoff's law and component parts. STEM-FE-6.2
3. Define Watt's law and component parts. STEM-FE-6.3
4. Design and analyze a simple circuit to determine the values of the various electronic component parts. STEM-FE-6.4
5. Demonstrate the use of metric prefixes and value conversions. STEM-FE-6.5

STEM-FE-7. Introduce electronic components that comprise an electronic system. STEM-FE-7

1. Identify Resistor Color Code and component polarity. STEM-FE-7.1
2. Identify and describe various resistors, capacitors, transistors, coils, semiconductors, etc. STEM-FE-7.2
3. Discuss circuit design and construction. STEM-FE-7.3
4. Develop and evaluate a prototype device. STEM-FE-7.4

STEM-FE-8. **Introduce the techniques and processes in electronics systems.** STEM-FE-8

1. Explain and demonstrate basic soldering techniques. STEM-FE-8.1
2. Explain procedures for connecting circuit components. STEM-FE-8.2
3. Conduct laboratory experiments utilizing appropriate soldering techniques. STEM-FE-8.3
4. Evaluate prototype produced. STEM-FE-8.4

STEM-FE-9. **Understand the various measuring apparatuses appropriate to electronics systems.** STEM-FE-9

1. Identify and demonstrate proper use of a multi-meter. STEM-FE-9.1
2. Identify and demonstrate proper use of an oscilloscope. STEM-FE-9.2
3. Discuss virtual computer simulation testing and how it is used in electronics. STEM-FE-9.3
4. Construct a continuity prototype device. STEM-FE-9.4

STEM-FE-10. **Use appropriate technology to collect, record, manipulate, analyze, and report data.** STEM-FE-10

1. Demonstrate the ability to recognize cause and effect when faced with projects or issues. STEM-FE-10.1
2. Recognize measurable attributes in units, objects, systems, and processes in assigned activities. STEM-FE-10.2
3. Organize data and the consequences of the problems or issues, and research the material placing it in manageable formats. STEM-FE-10.3
4. Attempt to predict the outcomes based on data collected in a project or experiment. STEM-FE-10.4
5. Defend one's position based on quality collection of facts and data supporting plans, processes, and/or projects. STEM-FE-10.5
6. Draw a conclusion when confronted with data or observations that focus on the observed plans, processes, or projects at hand. STEM-FE-10.6
7. Analyze change as a result of data differences and changing environmental values. STEM-FE-10.7
8. Use qualitative and quantitative skills to conduct a simple scientific inquiry and economic analysis; use the data to draw a conclusion based on the analysis. STEM-FE-10.8
9. Recognize the value of the reiterative process to improve data and to improve the design process. STEM-FE-10.9

STEM-FE-11. **Design a solution to an engineering and electronics problem applying math and science principles.** STEM-FE-11

1. Apply science and mathematics concepts and principles to resolve plans, projects, processes, issues, or problems through methods of inquiry. STEM-FE-11.1
2. Use the protocols in science and mathematics to integrate solutions related to technical, electronic, or engineering activities using the content and concepts related to the situation or problems. STEM-FE-11.2
3. Explain the role of modeling and/or simulation in electricity and electronics. STEM-FE-11.3
4. Communicate and collaborate with others on inquiry or resolution of issues/problems in the global community. STEM-FE-11.4
5. Defend one's solution based on quality collection of facts and data supporting plans, processes, and/or projects and communicate the solution both orally and written. STEM-FE-11.5

STEM-FE-12. **Construct an electronic device as a culminating experience.** STEM-FE-12

1. Construct Series, Parallel and Series/Parallel circuits. STEM-FE-12.1
2. Simulate test circuits utilizing electronic software. STEM-FE-12.2
3. Design, construct, and test an electronic device from component parts. STEM-FE-12.3

STEM-FE-13. 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. STEM-FE-13

1. Explain the goals, mission and objectives of CTSO's. STEM-FE-13.1
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. STEM-FE-13.2
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. STEM-FE-13.3
4. Explain how participation in career and technology education student organizations can promote lifelong responsibility for community service and professional development. STEM-FE-13.4
5. Demonstrate teamwork, leadership, interpersonal relations, and project management. STEM-FE-13.5
6. Through teamwork, apply the skills and abilities in requirements analysis and configuration control while working with plans, processes, and projects as assigned. STEM-FE-13.6
7. Through teamwork, use the skills required in project management to track and assess the progress of a plan, process, or project as assigned. STEM-FE-13.7
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. STEM-FE-13.8
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). STEM-FE-13.9
10. Understand and demonstrate proper work ethics when working with plans, processes, and projects as assigned. STEM-FE-13.10

Advanced AC and DC Circuits (21.453)

STEM-AACDCC-1. Demonstrate employability skills required by business and industry. STEM-AACDCC-1

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

STEM-AACDCC-2. Analyze fields of engineering and electronic specializations (i.e. aeronautical, automotive, chemical, civil, industrial, and mechanical, computer software, electrical, and biomedical) and identify associated career tracks. STEM-AACDCC-2

1. Design a project that conveys information about electronic specialization. STEM-AACDCC-2.1
2. Participate in activities related to career interests. STEM-AACDCC-2.2
3. Relate each engineering and electronic discipline to a green environment and sustainability situation STEM-AACDCC-2.3
4. Develop solutions to an ethical issue in engineering and electronic specialization. STEM-AACDCC-2.4
5. Analyze an ethical situation related to engineering graphics and engineering. STEM-AACDCC-2.5
6. Maintain a journal that relates standards in the course to the project work. STEM-AACDCC-2.6

STEM-AACDCC-3. **Describe and follow safety, health and environmental standards related to Science, Technology, Engineering and Math (STEM) workplaces.** STEM-AACDCC-3

1. Implement workplace and product safety standards such as Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA), International Organization for Standardization (ISO), Good Manufacturing Practice (GMP), and Underwriters (UL). STEM-AACDCC-3.1
2. Accurately interpret safety signs, symbols, and labels (Hazardous Communications). STEM-AACDCC-3.2
3. Demonstrate and incorporate safe laboratory procedures in lab, shop, and field environments. STEM-AACDCC-3.3
4. Explain how the incorporation or lack of safety [practices impact the economy and costs of safety in business and industry. STEM-AACDCC-3.4
5. Identify, select, and use appropriate Personal protective Equipment (PPE), follow work area organization procedures and follow Standard Operating Procedures (SOP) when performing work. STEM-AACDCC-3.5

STEM-AACDCC-4. **Investigate the history and development of analog circuits.** STEM-AACDCC-4

1. Discuss the history of analog circuits. STEM-AACDCC-4.1
2. Apply analog circuits. STEM-AACDCC-4.2
3. Identify and describe patterns of analog signals. STEM-AACDCC-4.3
4. Evaluate the advantages and disadvantages of analog signaling. STEM-AACDCC-4.4
5. Predict the future of analog electronics. STEM-AACDCC-4.5

STEM-AACDCC-5. **Research and present operational characteristics and applications of amplifiers.** STEM-AACDCC-5

1. Define and discuss power supplies. STEM-AACDCC-5.1
2. Technically sketch or draw and construct a power supply circuit STEM-AACDCC-5.2
3. Define and discuss the different types of transistors (Bipolar junction transistor or BJT and metal oxide semiconductor or MOS). STEM-AACDCC-5.3
4. Define and discuss different types of amplifiers (Class A, B, D amplifiers). STEM-AACDCC-5.4
5. Demonstrate negative feedback differential amplifiers. STEM-AACDCC-5.5
6. Conduct analysis and troubleshooting. STEM-AACDCC-5.6

STEM-AACDCC-6. Research and define oscillator characteristics and applications. STEM-AACDCC-6

1. Discuss the characteristics of oscillators related to positive feedback and unity gain. STEM-AACDCC-6.1
2. Define and discuss analog crystal oscillator circuits. STEM-AACDCC-6.2
3. Define and discuss digital oscillator circuits (comparators, latches). STEM-AACDCC-6.3
4. Conduct analysis and troubleshooting. STEM-AACDCC-6.4
5. Create a project to demonstrate knowledge of oscillator applications. STEM-AACDCC-6.5

STEM-AACDCC-7. Research and define operating characteristics and applications of communication circuits. STEM-AACDCC-7

1. Distinguish, contrast and compare analog and digital signals. STEM-AACDCC-7.1
2. Identify and describe modulation and demodulation. STEM-AACDCC-7.2
3. Demonstrate and apply simple receivers. STEM-AACDCC-7.3
4. Define and discuss super heterodyne receivers. STEM-AACDCC-7.4
5. Calculate frequency modulation and single sideband. STEM-AACDCC-7.5
6. Conduct receiver troubleshooting. STEM-AACDCC-7.6
7. Technically sketch or draw and then construct and predict results for communication circuits. STEM-AACDCC-7.7

STEM-AACDCC-8. Research and present characteristics and construction of integrated circuits. STEM-AACDCC-8

1. Recognize integrated circuits. STEM-AACDCC-8.1
2. Explain fabrication. STEM-AACDCC-8.2
3. Technically sketch or draw and then construct and critique the 555 timer. STEM-AACDCC-8.3
4. Estimate and measure to check outputs. STEM-AACDCC-8.4
5. Discuss additional integrated circuits. STEM-AACDCC-8.5
6. Model troubleshooting integrated circuits. STEM-AACDCC-8.6

STEM-AACDCC-9. **Research and present operational characteristics of electronic control devices and circuits.** STEM-AACDCC-9

1. Classify electronic control devices and circuits. STEM-AACDCC-9.1
2. Identify the silicon-controlled rectifier. STEM-AACDCC-9.2
3. Technically sketch or draw and construct full-wave devices. STEM-AACDCC-9.3
4. Calculate feedback in control devices. STEM-AACDCC-9.4
5. Identify and discuss three terminal regulators. STEM-AACDCC-9.5
6. Discuss regulated power supplies. STEM-AACDCC-9.6
7. Discuss and demonstrate troubleshooting of electronic control circuits. STEM-AACDCC-9.7

STEM-AACDCC-10. **Create a digital project that displays mastery of the standards involved with electronics.** STEM-AACDCC-10

1. Present the constructed projects from the standards in a digital portfolio through pictures, drawings, data and analysis. STEM-AACDCC-10.1
2. Make recommendations for improvements on each project based on experiences gained from the process. STEM-AACDCC-10.2

Digital Electronics (21.454)

STEM-DE-1. **Demonstrate employability skills required by business and industry.** STEM-DE-1

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

STEM-DE-2. **Analyze fields of engineering and electronic specializations (i.e. aeronautical, automotive, chemical, civil, industrial, and mechanical, computer software, electrical, and biomedical) and identify associated career tracks.** STEM-DE-2

1. Design a project that conveys information about electronic specialization. STEM-DE-2.1
2. Participate in activities related to career interests. STEM-DE-2.2
3. Relate each engineering and electronic discipline to a green environment and sustainability situation. STEM-DE-2.3
4. Develop solutions to an ethical issue in engineering and electronic specialization. STEM-DE-2.4

STEM-DE-3. **Describe and follow safety, health and environmental standards related to Science, Technology, Engineering and Math (STEM) workplaces 3.1 Implement workplace and product safety standards such as Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA), International Organization for Standardization (ISO), Good Manufacturing Practice (GMP), and Underwriters Laboratories (UL).** STEM-DE-3

2. Accurately interpret safety signs, symbols, and labels (Hazardous Communications). STEM-DE-3.2
3. Demonstrate and incorporate safe laboratory procedures in lab, shop, and field environments. STEM-DE-3.3
4. Explain how the incorporation or lack of safety [practices impact the economy and costs of safety in business and industry. STEM-DE-3.4
5. Identify, select, and use appropriate Personal protective Equipment (PPE), follow work area organization procedures and follow Standard Operating Procedures (SOP) when performing work. STEM-DE-3.5

STEM-DE-4. **Analyze characteristics of digital and analog systems.** STEM-DE-4

1. Differentiate between digital and analog systems through the use a visual meter (Oscilloscope). STEM-DE-4.1
2. Identify numbering systems used in digital electronics and calculate conversion between systems. STEM-DE-4.2
3. Apply Boolean concepts to simplification processes using DeMorgan laws for transformation or Karmaugh Maps (K Maps). STEM-DE-4.3

STEM-DE-5. Demonstrate knowledge of logic gates (IF, Then, Else). STEM-DE-5

1. Classify and compare names, symbols, truth tables and Boolean Expression for the following logic gates: AND, OR, NOT, NOR, NAND (Negated AND or NOT AND), exclusive OR, and exclusive NOR gates. STEM-DE-5.1
2. Classify and compare names, symbols, truth tables and Boolean Expression for the logic gates that include practical Transistor-Transistor Logic (TTL) and Complementary Metal Oxide Semiconductor (CMOS). STEM-DE-5.2
3. Classify and compare names, symbols, truth tables and Boolean Expression for the Institute of Electrical and Electronics Engineers (IEEE) logic symbols. STEM-DE-5.3

STEM-DE-6. Compare and contrast the use of several commonly used digital codes, including the differences between conversion of decimal numbers and letters to code. STEM-DE-6

1. Define and create a compare and contrast chart for 8421 Binary-Coded Decimal (BCD), Excess-3, and American Standard Code for Information Interchange (ASCII) codes. STEM-DE-6.1
2. Identify and discuss applications for encoders/decoders. STEM-DE-6.2
3. Construct a technical sketch or draw a display and/or multiplexers. STEM-DE-6.3
4. Determine the best code for specific industry problems. STEM-DE-6.4

STEM-DE-7. Use truth tables and interpret waveforms to determine flip-flop modes of operation and outputs. STEM-DE-7

1. Technically sketch or draw RS, D, and JK flip-flop circuits. STEM-DE-7.1
2. Technically sketch or draw Integrated Circuits (IC) Latches and Schmitt Triggers. STEM-DE-7.2
3. Create a project that demonstrates knowledge of operation and outputs. STEM-DE-7.3

STEM-DE-8. Analyze the output for a variety of counters based on a series of inputs. STEM-DE-8

1. Estimate output and then measure by ripple, synchronous, down, and self-stopping counters. Compile information into a table and present that suggests the most accurate method. STEM-DE-8.1
2. Graph and analyze the data for frequency dividers. STEM-DE-8.2
3. Interpret shift registers through critiquing the results. STEM-DE-8.3
4. Create counter circuits to solve real world scenarios. STEM-DE-8.4

STEM-DE-9. Analyze block-style logic diagrams. STEM-DE-9

1. Technically sketch or draw parallel adder circuits. STEM-DE-9.1
2. Technically sketch or draw parallel subtractor circuits. STEM-DE-9.2
3. Create a project that states the advantages and disadvantages of parallel added and subtracted circuits and includes binary multiplication. STEM-DE-9.3

STEM-DE-10. Investigate common memory and storage devices used in a microcomputer system. STEM-DE-10

1. Assess the value for common memory, microcomputer function block diagram and storage devices used in a microcomputer system. STEM-DE-10.1
2. Create a project that demonstrates the traits of Random Access Memory (RAM), Static RAM, Read-Only Memory (ROM), Programmable Read-Only Memory (PROMs), Arithmetic Logic Unit (ALU), and registers, control and data path. STEM-DE-10.2
3. Discuss non-volatile read/write in a project. STEM-DE-10.3
4. Compare various types of portable or temporary memory devices. STEM-DE-10.4

STEM-DE-11. Create a digital project that displays mastery of the standards involved with electronics. STEM-DE-11

1. Present the constructed projects from the standards in a digital portfolio through pictures, drawings, data and analysis. STEM-DE-11.1
2. Make recommendations for improvements on each project based on experiences gained from the process. STEM-DE-11.2

Engineering Concepts (21.471)

STEM-EC-1. Demonstrate employability skills required by business and industry. STEM-EC-1

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

STEM-EC-2. Demonstrate and follow safety, health, and environmental standards related to the Science, Technology, Engineering, and Math (STEM) workplaces. STEM-EC-2

1. Implement workplace and product safety standards such as Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA), International Organization for Standardization (ISO), Good Manufacturing Practice (GMP), and Underwriters Laboratories (UL). STEM-EC-2.1
2. Demonstrate and incorporate safe laboratory procedures in the classroom, lab, and field environments. STEM-EC-2.2
3. Explain the impact of safety standards such as Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA), International Organization for Standardization (ISO), Good Manufacturing Practice (GMP), and Underwriters Laboratories (UL) relating to engineering fields. STEM-EC-2.3
4. Implement safety precautions to maintain a safe work environment STEM-EC-2.4

STEM-EC-3. **Describe the characteristics of engineering disciplines and engineered products.** STEM-EC-3

1. Explain a contemporary definition of engineering. STEM-EC-3.1
2. Compare and contrast engineering to other approaches for solving technological and design problems. STEM-EC-3.2
3. Explain the duties and responsibilities of an Engineer. STEM-EC-3.3
4. Analyze and evaluate the implications of ethics in the engineering field. STEM-EC-3.4
5. Describe the principal fields of engineering specialization and identify associated career tracks. STEM-EC-3.5
6. Explain the developmental and life cycle of an engineered product. STEM-EC-3.6
7. Understand cost and risk analysis along with market analysis that is completed when creating engineered products. STEM-EC-3.7

STEM-EC-4. **Demonstrate the knowledge and skills required to pursue the full range of engineering post-secondary education and career opportunities.** STEM-EC-4

1. Explain the relationship between STEM and non-STEM Majors STEM-EC-4.1
2. Identify and describe educational requirements for engineering occupations along with locations where programs of study are available. STEM-EC-4.2
3. Compare and contrast the differences and similarities between engineering and engineering technology degrees. STEM-EC-4.3
4. Analyze the need to be a lifelong learner in the field of engineering STEM-EC-4.4
5. Identify and explain salaries associated with the different fields of engineering, including business services, healthcare, consulting services and technical administrative support in the consideration of career segments. STEM-EC-4.5

STEM-EC-5. Explain a whole systems approach to the engineering design process to solve a technical problem. STEM-EC-5

1. Describe the role of problem identification and definition, brainstorming, research, specifications, constraints, criteria, alternative solutions, analysis, decision making, communication, evaluation, and modification as activities comprising the engineering design process. STEM-EC-5.1
2. Apply the engineering design process to the solution of a technical problem. STEM-EC-5.2
3. Optimize and justify design solutions based on cost, time, schedule, and performance constraints. STEM-EC-5.3
4. Communicate design solutions to peers and potential consumers using graphical media, oral presentations, and technical writing. STEM-EC-5.4
5. Evaluate the design based on consumer research, peer feedback, financial and safety risk, and cost benefit analysis to optimize the design solution. STEM-EC-5.5
6. Demonstrate an understanding of the continuous improvement process as it applies to new designs and modifications of existing designs for new applications. STEM-EC-5.6

STEM-EC-6. Employ critical thinking skills and teamwork skills when working in groups to solve problems, to make decisions, achieve group goals and use team members' talents effectively. STEM-EC-6

1. Identify and describe common tasks that require employees to use problem-solving skills. STEM-EC-6.1
2. Analyze elements of a problem to develop creative solutions STEM-EC-6.2
3. Describe the value of using problem-solving and critical thinking skills to improve a situation or process. STEM-EC-6.3
4. Create ideas, proposals, and solutions to problems. STEM-EC-6.4
5. Work with others to achieve objectives in a timely manner. STEM-EC-6.5
6. Promote the full involvement and use of team members' individual talents and skills. STEM-EC-6.6
7. Demonstrate teamwork processes that provide team building, consensus, continuous improvement, respect for the opinions of others, cooperation, adaptability, and conflict resolution. STEM-EC-6.7
8. Take responsibility for shared group and individual work tasks. STEM-EC-6.8
9. Demonstrate sensitivity to and value for diversity. STEM-EC-6.9
10. Apply peer evaluation techniques to critique group members. STEM-EC-6.10
11. Integrate business principles when working as a team. STEM-EC-6.11

STEM-EC-7. Summarize and apply engineering solutions through the audience appropriate application of engineering graphics and technical writing. STEM-EC-7

1. Communicate design specifications through Engineering drawings and multiple medias. STEM-EC-7.1
2. Apply tools to mathematically analyze engineering design problems. STEM-EC-7.2
3. Apply accurate dimensions to a technical drawing, including size and geometric tolerances. STEM-EC-7.3
4. Prepare a persuasive proposal for an engineering solution. STEM-EC-7.4
5. Document engineering design processes using an engineering design notebook. STEM-EC-7.5
6. Prepare a report of engineering design activities including a description of analysis, optimization, and selection of a final solution. STEM-EC-7.6
7. Research and benchmark a technological problem or idea. STEM-EC-7.7
8. Use oral and visual communication skills to deliver an engineering design presentation. STEM-EC-7.8

STEM-EC-8. Apply basic engineering tools and resources to aid in data collection and problem solution sets. STEM-EC-8

1. Demonstrate understanding and application of various measurement systems. STEM-EC-8.1
2. Demonstrate understanding and application of various base units in both English and international systems (SI) STEM-EC-8.2
3. Demonstrate an understanding of the importance of tool calibration and precision measurement instruments. STEM-EC-8.3
4. Demonstrate the use of precision measuring instruments to measure and inspect parts to optimize the solution to a problem. STEM-EC-8.4
5. Use appropriate technologies or applications to generate data to optimize solutions to a problem. STEM-EC-8.5
6. Graphically display the collection of data. STEM-EC-8.6
7. Use laboratory tools, equipment, and technologies to demonstrate the properties of materials. STEM-EC-8.7

STEM-EC-9. **Cite evidence for the role of troubleshooting, research and development, inventions, and innovations in problem solving.** STEM-EC-9

1. Demonstrate an understanding of the difference between an invention and an innovation and the importance in developing solutions. STEM-EC-9.1
2. Use appropriate evaluation tools while troubleshooting during the design process. STEM-EC-9.2
3. Examine business and industry research to prepare devices and systems for the marketplace. STEM-EC-9.3
4. Use an interdisciplinary approach to problem solve. STEM-EC-9.4

STEM-EC-10. **Explore the use of social media and other 21st century technologies and their impact(s) on the fields of engineering and technology.** STEM-EC-10

1. Demonstrate an understanding of the different types of social media utilized in market products. STEM-EC-10.1
2. Evaluate positive and appropriate utilization of social media in the workplace STEM-EC-10.2
3. Employ open communication through social media applications as a medium across multiple platforms. STEM-EC-10.3
4. Investigate the impact(s) of various uses of social media (e.g., positive, negative, intended, unintended, etc.). STEM-EC-10.4
5. Explain aggregate data collected from researched social media platforms STEM-EC-10.5

STEM-EC-11. Critique and synthesize 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 (TSA). STEM-EC-11

1. Explain the goals, mission and objectives of Career Technical Student Organizations (CTSOs). STEM-EC-11.1
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. STEM-EC-11.2
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 STEM-EC-11.3
4. Explain how participation in career and technology education student organizations can promote lifelong responsibility for community service and professional development. STEM-EC-11.4
5. Demonstrate teamwork, leadership, interpersonal relations, and project management STEM-EC-11.5
6. Through teamwork, apply the skills and abilities in requirements analysis and configuration control while working with plans, processes, and projects as assigned. STEM-EC-11.6
7. Through teamwork, use the skills required in project management to track and assess the progress of a plan, process, or project as assigned. STEM-EC-11.7
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 STEM-EC-11.8
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). STEM-EC-11.9
10. Understand and demonstrate proper work ethics when working with plans, processes, and projects, as assigned. STEM-EC-11.10

Engineering Applications (21.472)

STEM-EA-1. Demonstrate employability skills required by business and industry. STEM-EA-1

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

STEM-EA-2. **Demonstrate and follow safety, health, and environmental standards related to the STEM workplace and apply specific engineering tools, machines, materials and processes in a safe and orderly manner to formulate, analyze, and verify engineering practices and solutions.** STEM-EA-2

1. Implement workplace and product safety standards such as Implement workplace and product safety standards such as Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA), International Organization for Standardization (ISO), Good Manufacturing Practice (GMP), American Disabilities Association (ADA), and Underwriters Laboratories (UL). STEM-EA-2.1
2. Demonstrate and incorporate safe laboratory procedures in the classroom, lab, and field environments. STEM-EA-2.2
3. Explain the impact of safety standards such as Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA), International Organization for Standardization (ISO), Good Manufacturing Practice (GMP), American Disabilities Association (ADA), and Underwriters Laboratories (UL) related to engineering fields. STEM-EA-2.3
4. Understand the environmental impact of engineering designs and processes. STEM-EA-2.4
5. Explain the criteria for selection of appropriate materials, tools, and processes. STEM-EA-2.5
6. Safely and effectively manipulate materials, tools, and processes. STEM-EA-2.6
7. Apply appropriate care and maintenance in the use of tools and machines. STEM-EA-2.7

STEM-EA-3. **Identify and explore career opportunities in one or more engineering career pathways to build an understanding of the opportunities available in the STEM workplace.** STEM-EA-3

1. Locate and identify career opportunities that appeal to personal career goals. STEM-EA-3.1
2. Match personal interests and aptitudes to selected careers. STEM-EA-3.2
3. Participate in career related field trips and/or career related presentations by professionals in STEM. STEM-EA-3.3

STEM-EA-4. **Apply knowledge of the engineering design process to solve engineering/ technological problems in the STEM workplace.** STEM-EA-4

1. Identify, define, and research a technological problem. STEM-EA-4.1
2. Utilize planning, time management, and leadership skills to organize an engineering project. STEM-EA-4.2
3. Research, select, and safely apply engineering concepts, machines, and tools for completion of the project. STEM-EA-4.3
4. Develop alternative solutions to a technological problem. STEM-EA-4.4
5. Select an appropriate solution that optimizes the outcome based on the specifications, constraints, and resources of the project. STEM-EA-4.5
6. Develop a 3D model of the solution using modeling software and/or physical materials. STEM-EA-4.6
7. Develop a working prototype of the solution 4.8 Test the prototype using engineering tools, concepts, and methods. STEM-EA-4.7
9. Analyze the results of the testing and modify the solution as needed. STEM-EA-4.9

STEM-EA-5. **Employ planning and time management skills and tools to enhance results and complete work tasks.** STEM-EA-5

1. Develop goals and objectives to complete a technological problem. STEM-EA-5.1
2. Prioritize tasks to be completed during a STEM project. STEM-EA-5.2
3. Develop project timelines using time management knowledge and skills. STEM-EA-5.3
4. Use project-management skills to improve workflow of a STEM project. STEM-EA-5.4

STEM-EA-6. Apply oral, written, and visual communication skills to obtain, interpret, and present information to and from intended audiences. STEM-EA-6

1. Apply the ability to read, interpret, and analyze STEM materials discerning the information and concepts. STEM-EA-6.1
2. Use appropriate listening skills to obtain and interpret messages or information provided to clarify issues, ideas, plans, projects, or processes. STEM-EA-6.2
3. Demonstrate understanding by responding to and/or restating information that will clarify STEM techniques to be used and/or information to be applied to projects, plans, or processes. STEM-EA-6.3
4. Use effective oral, written, and visual methods to communicate concepts of STEM to an audience. STEM-EA-6.4
5. Utilize an engineering design notebook and/or portfolios to collect, organize, and document the design process. STEM-EA-6.5

STEM-EA-7. Develop and apply detailed plans to solutions for design problems using mathematical and scientific concepts. STEM-EA-7

1. Analysis of design problems will be conducted and include flow charts, timelines, milestones, models, and other information to complete solutions. STEM-EA-7.1
2. Prove optimal solutions through the application of mathematical models and calculations necessary to complete predictive analysis. STEM-EA-7.2
3. Modify design plans and schedules that are informed directly by data collected and analyzed using graphical and algebraic solutions. STEM-EA-7.3
4. Critique the effectiveness and accuracy of design plans for each possible solution. STEM-EA-7.4
5. Implement failure analysis techniques to a design solution to enhance future solutions for a design problem. STEM-EA-7.5
6. Evaluate design solutions using the standards required to maintain a system in a condition of static equilibrium with respect to gravitational forces and normal operating conditions. STEM-EA-7.6
7. Devise technical solutions that demonstrate an understanding of the relationships between work, power, and energy within a system. STEM-EA-7.7
8. Develop design alternatives by incorporating the principles of energy transformations. STEM-EA-7.8
9. Optimize design solutions by evaluating and selecting appropriate mechanical devices and electrical components. STEM-EA-7.9

STEM-EA-8. Develop appropriate models. STEM-EA-8

1. Understand the concept of model as it relates to engineering design. STEM-EA-8.1
2. Understand the concept of scale as it relates to models. STEM-EA-8.2
3. Prepare mock-up and scale models. STEM-EA-8.3
4. Create 3D models using appropriate software and technologies. STEM-EA-8.4

STEM-EA-9. Design and construct a testable prototype. STEM-EA-9

1. Understand the concept of prototype as it relates to engineering design. STEM-EA-9.1
2. Select and apply appropriate materials, tools, and processes for prototype development. STEM-EA-9.2
3. Consider end user experience and interface in prototype development. STEM-EA-9.3
4. Test prototype for performance, usability, and durability. STEM-EA-9.4
5. Assess and evaluate prototype testing data to recommend design improvements, optimization, or re-design of prototype. STEM-EA-9.5

STEM-EA-10. Understand engineering impacts of social, economic, design and environmental issues. STEM-EA-10

1. Apply knowledge of external issues such as time constraints, budget, supply chain and available technology that strain the engineering design process to optimize a solution to a STEM problem. STEM-EA-10.1
2. Analyze and connect the impacts of events in the global marketplace to understand the importance of national standards, supply chains, and timelines. STEM-EA-10.2
3. Analyze the sustainability and life cycle of an engineered product and their applications on a worldwide scale. STEM-EA-10.3
4. Connect cultural diversity to possible impacts on creating solutions to engineering design problems. STEM-EA-10.4

STEM-EA-11. Explain the impact of business and marketing on engineering design. STEM-EA-11

1. Gather and synthesize information using social media and the internet. STEM-EA-11.1
2. Research the global nature of engineering design in multinational corporations. STEM-EA-11.2
3. Demonstrate an understanding of the design timeline, time to market, and the impact of a rapidly changing consumer market. STEM-EA-11.3
4. Generate and analyze market research in terms of consumer requirements, competitive landscape, and market opportunity. STEM-EA-11.4
5. Develop iterative accounting analysis for engineering designs such as cost analysis, return on investment, Bill of Materials, and labor and production costs using appropriate spreadsheet software. STEM-EA-11.5
6. Apply supply and demand economics to determine market pricing. STEM-EA-11.6
7. Create and present marketing plans to peers, decision makers, and potential investors. STEM-EA-11.7

STEM-EA-12. 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 cocurricular activities associated with the Technology Student Association (TSA). STEM-EA-12

1. Explain the goals, mission and objectives of Career Technical Student Organizations (CTSOs). STEM-EA-12.1
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. STEM-EA-12.2
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. STEM-EA-12.3
4. Explain how participation in career and technology education student organizations can promote lifelong responsibility for community service and professional development. STEM-EA-12.4
5. Demonstrate teamwork, leadership, interpersonal relations, and project management. STEM-EA-12.5
6. Through teamwork, apply the skills and abilities in requirements analysis and configuration control while working with plans, processes, and projects as assigned. STEM-EA-12.6
7. Through teamwork, use the skills required in project management to track and assess the progress of a plan, process, or project as assigned. STEM-EA-12.7
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. STEM-EA-12.8
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). STEM-EA-12.9
10. Understand and demonstrate proper work ethics when working with plans, processes, and projects as assigned. STEM-EA-12.10

Introduction to Drafting and Design (48.541)

AC-IDD-1. Demonstrate employability skills required by business and industry. AC-IDD-1

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

AC-IDD-2. Identify the disciplines related to architectural and engineering professions. AC-IDD-2

1. Identify the professional and/or trade associations related to the architectural and engineering professions. AC-IDD-2.1
2. Identify related occupations within the architectural and engineering professions. AC-IDD-2.2
3. Identify the employment opportunities in the architectural and engineering professions. AC-IDD-2.3
4. Match architectural and engineering occupational job titles with qualifications and responsibilities. AC-IDD-2.4
5. Identify education and training required to work in the various architectural and engineering professions. AC-IDD-2.5
6. Participate in activities related to career interests. AC-IDD-2.6

AC-IDD-3. Demonstrate the knowledge and skills to properly use the tools and equipment safely in the drafting lab. AC-IDD-3

1. Maintain workstation and storage area. AC-IDD-3.1
2. Demonstrate and incorporate proper use of ergonomics in the drawing lab. AC-IDD-3.2
3. Follow class and lab rules. AC-IDD-3.3

AC-IDD-4. Demonstrate the correct use and management of all drafting tools and supplies. AC-IDD-4

1. Identify and demonstrate the correct operation and maintenance of manual drafting equipment. AC-IDD-4.1
2. Use correct lead selection to produce drawings. AC-IDD-4.2
3. Identify and use the proper type of media. AC-IDD-4.3
4. Promote responsible use of drafting supplies. AC-IDD-4.4

AC-IDD-5. Create technical freehand sketches. AC-IDD-5

1. Demonstrate orthographic sketches. AC-IDD-5.1
2. Demonstrate pictorial sketches. AC-IDD-5.2

AC-IDD-6. Demonstrate proper lettering techniques. AC-IDD-6

1. Demonstrate vertical and/or inclined manual lettering. AC-IDD-6.1
2. Create text using appropriate annotation commands, orientation, style, size, and placement in CAD. AC-IDD-6.2

AC-IDD-7. Demonstrate the use of proper line types. AC-IDD-7

1. Demonstrate the ability to perform a drawing setup, e.g., sheet size, border, and title block. AC-IDD-7.1
2. Control entity properties by layer, color, and line type. AC-IDD-7.2
3. Demonstrate the use of the alphabet of lines. AC-IDD-7.3

AC-IDD-8. Demonstrate the ability to read and draw using the proper scale. AC-IDD-8

1. Demonstrate the ability to measure using the architect's scale, engineer's scale, and metric scale. AC-IDD-8.1
2. Select proper drawing scale. AC-IDD-8.2

AC-IDD-9. Demonstrate the knowledge and skills of computer operations. AC-IDD-9

1. Demonstrate definitions and procedures for file management techniques: copying, deleting, finding, saving, and renaming, based on operating/applications systems. AC-IDD-9.1
2. Use an on-line help tutorial based on the application system. AC-IDD-9.2
3. Demonstrate the ability to open a drawing file and create a drawing. AC-IDD-9.3
4. Identify and use all major components of hardware associated with a CAD system. AC-IDD-9.4

AC-IDD-10. Create and dimension single view drawings while applying geometric construction. AC-IDD-10

1. Produce geometric shapes such as straight lines, geometric angles, plane figures, circles and arcs, and irregular geometric figures. AC-IDD-10.1
2. Demonstrate geometric construction techniques given size, orientation, and location specifications. AC-IDD-10.2
3. Apply center lines to drawings in correct size and location. AC-IDD-10.3
4. Apply correct dimensioning procedures. AC-IDD-10.4

AC-IDD-11. Utilize orthographic projection to create and dimension multi-view drawings manually and using CADD. AC-IDD-11

1. Draw an object that is described with two views. AC-IDD-11.1
2. Draw an object that is described with three views. AC-IDD-11.2
3. Select proper drawing scale, views, and layout. AC-IDD-11.3
4. Draw an object that has an inclined surface. AC-IDD-11.4
5. Draw an object containing circles and arcs. AC-IDD-11.5
6. Correctly identify views of an object. AC-IDD-11.6
7. Create orthographic projections utilizing the necessary views. AC-IDD-11.7

Survey of Engineering Graphics (48.542)

STEM-SEDG-1. Demonstrate employability skills required by business and industry. STEM-SEDG-1

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

STEM-SEDG-2. **Demonstrate and follow safety, health, and environmental standards related to the STEM workplace and apply specific engineering tools, machines, materials and processes in a safe and orderly manner to formulate, analyze, and verify engineering practices and solutions.** STEM-SEDG-2

1. Identify and describe the professional and/or trade STEM-SEDG-2.1
2. Identify related occupations within engineering graphics and engineering professions. STEM-SEDG-2.2
3. Research out employment opportunities and education requirements for engineering graphics and engineering professions. STEM-SEDG-2.3
4. Participate in activities related to career interests. STEM-SEDG-2.4
5. Analyze an ethical situation related to engineering graphics and engineering STEM-SEDG-2.5
6. Maintain a journal that relates standards in the course to the project work. STEM-SEDG-2.6

STEM-SEDG-3. **Analyze applied math required by business and industry for engineering graphics.** STEM-SEDG-3

1. Analyze and apply correct tolerance in regards to (American National Standard for Information Systems) ANSI and National Institute of Standards and Technology (NIST) and other international bodies that control standards with the correct use of geometric constraints and symbols. STEM-SEDG-3.1
2. Estimate and measure using metric and imperial scale. Compare the estimate with the actual results and analyze. STEM-SEDG-3.2
3. Calculate the ratio and scale for specific problems. STEM-SEDG-3.3
4. Construct conversions STEM-SEDG-3.4
5. Identify and describe the correct units on existing drawings. STEM-SEDG-3.5
6. Measure using an engineering Scale and basic rulers. STEM-SEDG-3.6
7. Present how to determine the appropriate tool use for measurements. STEM-SEDG-3.7

STEM-SEDG-4. Demonstrate purpose and correct application of sectional views. STEM-SEDG-4

1. Identify and explain sectional views: full, half, offset, revolved, removed and brokenout sections. STEM-SEDG-4.1
2. Determine the six sectional views from provided drawings. STEM-SEDG-4.2
3. Create technical freehand sketch of a sectional view. STEM-SEDG-4.3
4. Prepare drawings that require sectional views. STEM-SEDG-4.4
5. Recommend materials for sectional views including hatching patterns and appropriate symbols based on strength and product requirements STEM-SEDG-4.5
6. Read and reproduce sectional view blueprint. STEM-SEDG-4.6
7. Create a sectional view from an existing multi-view drawing. STEM-SEDG-4.7

STEM-SEDG-5. Demonstrate purpose and correct application of Auxiliary views. STEM-SEDG-5

1. Identify and explain primary and secondary auxiliary views. STEM-SEDG-5.1
2. Recommend applications or purpose of auxiliary views for specific drawings or objects STEM-SEDG-5.2
3. Create technical freehand sketch of an auxiliary view. STEM-SEDG-5.3
4. Prepare drawings that require auxiliary views STEM-SEDG-5.4
5. Read, revise and produce auxiliary blueprint. STEM-SEDG-5.5

STEM-SEDG-6. Demonstrate purpose and correct application of pictorial views. STEM-SEDG-6

1. Identify and describe isometric and isometric exploded pictorial drawings. STEM-SEDG-6.1
2. Determine applications or purpose of pictorial drawings. STEM-SEDG-6.2
3. Create technical freehand sketch of pictorial drawings. STEM-SEDG-6.3
4. Prepare drawings that require pictorial view. STEM-SEDG-6.4
5. Read, revise and produce pictorial blueprint or an existing object or drawing. STEM-SEDG-6.5

STEM-SEDG-7. **Cite evidence of developments in engineering graphics and engineering.** STEM-SEDG-7

1. Identify and describe welding, sheet metal and geometric shapes as related to the general principals of pattern development. STEM-SEDG-7.1
2. Analyze applications or purpose of developments and patterns STEM-SEDG-7.2
3. Apply concepts for various geometric shapes to patterns. STEM-SEDG-7.3

STEM-SEDG-8. **Present appropriate views of an object.** STEM-SEDG-8

1. Create a table that states the advantages and disadvantages of sectional, auxiliary, pictorial views and save electronically and in a portfolio. STEM-SEDG-8.1
2. Insert at least one drawing from the course that demonstrates sectional, auxiliary, and pictorial views into the portfolio and save electronically. STEM-SEDG-8.2
3. Create an original object and generate sectional, auxiliary and pictorial views. STEM-SEDG-8.3
4. Place in the portfolio and save electronically. STEM-SEDG-8.4
5. Review journal entries and write a short statement about what has been learned about tolerance, appropriate tool use for measurement, sectional view, auxiliary view, pictorial view, and developments. STEM-SEDG-8.5

3D Modeling and Analysis (48.543)

STEM-3DMA-1. **Demonstrate employability skills required by business and industry.** STEM-3DMA-1

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

STEM-3DMA-2. Identify the disciplines related to engineering graphics and engineering professions. STEM-3DMA-2

1. Identify and describe the professional and/or trade associations related to the engineering and engineering graphics professions. STEM-3DMA-2.1
2. Identify and describe related occupations within engineering graphics and engineering professions. STEM-3DMA-2.2
3. Research employment opportunities and education requirements for engineering graphics and engineering professions. STEM-3DMA-2.3
4. Participate in activities related to career interests. STEM-3DMA-2.4
5. Analyze an ethical situation related to engineering graphics and engineering. STEM-3DMA-2.5
6. Maintain a journal that relates standards in the course to the project work. STEM-3DMA-2.6

STEM-3DMA-3. Analyze applied math required by business and industry for engineering graphics. STEM-3DMA-3

1. Analyze and apply correct tolerance in regards to (American National Standard for Information Systems) ANSI and National Institute of Standards and Technology (NIST) and other international bodies that control standards. STEM-3DMA-3.1
2. Apply correct dimensioning techniques in regard to ANSI/NIST and other international bodies that control and recommend standards. STEM-3DMA-3.2
3. Apply correct usage of geometric constraints and symbols. STEM-3DMA-3.3
4. Calculate area and volume for basic geometric shapes. STEM-3DMA-3.4
5. Apply correct usage of units for given examples. STEM-3DMA-3.5
6. Calculate mass of given objects. STEM-3DMA-3.6
7. Calculate density of given objects. STEM-3DMA-3.7
8. Create a comparison table that discusses constraint issues (i.e. appearance, funds, space, material, personnel limitations. STEM-3DMA-3.8
9. Identify and explain clearance fit and degree of freedom on existing drawings. STEM-3DMA-3.9

STEM-3DMA-4. **Demonstrate an understanding for fasteners and the correct application in engineering graphics and product design.** STEM-3DMA-4

1. Identify and describe various types of fasteners (temporary, semi-permanent, and permanent). STEM-3DMA-4.1
2. Create a short paragraph that explains the importance and applications of clearance fit and degree of freedom. STEM-3DMA-4.2
3. Specify threads and fasteners on a technical drawing. STEM-3DMA-4.3
4. Generate the call-out information for a fastener. STEM-3DMA-4.4
5. Create technical freehand sketch of provided fastener. STEM-3DMA-4.5
6. Model various types of threaded connections. STEM-3DMA-4.6
7. Apply knowledge of strength of materials in determining the appropriate fastener. STEM-3DMA-4.7

STEM-3DMA-5. **Produce a working drawing artifact that conveys all of the information needed to manufacture and assemble a design.** STEM-3DMA-5

1. Demonstrate an understanding of what drawings are required to accurately present an object. STEM-3DMA-5.1
2. Create a project that demonstrates the impact of tension and compression on an object from a working drawing. STEM-3DMA-5.2
3. Orally present an understanding of callouts or balloons on working drawings. STEM-3DMA-5.3
4. Identify and explain important components required on a bill of materials or part list. STEM-3DMA-5.4
5. Create a bill of materials for an existing working drawing. STEM-3DMA-5.5
6. Produce a set of working drawings based on an assembled object. STEM-3DMA-5.6
7. Produce a detailed drawing of a threaded component. STEM-3DMA-5.7

STEM-3DMA-6. Evaluate and develop assembly drawings. STEM-3DMA-6

1. Demonstrate an understanding of the purpose and application for assembly drawings. STEM-3DMA-6.1
2. Create an original title block. STEM-3DMA-6.2
3. Determine when auxiliary or sectional views are required in an assembly drawing. STEM-3DMA-6.3
4. Write a short paragraph that describes when a subassembly drawing is necessary in an assembly drawing. STEM-3DMA-6.4
5. Demonstrate how information on the Bill of Materials relates back to the assembly drawing. STEM-3DMA-6.5
6. Create technical freehand sketch of an assembly drawing. STEM-3DMA-6.6
7. Construct accurate drawing representations of a 3D assembly model. STEM-3DMA-6.7

STEM-3DMA-7. Construct a 3D assembly model showing criteria, constraints, design, and quality of a final product by creating a presentation or capstone final project. STEM-3DMA-7

1. Identify and explain the purposes and uses of extracting geometric data from surfaces and wireframes. STEM-3DMA-7.1
2. Create a chart that shows what drawings are necessary to produce products based on characteristics of the product such as inclined, materials, and fasteners. STEM-3DMA-7.2
3. Identify the purpose and uses of rendering a model's image. STEM-3DMA-7.3
4. Demonstrate an understanding of the application of mass and density of materials when designing an object. STEM-3DMA-7.4
5. Render an image of a model. STEM-3DMA-7.5
6. Shade a rendered image of a model. STEM-3DMA-7.6
7. Animate an image of a model. STEM-3DMA-7.7
8. Create a summary for an analysis of the object. STEM-3DMA-7.8
9. Create a presentation of a model that communicates material, finish, mass, and density. STEM-3DMA-7.9
10. Incorporate all of pathway standards into a capstone project based on the model presentation (including material, finish, mass, and density). Required working and detail drawings like auxiliary and sectional views are to be included in the final project. STEM-3DMA-7.10