Ohio Engineering and Science Technology Suites Course

In assessing the units and competencies for the Ohio Engineering and Science Technology Career Pathway we determined which units had at least one competency that would be met by the Suites that we propose for this type of course. Here are the results of our findings:

Total # of Units in the Ohio Engineering and Science Technology Career Pathway: 106

Number of Units that had a least one competency covered by Suite

	Engineering	Digital Manufacturing	Aerospace Rocketry	Intelligent Systems
Units covered	62	44	32	38
% of units covered	58%	42%	30%	36%

Total units covered by the standard grouping of health science Suites: 75 of 106 for 71%

For the Engineering and Science Technology Career Pathway, we also determined which Suites covered each competency for all 106 units. There are a total of 530 competencies for each unit. The following chart shows how each Suite stacked up at the competency level.

	Engineering	Digital Manufacturing	Aerospace Rocketry	Intelligent Systems
Competencies hit	165	123	61	74
% of competencies hit	31%	23%	12%	14%

Total competencies covered by the four engineering Suites: 226 of 530 for 43%

List of Units not covered by the engineering Suites:

- Unit 9: Security Awareness Issues
- Unit 28: Engineering and Engineering Technology for Reliability
- Unit 31: Number Systems
- Unit 32: Gates
- Unit 35: Adding
- Unit 36: Flip-Flops
- Unit 37: Shift Registers and Counters
- Unit 38: Families and Specifications
- Unit 44: Introduction
- Unit 46: Components
- Unit 50: Fuel Cell System Capstone Project
- Unit 51: Introduction to Materials Joining Technology
- Unit 52: Arc Welding Processes
- Unit 53: Non-Arc Welding Processes
- Unit 54: Physics of Welding
- Unit 55: Heat Flow
- Unit 57: Welding Metallurgy
- Unit 59: Testing and Inspection
- Unit 60: Safety
- Unit 63: Advanced Techniques
- Unit 68: Site Information
- Unit 70: Description of the Property
- Unit 71: Land Surveying
- Unit 72: Site Plan Layout
- Unit 73: Public Ingress and Egress
- Unit 74: Site Grading
- Unit 76: Landscaping
- Unit 77: Water Supply and Waste Water Treatment
- Unit 81: Introduction to Engineering Design and Development
- Unit 92: Dynamics
- Unit 104: Biofuels Energy

Unit and Competency Correlations

Unit/Competency	Engineering	Digital Manufacturing	Aerospace Rocketry	Intelligent Systems
Engineering and Science Core Body of Knowledge				
Unit 1: Career Exploration and Development	X	X	X	X
1.1 Explore careers in engineering and science.	X	X	X	X
1.2 Demonstrate the ability to seek and apply for employment.				
1.3 Demonstrate positive work behaviors and personal qualities.	X	X	X	X
1.4 Demonstrate respect for cultural and generational values.				
1.5 Employ critical thinking and problem solving skills independently or in teams to formulate solutions to problems.	X	X	X	X
1.6 Demonstrate the ability to lead or work on a team through team participation.	X	X	X	X
Unit 2: Business Processes	X	X	X	X
2.1 Develop a business process model for engineering and science operations.				
2.2 Analyze the engineering and science industries.				
2.3 Explain how planning, budgeting and scheduling are used to accomplish organizational goals and objectives.	X			
2.4 Analyze practices for managing human resources.	X			
2.5 Explain material control and product inventories necessary for meeting customer and business requirements.		X		
2.6 Explain the measures used by organizations to manage and improve performance.				
2.7 Benchmark financial and market performance against competitors.				
2.8 Explain how changes outside the career field impact engineering and science.	X			
2.9 Explain the role of risk management in reducing risks and improving performance in engineering and science.				
2.10 Explain the roles and functions of government in regulating and supporting engineering and science.				
2.11 Assess how engineering and science impacts customer relationships.	X	X		
2.12 Identify basic procedures in the accounting cycle.				
2.13 Demonstrate effective use of technology.	X	X	X	X
2.14 Develop and coordinate the diverse components of a project.	X	X		
Unit 3: Communications	X	X	X	X
3.1 Write and utilize coherent, persuasive and focused technical communications that support a defined perspective for engineering and science.				
3.2 Deliver formal and informal presentations that demonstrate organization and delivery skill.	X	X	X	X
3.3 Listen and speak effectively to contribute to	X	X	X	X

group discussions and meetings.				
3.4 Apply active listening skills to obtain and clarify information provided in oral communications.	X	X	X	X
3.5 Utilize written documents to direct engineering and science operations.	X	X	X	X
3.6 Explain and apply the fundamentals of engineering and science drawings, schematics, specifications and diagrams.	X	X		X
Unit 4: Legal and Ethical Responsibilities	X	X	X	X
4.1 Differentiate between legal and ethical issues.	X	X	X	X
4.2 Describe current ethical and legal standards in the science, mathematics, engineering and technology community.	X	X	X	X
4.3 Perform duties according to laws, regulations and contract provisions applicable to the content area.				
4.4 Complete work-related duties within an ethical framework.	X	X	X	X
4.5 Assess the implications of ethical and unethical behavior.	X	X		
4.6 Comply with laws and regulations governing information gathering and product orservice production.				
Unit 5: Safety and Ergonomic Issues	X	X	X	X
5.1 Maintain general safety in accordance with government regulations, health standards and company policies.	X	X	X	X
5.2 Evaluate the ergonomic factors associated with the engineering and science industry.				
5.3 Identify state, federal, and local worker safety, health and environmental regulations.	X	X		
5.4 Demonstrate practices that contribute to an accident-free environment.	X	X	X	X
5.5 Explain emergency response plans in a variety of settings.				
5.6 Complete and apply operations and safety training on all equipment.	X	X	X	X
Unit 6: Health and Environment	X	X		
6.1 Identify practices that contribute to a healthy environment.				
6.2 Explain the environmental aspects of work sites with contaminated waste.	X			
6.3 Handle hazardous materials in accordance with government regulations and health standards.				
6.4 Identify the relationship between production processes and human health and environmental problems.		X		
Unit 7: Material Science	X	X		
7.1 Explain material science as being primarily involved with solids.		X		
7.2 Examine the characteristics of solids.		X		
7.3 Explain mechanical properties and reactivity.		X		
7.4 Explain the impact of choosing a specific material based on the cost, value and function of the final part.	X	X		
7.5 Explain the role alloys play in metal	X	X		

compositions.				
7.6 Analyze cast iron and powered metals.				
7.7 Analyze non-ferrous metals and their characteristics.				
7.8 Analyze the various heat treatment processes that alter the properties of steel.				
7.9 Analyze ceramics and their characteristics.		X		
7.10 Examine glass as a special ceramic.				
7.11 Explain the chemistry of polymers.		X		
7.12 Examine the engineering processes for polymers.				
7.13 Examine the manufacturing processes for polymers.				
7.14 Analyze composites and their role in material science.		X		
7.15 Examine fiber-reinforced composites.	X			
7.16 Analyze material failure.		X		
Unit 8: Quality Assurance	X	X		
8.1 Explain quality assurance and management.	X	X		
8.2 Explain the difference between the characteristics of quality in a final product and the control of quality in each step of a process.				
8.3 Plan and conduct quality testing for a given process and product.	X	X		
8.4 Analyze the fundamentals and principles of quality management.				
8.5 Define the statistical parameters of a population.				
8.6 Interpret data that has been collected using statistical methods.	X	X	X	
Unit 9: Security Awareness Issues				
9.1 Explain issues associated with information technology (IT) security.				
9.2 Explain issues associated with physical security.				
9.3 Examine issues associated with technical and engineering security.				
Engineering Pathway				
Engineering Science Specialization				
Introduction to Engineering and Engineering Technology Design Course				
Unit 10: Introduction	X	X	X	X
10.1 Discuss the history of engineering and engineering technology design.	X			
10.2 Explore career pathways in engineering and engineering technology related to design.	X	X	X	X
Unit 11: Introduction to Design	X	X	X	
11.1 Apply the steps of the design process to solve a variety of design problems.	X	X	X	
11.2 Describe the application of the principles and elements of design utilized in products, print media and art forms.	X	X		
Unit 12: Student Portfolio Development	X	X	X	X
12.1 Develop a portfolio to organize and display evidence of work.	X	X	X	X
12.2 Use the portfolio to make a presentation that defends current proficiency.	X	X	X	X

Unit 13: Sketching and Visualization	X	X		X
13.1 Utilize sketching and visualization techniques.	X	X		X
13.2 Select and produce the appropriate pictorial style to best communicate solutions in the design process.	X	X		
13.3 Evaluate and select the necessary view to graphically communicate design solutions.	X	X		X
Unit 14: Geometric Relationships		X		
14.1 Construct various geometric forms and shapes.				
14.2 Describe geometric constraints.				
14.3 Demonstrate the Cartesian coordinate system.		X		
Unit 15: Modeling	X	X	X	X
15.1 Communicate conceptual ideas through written and verbal formats.	X	X	X	X
15.2 Analyze and develop graphical representation of given data.	X	X	X	X
15.3 Select the appropriate modeling materials to complete a three-dimensional prototype or mockup.	X	X	X	X
15.4 Critique design solutions using mathematical applications (e.g., volume of a bottle).	X		X	
15.5 Evaluate a sketch and generate a model utilizing Computer Aided Design (CAD) software.	X	X		
Unit 16: Assembly Modeling	X		X	X
16.1 Explore and demonstrate assembly modeling skills to solve a variety of design problems.	X		X	X
16.2 Explore and demonstrate assembly constraints, part libraries, sub-assemblies, driving constraints and adaptive design.				
Unit 17: Model Analysis and Verification	X	X	X	
17.1 Evaluate the accuracy of mass properties calculations.				
17.2 Interpret and use correct tolerancing techniques when dimensioning solid models.	X	X	X	
Unit 18: Model Documentation	X	X		
18.1 Translate a three-dimensional drawing or model into corresponding orthographic drawing views.	X			
18.2 Demonstrate appropriate dimensioning rules and practices.	X	X		
18.3 Apply appropriate annotations on sketches and drawings.	X	X		
Unit 19: Presentation	X	X	X	X
19.1 Practice effective oral communication techniques.	X	X	X	X
19.2 Utilize the most appropriate presentation aids in oral and written presentations.	X	X	X	X
Unit 20: Production	X	X		X
20.1 Evaluate material characteristics for manufacturing a specific product and identify the correct manufacturing process needed to produce that product.	X	X		
20.2 Examine and apply the most appropriate machine process.				X

20.3 Discuss trends in automated manufacturing.		X		
20.4 Explain material procurement, handling and cost analysis.	X	X		
Unit 21: Marketing	X			
21.1 Explain product cost analysis.	X			
21.2 Design a package for a given product (e.g., egg drop).				
Principles of Engineering Required Course				
Unit 22: Definition and Types of Engineering and Engineering Technology	X	X	X	X
22.1 Define engineers as innovators and problem solvers.	X			
22.2 Interpret the role of an engineering and engineering technology team.				
22.3 Explore careers in engineering and engineering technology.	X	X	X	X
Unit 23: Communication and Documentation	X	X	X	X
23.1 Compose sketches using proper sketching techniques in the solution of design problems.	X	X		
23.2 Research a career field in engineering and engineering technology; document this research in a written technical report.	X	X	X	X
23.3 Prepare and deliver a technical presentation.	X	X	X	X
Unit 24: Design Process	X	X	X	X
24.1 Compose and diagram the product development lifecycle of an invention.	X	X		
24.2 Design a product.	X	X	X	X
Unit 25: Engineering and Engineering Technology Systems	X		X	X
25.1 Select simple machines to create mechanical systems for solving design problems.	X			
25.2 Create an energy transfer model of a structure and calculate the heat loss through walls and windows.				
25.3 Configure proper setup and adjustment of a fluid power system.			X	
25.4 Estimate current flow through a circuit and compare estimates to accurate measurements.	X			
25.5 Design, diagram and implement a program for controlling a device constructed to perform a sorting operation.				X
Unit 26: Statics and Strength of Materials	X	X	X	
26.1 Mathematically evaluate a simple truss to determine types and magnitude of forces supported in the truss.				
26.2 Explain the effects that stress has on a material and explain how the material will react.	X	X	X	
Unit 27: Materials and Materials Testing in Engineering and Engineering Technology	X	X		
27.1 Compare and contrast and analyze the physical properties of organics, metals, polymers, ceramics and composites.		X		
27.2 Assess and document the properties of materials.	X	X		
27.3 Specify the production processes used to create products from categories of materials.		X		
27.4 Explain the difference between the				

characteristics of quality in a final product and the control of quality in each step of a production process.				
27.5 Analyze a material failure.	X	X		
Unit 28: Engineering and Engineering Technology for Reliability				
28.1 Mathematically determine the chance of a system's failure, given information on certain components.				
28.2 Analyze an engineering failure which identifies causes, damage done, design failures, where the failure has impacted the environment or society.				
Unit 29: Introduction to Dynamics and Kinematics	X		X	X
29.1 Construct a device that will illustrate linear motion.			X	X
29.2 Summarize test data to explain trajectory motion.	X		X	
Digital Electronics Required Course				
Unit 30: Fundamentals	X			
30.1 Appraise hazards in the lab, record locations of the safety equipment and describe how to use the safety equipment.				
30.2 Explain basic electron theory.	X			
30.3 Utilize prefixes, and engineering and engineering technology notation.				
30.4 Calculate the tolerance levels of various resistors to determine whether the measured value is within specifications.				
30.5 Select and utilize electrical meters to determine voltage, resistance and current in simple circuits.	X			
30.6 Calculate the value of capacitors, both mathematically and through the use of instrumentation.				
30.7 Calculate the output frequency of circuits using both observations and the oscilloscope.				
30.8 Obtain electronic component data sheets.				
Unit 31: Number Systems				
31.1 Identify and describe the number systems appropriate to electronic components.				
31.2 Convert values from one number system to another.				
Unit 32: Gates				
32.1 Identify and recognize the gates and their truth table.				
32.2 Apply logic gates to solve a problem.				
Unit 33: Boolean Algebra				X
33.1 Create Boolean expressions, logic circuit diagrams or truth tables from information provided in the solution of design problems.				X
33.2 Apply the rules of Boolean algebra to logic diagrams and truth tables to minimize the circuit size necessary for solving a design problem.				
33.3 Asses duality of logic functions.				
Unit 34: Combinational Circuit Design				X
34.1 Design a paradigm for combinational logic				

problems.				
34.2 Design a specific medium scale integration (MSI) gate application.				
34.3 Evaluate programmable logic devices (PLD).				X
Unit 35: Adding				
35.1 Design, construct and test adder circuits using discrete gates.				
35.2 Design, construct and test adder circuits using MSI gates.				
Unit 36: Flip-Flops				
36.1 Interpret, design, draw and evaluate circuits using the logic symbols for latches and flip-flops.				
36.2 Compare and contrast the operation of synchronous with asynchronous flip-flop circuits they construct.				
36.3 Evaluate triggers used by latches and flip-flops.				
36.4 Assemble circuits and interpret information about the various applications of flip-flops.				
Unit 37: Shift Registers and Counters				
37.1 Evaluate the use of shift registers in product design and the speeds at which those products run.				
37.2 Evaluate asynchronous counter operations and characteristics.				
37.3 Evaluate synchronous counter operations and characteristics.				
Unit 38: Families and Specifications				
38.1 Define, calculate and measure fan-out delay.				
38.2 Define, calculate and measure propagation delay.				
Unit 39: Microprocessors				X
39.1 Assess microcontrollers.				X
39.2 Assess interfacing with motors.				X
Computer Integrated Manufacturing Elective				
Unit 40: Computer Modeling	X	X		
40.1 Demonstrate the fundamentals of computer modeling.		X		
40.2 Utilize object construction techniques.		X		
40.3 Illustrate parts modeling techniques.		X		
40.4 Develop multi-view drawings such as top, front, right side, isometric, section and auxiliary views from the solid model.	X	X		
40.5 Create assembly models through the integration of individual parts and sub-assemblies.		X		
40.6 Prepare a rapid prototype file from a drawing database.		X		
Unit 41: Programmable Machines	X	X		
41.1 Summarize the history of programmable machining.				
41.2 Explain the different elements of a computer numeric control (CNC) machine.		X		
41.3 Select and demonstrate CNC programming techniques.		X		
41.4 Operate a CNC machine to machine a part to specifications.		X		
41.5 Make precision measurements to the degree of accuracy required by plan specification, using	X	X		

appropriate instruments.				
41.6 Use a computer aided manufacturing (CAM) package to generate and edit tool paths by applying appropriate machining processes to geometry imported from a CAD program.		X		
Unit 42: Introduction to Robotics		X		X
42.1 Describe the development of robotics.				X
42.2 Discuss robotics and automated systems.		X		X
42.3 Contrast different working models of robots.				X
42.4 Utilize mechanical components in CIM operations.		X		
42.5 Develop a feeder system with sensors to detect whether parts are present and to alert the operator if the quantity of parts is below the required number.				X
42.6 Program a robot to perform several tasks.				X
42.7 Analyze and generate a tooling solution to a robotic manufacturing problem.				X
Unit 43: Computer Integrated Manufacturing (CIM)		X		
43.1 Discuss the rationale for CIM.		X		
43.2 Compare and contrast types of CIM systems.		X		
43.3 Explain the components of a CIM system for a given industrial application.		X		
43.4 Assemble and test individual component designs by integrating them into a complete miniature FMS built from the Fischertechnik models.				
Fuel Cell Technology Elective				
Unit 44: Introduction				
44.1 Explain the key issues of fuel cell research and development.				
44.2 Trace the history of fuel cells.				
44.3 Describe career opportunities in fuel cell technologies and applications.				
Unit 45: Function	X			
45.1 Describe a fuel cell.	X			
45.2 Demonstrate the conversion of chemical energy into electrical energy.	X			
Unit 46: Components				
46.1 Analyze the function of the cathode.				
46.2 Assess the function of the electrolyte.				
46.3 Explain the role the anode plays in a fuel cell.				
46.4 Analyze the fuel cell stack.				
Unit 47: Fuels Processing	X			
47.1 Evaluate hydrogen as a fuel.	X			
47.2 Evaluate hydrogen safety practices and procedures.				
47.3 Explain how fuel processors work.				
Unit 48: Alternate Structures of Fuel Cells	X			
48.1 Analyze proton exchange membrane (PEM) fuel cell technology.	X			
48.2 Analyze solid oxide fuel cell (SOFC) technology.				
48.3 Analyze alkali fuel cell technology.				
48.4 Analyze phosphoric acid fuel cell technology.				
48.5 Analyze molten carbonate fuel cell				

technology.				
48.6 Analyze direct methanol fuel cell technology.				
48.7 Analyze regenerative fuel cell technology.				
48.8 Discuss fuel cell systems integration.				
Unit 49: Implementation Strategies and Challenges	X			
49.1 Explore applications and markets for fuel cells.				
49.2 Examine fuel cell emissions.				
49.3 Describe the market entry challenges associated with fuel cells.	X			
Unit 50: Fuel Cell System Capstone Project				
50.1 Design a fuel cell system.				
50.2 Build a fuel cell system.				
50.3 Evaluate the project's performance.				
Materials Joining Technology Elective				
Unit 51: Introduction to Materials Joining Technology				
51.1 Define welding engineers and material joining technicians.				
51.2 Describe the background related to materials joining.				
51.3 Classify the categories of welding and joining processes.				
Unit 52: Arc Welding Processes				
52.1 Contrast the classification of arc welding processes and describe how they fit in all fusion welding processes.				
52.2 Explain the shielded metal arc welding (SMAW) process and its uses.				
52.3 Explain the gas metal arc welding (GMAW) process and its uses.				
52.4 Explain the flux core arc welding process (FCAW) and its uses.				
52.5 Explain the submerged arc welding (SAW) process and its uses.				
52.6 Explain the gas tungsten arc welding (GTAW) process and its uses.				
52.7 Explain the plasma arc welding (PAW) process and its uses.				
52.8 Explain the electroslag (ES) and electrogas (EG) welding processes and their uses.				
52.9 Explain the arc stud welding process and its uses.				
52.10 Develop an automated arc welding procedure for the manufacture of a part (e.g., pacemaker body, bellows).				
Unit 53: Non-Arc Welding Processes				
53.1 Summarize the non-arc welding processes.				
53.2 Explain the resistance welding (RW) process.				
53.3 Explain the oxy-fuel gas welding processes.				
53.4 Explain the thermit welding process.				
53.5 Explain the solid state bonding processes.				
53.6 Explain the high energy density fusion welding processes.				
53.7 Explain the brazing and soldering processes.				
53.8 Explain the processes used for joining plastics.				

53.9 Explain adhesive bonding of parts.				
53.10 Develop a manual welding procedure for the bonding of thermoplastic parts using a hot air gun.				
53.11 Develop a resistance weldability “Lobe Curve” using a virtual online resistance welding machine.				
Unit 54: Physics of Welding				
54.1 Explain the concept of welding heat input.				
54.2 Describe the characteristics of the welding arc.				
54.3 Describe the physics of metal transfer.				
54.4 Describe the physics of the arc welding power sources.				
54.5 Describe the physics of arc blow.				
Unit 55: Heat Flow				
55.1 Describe heat flow in welds.				
55.2 Describe how heat flow affects the temperate profile around a weld.				
55.3 Develop a thermal profile around a moving weld.				
Unit 56: Metallurgical Background		X		
56.1 Define phases of matter and phase changes during solidification.		X		
56.2 Explain the common crystal structures in metallic materials.		X		
56.3 Explain imperfection in crystal structure.				
56.4 Define phase changes and phase diagrams.				
56.5 Define phase changes of eutectoid steels.				
56.6 Explain tie line.				
56.7 Explain transformation strengthening.				
56.8 Explain deformation strengthening.				
56.9 Explain precipitation strengthening.				
Unit 57: Welding Metallurgy				
57.1 Define weld regions.				
57.2 Define fusion and unmixed zones.				
57.3 Define the partially melted zone.				
57.4 Define the heat affected zone (HAZ).				
57.5 Define the base metal zone.				
Unit 58: Design		X		
58.1 Explain the mechanical properties of materials.		X		
58.2 Explain the fatigue properties of materials.		X		
58.3 Explain the fracture toughness properties of materials.		X		
58.4 Explain the hardness properties of materials.		X		
58.5 Explain creep testing of materials.				
58.6 Explain other physical properties.		X		
58.7 Explain weld joint design.				
58.8 Explain the uses of codes and standards.				
58.9 Explain the uses of codes and standards in weldment joint design.				
58.10 Explain the use of welding symbols to communicate weld design.				
58.11 Explain residual stresses and distortion in weldments.				
58.12 Explain the development of welding procedures and weld qualifications.				

58.13 Design a welded structure.				
58.14 Evaluate a failed structure.				
Unit 59: Testing and Inspection				
59.1 Explain the factors considered in weld quality.				
59.2 Explain discontinuity and defect.				
59.3 Explain destructive weldment testing techniques.				
59.4 Explain weldability tests.				
59.5 Explain the need for non-destructive examination (NDE).				
59.6 Perform visual examination.				
59.7 Describe dye penetrant examination.				
59.8 Describe magnetic particle examination.				
59.9 Explain radiographic examination.				
59.10 Describe eddy current examination.				
59.11 Describe ultrasonic examination.				
59.12 Describe acoustic emission examination.				
59.13 Examine a weld structure.				
59.14 Appraise the quality of a welded part by NDE.				
Unit 60: Safety				
60.1 Describe the importance of safety training.				
60.2 Assess work area safety.				
60.3 Practice personal safety and select appropriate equipment.				
60.4 Describe fumes, gases and toxic materials.				
60.5 Demonstrate gas storage safety.				
60.6 Demonstrate fire safety.				
60.7 Demonstrate electrical safety.				
60.8 Demonstrate radiation safety.				
60.9 Demonstrate proper ergonomic practices.				
Computational Science and Engineering Elective				
Unit 61: Introduction	X	X	X	X
61.1 Explain the role of modeling in science and engineering.	X	X	X	
61.2 Analyze modeling and simulation in computational science.				
61.3 Create a conceptual model.	X	X	X	X
Unit 62: Basics of Computational Modeling and Simulation	X	X	X	X
62.1 Examine various mathematical representations of functions.	X		X	
62.2 Analyze issues in accuracy and precision.	X	X	X	
62.3 Demonstrate computational programming utilizing MATLAB™.				
62.4 Assess computational models.				
62.5 Build event-based models.				
Unit 63: Advanced Techniques				
63.1 Demonstrate advanced graphical techniques to represent data functions and relationships.				
63.2 Demonstrate parallel and high-performance computing.				
Unit 64: Research and Design	X	X	X	X
64.1 Complete a team-based, real-world model project.	X	X	X	X

64.2 Demonstrate technical communication.	X	X	X	X
Architecture and Civil Engineering Elective				
Unit 65: Overview	X		X	
65.1 Compare and contrast civil engineering and architecture.	X			
65.2 Describe the various individuals and agencies and their roles during the design and development of a civil engineering and architectural project.				
65.3 Describe postsecondary education and career opportunities in the field of civil engineering and architecture.	X		X	
Unit 66: Project Design	X	X	X	X
66.1 Analyze criteria and constraints that promote viable decisions regarding the development of a solution.	X	X	X	X
66.2 Apply common practices utilized in civil engineering and architecture to develop a viable solution to a project.	X			
Unit 67: Project Documentation	X	X	X	X
67.1 Explain the need for and development of a portfolio as documentation.	X	X	X	X
67.2 Amend ideas, notes and presentations, based on personal review.	X	X	X	X
67.3 Describe in daily journals the advantages and disadvantages of various information gathering, communications and design processes.				
67.4 Develop two- and three-dimensional imagery and graphics, using both manual and computer-assisted processes.	X	X		
Unit 68: Site Information				
68.1 Determine the viability and feasibility of the project site.				
68.2 Research zoning ordinances and regulations to determine the necessary procedures for finishing a project.				
68.3 Apply principles of reading a contour map.				
Unit 69: Development Options, Selection of Project and Revisiting Viability Analysis	X	X	X	X
69.1 Evaluate the team's design idea and explain why it is viable.	X	X	X	X
69.2 Describe the relationship between structures and land and the responsibility of designers to handle resources in an ethical manner.	X			
Unit 70: Description of the Property				
70.1 Summarize legal descriptions.				
70.2 Describe a visual survey of a site and necessary observations.				
Unit 71: Land Surveying				
71.1 Explore the history of surveying.				
71.2 Explain data collection, coordinate geometry and presentation.				
71.3 Explore state-of-the-sart technology.				
Unit 72: Site Plan Layout				
72.1 Summarize issues and concerns that must be addressed in the site plan layout.				
72.2 Analyze the pros and cons of local, state and federal regulations on site development.				

Unit 73: Public Ingress and Egress				
73.1 Interpret topographical data and design criteria to create and document the vertical and horizontal transit lines and station points necessary to lay out a road with proper alignment.				
73.2 Apply appropriate codes and parameters to design a suitable and accessible parking lot for a commercial project.				
Unit 74: Site Grading				
74.1 Analyze issues that must be addressed before grading the site.				
74.2 Calculate the amount of water a rainstorm will drop on a proposed site, and use that information in the design and sizing of a drainage system.				
74.3 Use a site plan with contours to locate and create a cut and fill plan for a proposed improvement.				
Unit 75: Utilities	X			
75.1 Explain the reason for a site investigation phase of a project that involves site access, utility availability and transportation.				
75.2 Communicate information to peers using schematic symbols.	X			
75.3 Compute the utility needs of a project, and size the utility supply lines.				
Unit 76: Landscaping				
76.1 Analyze the selection and placement of plantings to ensure the proper use of resources and aesthetic appeal.				
76.2 Design a landscape site for a structure or structures.				
Unit 77: Water Supply and Waste Water Treatment				
77.1 Determine the source of water for a project site.				
77.2 Perform preliminary design calculations and layouts of the selected wastewater management system.				
Unit 78: Architecture	X			
78.1 Describe architectural styles for various structures.				
78.2 Compare and contrast architectural styles historically, geographically and economically.				
78.3 Describe the floor plan spatial relationships and the design elements necessary to make those spaces function properly.				
78.4 Research and define an appropriate energy system.	X			
78.5 Calculate and determine the heat loss or gain of the building envelope.				
78.6 Compare and contrast the various elevation views.				
78.7 Draw the exterior and interior elevations of the project.				
78.8 Draw the sections and details of a structure.	X			

78.9 Identify and create the necessary schedules for the project.	X			
78.10 Research mechanical, electrical and protection systems.				
78.11 Determine the mechanical, electrical and protection systems necessary for the project.				
78.12 Draw the diagrams for the mechanical, electrical and protection systems.				
Unit 79: Structural Engineering	X			
79.1 Identify the work of a structural engineer.	X			
79.2 Determine the live and dead loads of a structure using load tables and appropriate mathematics.				
79.3 Compare and contrast the efficiencies and limitations of various types of structural roof systems.				
79.4 Calculate the load for roof members.				
79.5 Determine the strength of columns and beams required for a structure.	X			
79.6 Size floor members according to loads and modify section details to show the sizing of supporting materials.				
79.7 Sketch various foundations and describe their advantages and disadvantages.				
Unit 80: Architecture and Civil Engineering Capstone Project	X			
80.1 Report on a team-based, real-world model project.	X			
80.2 Conduct an oral presentation regarding the design and development of a project.	X			
Engineering Design and Development Required Course				
Unit 81: Introduction to Engineering Design and Development				
81.1 Identify the scope of and purpose for an engineering design and development research project.				
81.2 Determine the structure for evaluating a research project.				
Unit 82: Elements of Formal Research	X	X	X	X
82.1 Use a journal as the source for returning to any desired previously encountered information.				
82.2 Use conventional library resources as a starting point for all research.				
82.3 Use the computer as a research tool.	X	X	X	X
82.4 Contact the experts.				
Unit 83: Guided Research	X	X	X	X
83.1 Demonstrate methods of brainstorming.	X	X	X	X
83.2 Research a topic.	X	X	X	X
83.3 Formulate a hypothesis and a problem statement.				
83.4 Research and develop alternative solutions.	X	X		X
83.5 Redefine and justify alternative solutions.	X	X	X	X
83.6 Demonstrate presentation methods.	X	X	X	X
Unit 84: Independent Research	X	X	X	X
84.1 Describe procedures for completing an				

independent research project.				
84.2 Develop a prototype.	X	X	X	X
84.3 Prepare a research paper.				
Unit 85: Formal Presentations	X	X	X	X
85.1 Create a presentation.	X	X	X	X
85.2 Make a formal presentation.	X	X	X	X
Engineering Technology Specialization				
Unit 86: Technical Drawing	X	X		
86.1 Demonstrate technical applications common to all types of drafting.	X	X		
86.2 Construct various geometric forms and shapes.		X		
86.3 Produce basic orthographic drawings.	X	X		
86.4 Sketch views of given objects.	X	X		
86.5 Demonstrate geometric dimensioning and tolerancing (GDT).	X	X		
86.6 Demonstrate computer-aided drafting and design (CADD) skills.	X	X		
86.7 Evaluate a sketch and generate a model utilizing CAD software.	X	X		
86.8 Demonstrate technical skills for making auxiliary view drawings.				
86.9 Demonstrate technical skills for making sectional view drawings.				
86.10 Demonstrate technical skills for making mechanical engineering working drawings.	X			
86.11 Demonstrate technical skills for making a reverse engineered drawing from a solid object.				
86.12 Differentiate among various types of engineering drawings and blueprints.	X			
86.13 Select the necessary view to graphically communicate design features.	X	X		
Unit 87: Elements of Machine Design				X
87.1 Describe the importance of integrating individual machine elements into a more comprehensive mechanical system.				
87.2 Analyze basic machine elements commonly found in mechanical devices and equipment.				X
87.3 Describe other machine design elements.				
Unit 88: Manufacturing Processes		X		
88.1 Explain the various manufacturing processes.		X		
88.2 Demonstrate technical skills for manufacturing engineering technology.		X		
88.3 Demonstrate measurement, metrology instrumentation and inspection techniques.				
Unit 89: Power Systems				X
89.1 Explain the basic principles of fluid mechanics.				X
89.2 Explain basic hydraulic systems.				X
89.3 Explain basic pneumatic systems.				X
89.4 Explain basic fluid power and operational components.				X
89.5 Explain power transmission systems.				X
Unit 90: Strength of Materials	X	X		X
90.1 Explain the difference among the various modes of stresses.	X	X		
90.2 Differentiate between stress and strain.	X			X

90.3 Construct a stress-strain diagram.				
90.4 Calculate torsion problems.	X			
90.5 Use shear and bending moment diagrams in solving strength problems.				
90.6 Calculate the stresses in beams.	X			
90.7 Calculate beam deflection.	X			
90.8 Solve basic combined stress problems.				
90.9 Solve simple column problems.				
90.10 Describe material behavior in electrical, electronic and optical devices.				
Unit 91: Statics			X	
91.1 Explain the fundamental concepts and principles of statics.				
91.2 Examine the basic mechanics of a mechanical system.				
91.3 Calculate the resultant of coplanar force systems.				
91.4 Associate moments and couples.				
91.5 Solve problems under equilibrium conditions.				
91.6 Analyze structures under equilibrium conditions.				
91.7 Solve problems involving friction.			X	
91.8 Calculate the centroid, center of gravity and moment of inertia of a body.			X	
Unit 92: Dynamics				
92.1 Explain the concepts used in kinematics.				
92.2 Explain the concepts used in kinetics.				
92.3 Explain planar kinematics and kinetics of rigid bodies.				
92.4 Discuss the concepts of kinematics and kinetics of basic mechanical mechanisms.				
Unit 93: Thermodynamics and Heat Transfer	X			
93.1 Explain how the first law of thermodynamics is used to solve problems on work, heat and reversibility.	X			
93.2 Explain how the second law of thermodynamics is used to solve heat engine problems.				
93.3 Explain heat transfer modes and applications.				
Unit 94: Fundamentals of Electricity	X			
94.1 Explain basic electrical theory.	X			
94.2 Analyze series and parallel circuits.	X			
94.3 Construct series and parallel electrical circuits.	X			
94.4 Explain magnetic theory.	X			
94.5 Utilize electrical test equipment, and record measurements.	X			
94.6 Analyze the fundamentals of AC and DC.				
94.7 Examine electronic devices used in industrial circuits.	X			
94.8 Examine transformers, three-phase and single-phase voltage.				
94.9 Describe relays, contactors, solenoids and integrated circuits.				
Unit 95: Fundamentals of Electronics	X			X
95.1 Identify and describe electronic components.	X			
95.2 Explain and demonstrate soldering and				

desoldering applications.				
95.3 Explain block diagrams, schematics and wiring diagrams.	X			
95.4 Explain and demonstrate cabling applications.				
95.5 Explain the function and applications of power supplies.	X			
Unit 96: Motors				X
96.1 Describe industrial motor controls.				
96.2 Explain motor starters and over-current controls.				
96.3 Examine single-phase AC motors.				
96.4 Describe the operational features of three-phase motors.				
96.5 Describe motor control devices and circuits.				
96.6 Create Boolean expressions, logic circuit diagrams or truth tables.				X
96.7 Develop software applications.				X
96.8 Explain the function and operational features of programmable controllers.				X
Unit 97: Engineering Technology Capstone Project	X	X	X	X
97.1 Develop a team-based, real-world model project.	X	X	X	X
97.2 Present an oral report regarding the design and development of a project.	X	X	X	X
Science Pathway				
Energy Science Specialization				
Unit 98: Energy Trends and Issues	X			
98.1 Explore the history of energy.	X			
98.2 Examine the economics of energy.	X			
98.3 Explain laws, regulations and public policies.				
98.4 Evaluate the entrepreneur's role in the alternative and renewable energy industry.	X			
98.5 Develop a business plan for alternative and/or renewable energy projects.				
98.6 Examine the structural, architectural and design implications of alternative and/or renewable energy applications.	X			
98.7 Discuss the societal, economic and political effects of decentralized power.				
98.8 Assess the principles of energy conservation technology.				
98.9 Analyze the roles of turbines, power generators and energy transmission in the alternative and/or renewable energy industry.	X			
98.10 Analyze electrical energy as a principal of energy science.	X			
Unit 99: Fundamentals of Electricity	X			
99.1 Explain basic electrical theory.	X			
99.2 Analyze series and parallel circuits.	X			
99.3 Explain magnetic theory.	X			
99.4 Analyze the fundamentals of AC and DC.				
99.5 Examine transformers, and three-phase and single-phase voltage.				
99.6 Describe relays, contactors, solenoids and integrated circuits.				
Unit 100: Solar Energy	X			

100.1 Explain solar radiation as energy from the sun.	X			
100.2 Analyze solar as a renewable energy source.	X			
100.3 Examine the classifications of solar power technology.				
100.4 Analyze the types of technologies developed to make use of solar radiation.				
100.5 Explain the issues and trends affecting the distribution and storage of solar energy.				
100.6 Explain how photovoltaic (PV) cells produce electrical energy.				
100.7 Explain the factors associated with a site survey for installing PV systems.				
100.8 Select a system design based on site survey results.				
100.9 Adapt the PV system's mechanical design to the respective installation.				
100.10 Adapt the electrical design to the respective installation.				
100.11 Install subsystems and components at the site.				
100.12 Perform a system checkout and inspection.				
100.13 Maintain and troubleshoot a PV system.				
100.14 Explain how solar thermal systems collect and transfer energy.				
Unit 101: Wind Energy	X			
101.1 Explain wind power as an energy source.	X			
101.2 Analyze wind power as a renewable energy source.	X			
101.3 Analyze turbine selection and location in relation to maximum wind energy generated.	X			
101.4 Describe factors and trends that lead to further development of wind energy locally, nationally and internationally.				
101.5 Examine the growth and development of small-scale, small utility scale and large utility scale wind turbine utilization.				
101.6 Explain the factors associated with site surveys for installing small-scale, small utility scale and large utility scale wind turbine systems.				
101.7 Select a system design based on site survey results.				
101.8 Adapt the wind turbine or farm design to respective needs of the consumer, institution, industry or community.				
101.9 Adapt the electrical design to the respective small-scale, small utility scale or large utility scale installation.				
101.10 Install onsite subsystems and components respective to small-scale, small utility scale or large utility scale installation.				
101.11 Perform a system checkout and inspection respective to small-scale, small utility scale or large utility scale installation.				
101.12 Perform maintenance and troubleshooting on wind turbines for small-scale, small utility scale or large utility scale installation.				

101.13 Analyze major issues impacting wind power development.				
Unit 102: Fossil Fuel and Nuclear Energy	X			
102.1 Analyze fossil fuels as a principle of energy science.	X			
102.2 Explain the classifications of fossil fuel technology.	X			
102.3 Analyze the types of technologies developed to make use of coal.				
102.4 Explain the issues affecting the transportation and storage of fossil fuels.				
102.5 Explain how fossil fuels are utilized to produce electrical energy.	X			
102.6 Explain the factors associated with a site survey for installing fossil fuel generating plants.				
102.7 Discuss a system design, based on site survey results.				
102.8 Explain the issues and trends affecting the extraction, distribution and storage of fossil fuels.				
102.9 Analyze nuclear energy as a principle of energy science.	X			
102.10 Explore the origin and evolution of nuclear power.				
102.11 Explain the societal and political concerns about nuclear power.	X			
102.12 Describe the types of technologies developed to make use of nuclear fuel.				
102.13 Explain the issues affecting the transportation and storage of nuclear fuels.				
102.14 Explain how nuclear fuels produce electrical energy.	X			
102.15 Discuss the factors affecting a site survey for installing nuclear fuel generating plants.				
102.16 Discuss a system design, based on site survey results.				
102.17 Explain issues and trends affecting fossil fuel, environmental controls and advanced technology.				
Unit 103: Hydro, Geothermal and Biomass Energy	X			
103.1 Analyze hydropower as a renewable energy source.	X			
103.2 Explain the issues and trends affecting the production, distribution and storage of hydroelectricity.	X			
103.3 Analyze wave power as a renewable energy source.	X			
103.4 Explain the issues and trends affecting the production, distribution and storage of wave power.	X			
103.5 Analyze tidal power as a renewable energy source.	X			
103.6 Explain the issues and trends affecting the production, distribution and storage of tidal power.	X			
103.7 Analyze oceanic thermal energy conversion (OTEC) as a renewable energy source.				
103.8 Explain the issues and trends affecting the				

production, distribution and storage of OTEC.				
103.9 Analyze geothermal power as a renewable energy source.	X			
103.10 Explain biomass as a renewable energy source.				
103.11 Explain the issues and trends affecting the production, distribution and storage of biomass energy.				
Unit 104: Biofuels Energy				
104.1 Analyze biodiesel as an energy source.				
104.2 Explain the issues and trends affecting the production, storage and distribution of biodiesel.				
104.3 Analyze ethanol as an energy source.				
104.4 Explain the issues and trends affecting the production, storage and distribution of ethanol.				
Unit 105: Fuel Cell Energy	X			
105.1 Explore the history of fuel cell development.				
105.2 Explain fuel cell processes and systems.	X			
105.3 Describe the use of fossil fuels in fuel cell systems.				
105.4 Explain fuel cell types and characteristics in relation to the designs for specific applications.				
105.5 Analyze thermodynamics and heat transfer as they relate to fuel cells.				
105.6 Explain combined heat and power in relation to fuel cells.				
105.7 Describe the various types of fuel cells.				
105.8 Describe fuel cell system operations.	X			
105.9 Analyze the mechanical aspects of fuel cell systems.				
105.10 Explain fuel cell installation, commissioning, troubleshooting and repair.				
Unit 106: Energy Capstone Project	X	X	X	X
106.1 Develop a team-based, real-world model project.	X	X	X	X
106.2 Conduct an oral presentation regarding the design and development of a project.	X	X	X	X
Total X's	227	167	93	112
Units Hit	62	44	32	38
Total Units	106	106	106	106
Competencies Hit	165	123	61	74
Total Competencies	530	530	530	530
% Units Hit	58	42	30	36
% Competencies Hit	31	23	12	14