

Course Title: Introduction to Engineering Design
Course Number: 8600550
Course Credit: 1

Course Description:

This course exposes students to the design process, research and analysis, teamwork, communication methods, global and human impacts, engineering standards, and technical documentation. Students will employ engineering and scientific concepts in the solution of engineering design problems. In addition, they will learn to use 3D solid modeling design software to design solutions to problems. Students will develop problem-solving skills and apply their knowledge of research and design to create solutions, document the process, and communicate the results.

CTE Standards and Benchmarks		NGSSS-Sci
04.0	Demonstrate an understanding of the design process and the activities associated with each step--The student will be able to:	SC.912.N.1.1; 3.5
04.01	Apply engineering notebook standards and protocols.	
04.02	Identify and apply group brainstorming techniques and the rules associated with brainstorming.	
04.03	Create and deliver a PowerPoint presentation depicting research on the impact of innovation on the evolution of a product.	
04.04	Use online and published works to research aspects of design problems.	
04.05	Describe the design process steps used in given scenarios.	
05.0	Demonstrate skill in sketching and drawing, and describe their importance to engineering design--The student will be able to:	SC.912.N.1.7
05.01	Identify, sketch, and explain the function of points, construction lines, object lines, and hidden lines.	
05.02	Plot points on grid paper to aid in the creation of sketches and drawings.	
05.03	Explain the concepts of technical sketching and drawing.	
05.04	Sketch an isometric view of simple geometric solids.	
05.05	Explain how an oblique view of simple geometric solids differs from an isometric view.	
05.06	Sketch one-point, two-point, and three-point perspectives of simple geometric solids.	
05.07	Describe the concept of proportion as it relates to freehand sketching.	
05.08	Sketch multiview drawings of simple geometric solids.	
05.09	Determine the front view for a given object.	

CTE Standards and Benchmarks	NGSS-Sci
06.0 Take, record, manipulate, and convert measurements using both standard and metric systems of linear measurement--The student will be able to:	
06.01 Research and design a presentation piece depicting the origins of the measurement systems.	
06.02 Measure and record linear distances using a scale to a precision of 1/16 inch and 1 mm.	
06.03 Measure and record linear distances using a dial caliper to a precision of 0.001 inch.	
06.04 Add and subtract U.S. standard and metric linear measurements.	
06.05 Convert linear distance measurements from inches to millimeters and vice versa.	
06.06 Apply linear dimensions to a multiview drawing.	
06.07 Calculate the mean, mode, median, and range of a data set.	
06.08 Create a histogram of recorded measurements showing data elements or class intervals, and frequency.	
07.0 Create and assemble a prototype using CAD modeling software--The student will be able to:	
07.01 Brainstorm and sketch possible solutions to an existing design problem.	
07.02 Select an approach that meets or satisfies the constraints given in a design brief.	
07.03 Create simple extruded solid Computer Aided Design (CAD) models from dimensioned sketches.	
07.04 Generate dimensioned multiview drawings from simple CAD models.	
07.05 Measure and Fabricate parts for a functional prototype from the CAD multiview drawings.	
07.06 Assemble the product using the CAD modeling software.	
07.07 Test and evaluate the prototype and record results.	
07.08 Apply geometric and numeric constraints to CAD sketches.	
07.09 Identify the purpose of packaging in the design of consumer products.	
08.0 Demonstrate an understanding of mathematics and dimensioning associated with CAD design software--The student will be able to:	
08.01 Identify common geometric shapes and forms by name.	
08.02 Calculate the area of simple geometric shapes.	
08.03 Calculate the surface area and volume of simple geometric forms.	

CTE Standards and Benchmarks	NGSS-Sci
08.04 Identify and explain the various geometric relationships that exist between the elements of two-dimensional shapes and three-dimensional forms.	
08.05 Identify and define the axes, planes, and sign conventions associated with the Cartesian coordinate system.	
08.06 Apply geometric and numeric constraints to CAD sketches.	
08.07 Utilize sketch-based, work reference, and placed features to develop solid CAD models from dimensioned drawings.	
08.08 Explain how a given object's geometry is the result of sequential additive and subtractive processes.	
08.09 Explain the differences between size and location dimensions.	
08.10 Differentiate between datum dimensioning and chain dimensioning.	
08.11 Identify and dimension fillets, rounds, diameters, chamfers, holes, slots, and screw threads in orthographic projection drawings.	
08.12 Explain the rules that are associated with the application of dimensions to multiview drawings.	
09.0 Demonstrate an understanding of tolerances and their implications on an engineering design--The student will be able to:	
09.01 Identify, sketch, and explain the difference between general tolerances, limit dimensions, unilateral, and bilateral tolerances.	
09.02 Differentiate between clearance and interference fits.	
09.03 Sketch and model an auxiliary view of a given object to communicate the true size and shape of its inclined surface.	
09.04 Describe the purpose and demonstrate the application of section lines and cutting plane lines in a section view drawing.	
09.05 Sketch a full and half section view of a given object to communicate its interior features.	
09.06 Identify algebraic relationships between the dimensional values of a given object.	
10.0 Demonstrate proficiency in designing and assembling parts using CAD software to animate the parts and control design constraints--The student will be able to:	
10.01 Apply assembly constraints to individual CAD models to create mechanical systems.	
10.02 Perform part manipulation during the creation of an assembly model.	
10.03 Explain how assembly constraints are used to systematically remove the degrees of freedom for a set of components in a given assembly.	
10.04 Create an exploded model of a given assembly.	

CTE Standards and Benchmarks	NGSS-Sci
10.05 Determine ratios and apply algebraic formulas to animate multiple parts within an assembly model.	
10.06 Create and describe the purpose of the following items: exploded isometric assembly view, balloons, and parts list.	
11.0 Create parts using CAD software, adhering to constraints provided in the design brief--The student will be able to:	
11.01 Brainstorm and sketch possible solutions to an existing design problem.	
11.02 Create a decision making matrix.	
11.03 Select an approach that meets or satisfies the constraints given in a design brief.	
11.04 Create solid computer-aided design (CAD) models of each part from dimensioned sketches using a variety of methods.	
11.05 Apply geometric numeric and parametric constraints to form CAD modeled parts.	
11.06 Generate dimensioned multiview drawings from simple CAD modeled parts.	
11.07 Assemble the product using the CAD modeling software.	
11.08 Explain what constraints are and why they are included in a design brief.	
11.09 Create a three-fold brochure marketing the designed solution for the chosen problem, such as a consumer product, a dispensing system, a new form of control system, or extend a product design to meet a new requirement.	
12.0 Explain the concept of fluid power, and the difference between hydraulic and pneumatic power systems--The student will be able to:	
12.01 Define fluid power	
12.02 Define hydraulic system	
12.03 Define pneumatic system	
12.04 Explain the uses of fluid power systems in current society and cite specific examples.	
12.05 Describe the advantages of fluid power systems	
12.06 Describe the disadvantages of fluid power systems	
12.07 Discuss the historical impacts related to the development of the fluid power industry.	
13.0 Describe the impact of visual design on the success or acceptability of an engineering design--The student will be able to:	
13.01 Identify visual design elements within a given object.	

CTE Standards and Benchmarks	NGSS-Sci
13.02 Explain how visual design principles were used to manipulate design elements within a given object.	
13.03 Explain what aesthetics is, and how it contributes to a design's commercial success.	
13.04 Identify the purpose of packaging in the design of consumer products.	
13.05 Identify visual design principles and elements that are present within marketing ads.	
13.06 Identify the intent of a given marketing ad and demographics of the target consumer group for which it was intended.	
14.0 Demonstrate an understanding of reverse engineering--The student will be able to:	
14.01 Define reverse engineering and describe its value to engineering design.	
14.02 Describe the value to engineers of reverse engineering products.	
14.03 Describe the function of a given manufactured object as a sequence of operations through visual analysis and inspection (prior to dissection).	
15.0 Reverse engineer a product--The student will be able to:	SC.912.N.2.2
15.01 Describe the differences between joinery, fasteners, and adhesives.	
15.02 Identify the types of structural connections that exist in a given object.	
15.03 Use dial calipers to precisely measure outside and inside diameter, hole depth, and object thickness.	
15.04 Identify a given object's material type.	
15.05 Identify material processing methods that are used to manufacture the components of a given commercial product.	
15.06 Assign a density value to a material, and apply it to a given solid CAD model.	
15.07 Perform computer analysis to determine mass, volume, and surface area of a given object.	
16.0 Demonstrate an understanding of design briefs and their role in the engineering design process--The student will be able to:	
16.01 Write design briefs that focus on product innovation.	
16.02 Identify group brainstorming techniques and the rules associated with brainstorming.	
16.03 Use decision matrices to make design decisions.	
16.04 Explain the difference between invention and innovation.	

CTE Standards and Benchmarks		NGSS-Sci
17.0	Demonstrate an understanding of product lifecycle and its implications on successive engineering designs--The student will be able to:	SC.912.L.17.16, 17, 20
17.01	Create and deliver a presentation depicting the lifecycle of a product as a timeline based on research.	
17.02	Describe how a product may be recycled and used to make other products after its lifecycle is complete.	
17.03	Identify the five steps of a product's lifecycle and propose recyclable uses for the material once the lifecycle of the product is complete.	
18.0	Actively participate on a virtual project team--The student will be able to:	
18.01	Explain why teams of people are used to solve problems.	
18.02	Identify group norms that allow a virtual design team to function efficiently.	
18.03	Establish file management and file revision protocols to ensure the integrity of current information.	
18.04	Use internet resources, such as email, to communicate with a virtual design team member throughout a design challenge.	
18.05	Identify strategies for addressing and solving conflicts that occur between team members.	
18.06	Create a Gantt chart to manage the various phases of their design challenge.	

Course Title: Principles of Engineering
Course Number: 8600520
Course Credit: 1

Course Description:

This course helps students understand the field of engineering/engineering technology and prepares them for postsecondary engineering programs by developing a more in-depth mastery of the required knowledge and skills in mathematics, science, and technology. Through problem-based learning strategies, students study key engineering topics, including mechanisms, energy sources, energy applications, machine control, fluid power, statics, material properties, material testing, statistics, and kinematics. Exploring various technology systems and manufacturing processes help students learn how engineers and technicians use math, science and technology in an engineering problem solving process to benefit people. The course also includes concerns about social and political consequences of technological change.

CTE Standards and Benchmarks		NGSSS-Sci
19.0	Demonstrate an understanding of the engineering field. – The student will be able to:	
19.01	Differentiate between engineering and engineering technology.	
19.02	Identify and differentiate among different engineering disciplines.	
20.0	Demonstrate an understanding of engineering complexities ranging from simple machines to compound machine design. – The student will be able to:	SC.912.P.10.3
20.01	Measure forces and distances related to mechanisms.	
20.02	Distinguish between the six simple machines, their attributes, and components.	
20.03	Calculate mechanical advantage and drive ratios of mechanisms.	
20.04	Design, create, and test gear, pulley, and sprocket systems.	
20.05	Calculate work and power in mechanical systems.	
20.06	Determine efficiency in a mechanical system.	
20.07	Design, create, test, and evaluate a compound machine design.	
21.0	Demonstrate an understanding of energy sources, their characteristics, and their renewability. – The student will be able to:	SC.912.L.17.11
21.01	Identify and categorize energy sources as nonrenewable, renewable, or inexhaustible.	
21.02	Create and deliver a presentation to explain a specific energy source.	
22.0	Perform mathematical operations specific to electrical systems. – The student will be able to:	SC.912.P.10.15

CTE Standards and Benchmarks	NGSSS-Sci
22.01 Define the possible types of power conversion.	
22.02 Calculate work and power.	
22.03 Demonstrate the correct use of a digital multimeter.	
22.04 Calculate power in a system that converts energy from electrical to mechanical.	
22.05 Determine efficiency of a system that converts an electrical input to a mechanical output.	
22.06 Calculate circuit resistance, current, and voltage using Ohm's law.	
22.07 Understand the advantages and disadvantages of parallel and series circuit design in an application.	
23.0 Demonstrate an understanding of the applications of alternative energy solutions. – The student will be able to:	
23.01 Test and apply the relationship between voltage, current, and resistance relating to a photovoltaic cell and a hydrogen fuel cell.	
23.02 Experiment with a solar hydrogen system to produce mechanical power.	
24.0 Demonstrate an understanding of insulation, the suitability of specific materials for use as insulation, and associated mathematics. – The student will be able to:	
24.01 Design, construct, and test recyclable insulation materials.	
24.02 Test and apply the relationship between R-values and recyclable insulation.	
24.03 Complete calculations for conduction, R-values, and radiation.	
25.0 Analyze an energy-related problem and design a solution to the problem. – The student will be able to:	SC.912.N.1.1
25.01 Brainstorm and sketch possible solutions to the design problem.	
25.02 Create a decision-making matrix for the design problem.	
25.03 Select an approach that meets or satisfies the constraints provided in the design brief.	
25.04 Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon the design team's decision matrix.	
25.05 Present a workable solution to the design problem.	
26.0 Demonstrate an understanding of machine control systems, logic, and devices. – The student will be able to:	
26.01 Create detailed flow charts utilizing a computer software application.	

CTE Standards and Benchmarks		NGSS-Sci
26.02	Create control system operating programs utilizing computer software.	
26.03	Create system control programs that utilize flowchart logic.	
26.04	Choose appropriate inputs and outputs devices based on the need of a technological system.	
26.05	Differentiate between the characteristics of digital and analog devices.	
26.06	Judge between open and closed loop systems in order to choose the most appropriate system for a given technological problem.	
26.07	Design and create a control system based on given needs and constraints.	
27.0	Demonstrate an understanding of the characteristics, devices, components, limitations, and associated mathematics of hydraulic and pneumatic systems. – The student will be able to:	SC.912.P.12.10
27.01	Identify devices that utilize fluid power.	
27.02	Identify and explain basic components and functions of fluid power devices.	
27.03	Differentiate between the characteristics of pneumatic and hydraulic systems.	
27.04	Distinguish between hydrodynamic and hydrostatic systems.	
27.05	Design, create, and test a hydraulic device.	
27.06	Design, create, and test a pneumatic device.	
27.07	Calculate values in a fluid power system utilizing Pascal's Law.	
27.08	Distinguish between pressure and absolute pressure.	
27.09	Distinguish between temperature and absolute temperature.	
27.10	Calculate values in a pneumatic system utilizing the perfect gas laws.	
27.11	Calculate flow rate, flow velocity, and mechanical advantage in a hydraulic system.	
28.0	Demonstrate an understanding of the analysis of loads on physical systems in static equilibrium (statics). – The student will be able to:	SC.912.P.12.1
28.01	Create free body diagrams of objects, identifying all forces acting on the object.	
28.02	Mathematically locate the centroid of structural members.	
28.03	Calculate moment of inertia of structural members.	

CTE Standards and Benchmarks	NGSS-Sci
28.04 Differentiate between scalar and vector quantities.	
28.05 Identify magnitude, direction, and sense of a vector.	
28.06 Calculate the X and Y components given a vector.	
28.07 Calculate moment forces given a specified axis.	
28.08 Use equations of equilibrium to calculate unknown forces.	
28.09 Use the method of joints strategy to determine forces in the members of a statically determinate truss.	
29.0 Demonstrate an understanding of analyzing the material properties of products. – The student will be able to:	
29.01 Investigate specific material properties related to a common household product.	
29.02 Conduct investigative non-destructive material property tests on selected common household products. Property testing conducted to identify continuity, ferrous metal, hardness, and flexure.	
29.03 Calculate weight, volume, mass, density, and surface area of selected common household product	
29.04 Identify the manufacturing processes used to create the selected common household product.	
29.05 Identify the recycling codes.	
30.0 Perform tensile and stress tests on sample material. – The student will be able to:	
30.01 Obtain measurements of material samples.	
30.02 Tensile test a material test sample.	
30.03 Identify and calculate test sample material properties using a stress strain curve.	
31.0 Analyze problem related to materials and structures, and design a solution to the problem. – The student will be able to:	
31.01 Brainstorm and sketch possible solutions to the design problem.	
31.02 Create a decision making matrix for the design problem.	
31.03 Select an approach that meets or satisfies the constraints given in the design brief.	
31.04 Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon your team's decision matrix.	
31.05 Present a workable design solution.	

CTE Standards and Benchmarks	NGSSS-Sci
32.0 Design and create a control system based on given needs and constraints. – The student will be able to:	
32.01 Create detailed flow charts utilizing a computer software application.	
32.02 Create control system operating programs utilizing computer software.	
32.03 Create system control programs that utilize flowchart logic.	
32.04 Choose appropriate inputs and output devices based on the need of a technological system.	
32.05 Differentiate between the characteristics of digital and analog devices.	
32.06 Judge between open and closed loop systems in order to choose the most appropriate system for a given technological problem.	
33.0 Design, create, test, and present a workable solution to a design problem involving hydraulic and/or pneumatic technology. – The student will be able to:	
33.01 Identify devices that utilize fluid power.	
33.02 Identify and explain basic components and functions of fluid power devices.	
33.03 Differentiate between the characteristics of pneumatic and hydraulic systems.	
33.04 Distinguish between hydrodynamic and hydrostatic systems.	
33.05 Design, create, and test a hydraulic device.	
33.06 Design, create, and test a pneumatic device.	
33.07 Calculate values in a fluid power system utilizing Pascal's Law.	
33.08 Distinguish between pressure and absolute pressure.	
33.09 Distinguish between temperature and absolute temperature.	
33.10 Calculate values in a pneumatic system, utilizing the perfect gas laws.	
33.11 Calculate flow rate, flow velocity, and mechanical advantage in a hydraulic system.	
33.12 Brainstorm and sketch possible solutions to the design problem.	
33.13 Create a decision-making matrix.	
33.14 Select an approach to satisfy the constraints provided in the design brief.	

CTE Standards and Benchmarks	NGSSS-Sci
33.15 Create a detailed pictorial sketch or use 3D modeling software to illustrate the best choice derived from the design team's decision matrix.	
34.0 Apply principles of statistics to calculate the theoretical probability that an event will occur. – The student will be able to:	
34.01 Calculate the experimental frequency distribution of an event occurring.	
34.02 Apply the Bernoulli process to events that only have two distinct possible outcomes.	
34.03 Apply AND, OR, and NOT logic to probability.	
34.04 Apply Bayes' theorem to calculate the probability of multiple events occurring.	
34.05 Create a histogram to illustrate frequency distribution.	
34.06 Calculate the central tendency of a data array, including mean, median, and mode.	
34.07 Calculate data variation, including range, standard deviation, and variance.	
35.0 Apply principles of kinematics and statistics to design and present a workable solution to a design problem associated with bodies in motion. – The student will be able to:	SC.912.P.12.2, 3
35.01 Calculate distance, displacement, speed, velocity, and acceleration from data.	
35.02 Design, build, and test a vehicle that stores and releases potential energy for propulsion.	
35.03 Calculate acceleration due to gravity given data from a free fall device.	
35.04 Calculate the X and Y components of a projectile motion.	
35.05 Determine the needed angle to launch a projectile a specific range given the projectile's initial velocity.	
35.06 Brainstorm and sketch possible solutions to an existing design problem.	
35.07 Create a decision-making matrix for their design problem.	
35.08 Select an approach that meets or satisfies the constraints provided in a design brief.	
35.09 Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon the design team's decision matrix.	
35.10 Present a workable solution to the design problem.	

Course Title: Digital Electronics
Course Number: 8600530
Course Credit: 1

Course Description:

This is a course in applied logic that encompasses the application of electronic circuits and devices. Students are exposed to the design process of combinational and sequential logic design, teamwork, communication methods, engineering standards, and technical documentation. Computer simulation software is used to design and test digital circuitry prior to the actual construction of circuits and devices.

CTE Standards and Benchmarks	
39.0	Demonstrate an understanding of the foundations of digital electronics. – The student will be able to:
39.01	Describe and apply three common notational forms of expressing numbers.
39.02	Identify and describe the operation of common electronic components.
39.03	Perform basic soldering techniques and printed circuit board construction.
39.04	Define and apply Ohm’s Law and Kirchhoff’s Laws in the design of series and parallel electronic circuitry.
39.05	Analyze simple analog and digital circuits using common electronic test equipment and tools.
39.06	Determine the characteristics of analog and digital signals.
39.07	Translate data specifications into truth tables and extract logical expressions.
39.08	Use Boolean algebra and DeMorgan’s Theorem to simplify logic expressions.
40.0	Demonstrate an understanding of combinational logic analysis and design. – The student will be able to:
40.01	Describe the operation of basic logic components, including gates, inverters, and flip-flops.
40.02	Design a combinational logic circuit using basic logic gates.
40.03	Simulate and prototype a logic circuit.
40.04	Design a combinational logic circuit incorporating negative logic.
40.05	Simulate and prototype a logic circuit employing negative logic.
40.06	Design half-adder, full-adder, and binary adder logic circuits using exclusive logic.
40.07	Design a combinational logic circuit using a programmable logic device.
40.08	Simulate and prototype a combinational logic circuit employing a programmable logic device.

CTE Standards and Benchmarks

40.09 Analyze and design basic flip-flop applications, including event detection circuits, data synchronizers, shift registers, and frequency dividers.

41.0 Demonstrate an understanding of sequential logic analysis and design. – The student will be able to:

41.01 Design, simulate, and prototype a basic flip-flop application.

41.02 Design, simulate, and prototype SSI and MSI asynchronous counters.

41.03 Describe the components of a state machine.

41.04 Design, simulate, and prototype state machines using discrete or programmable logic.

42.0 Demonstrate an understanding of the role of microcontrollers in process control. – The student will be able to:

42.01 Program and test an autonomous robot.

42.02 Flowchart a microcontroller program to maneuver a robot.

42.03 Program a microcontroller to maneuver a robot.

Course Title: Computer Integrated Manufacturing
Course Number: 8600560
Course Credit: 1

Course Description:

This course applies principles of robotics and automation. The course builds on computer solid modeling skills developed in Introduction to Engineering Design. Students use CNC equipment to produce actual models of their three-dimensional designs. Fundamental concepts of robotics used in automated manufacturing, and design analysis are included.

CTE Standards and Benchmarks	
43.0	Demonstrate an understanding of manufacturing, its history, models, and procedures. – The student will be able to:
43.01	Explore manufacturing through research and projects.
43.02	Understand what the enterprise wheel represents and how it represents the overall manufacturing scheme.
43.03	Research a topic in manufacturing, develop a presentation, and present findings to a group.
43.04	Explain the different procedures used in manufacturing.
44.0	Demonstrate an understanding of control systems and methods to describe or document their processes. – The student will be able to:
44.01	Identify basic flowcharting symbols and discuss their functions.
44.02	Create a flowchart that portrays a manufacturing process.
44.03	Apply flowcharting to areas other than manufacturing.
44.04	Identify a control system and explain its application to manufacturing.
44.05	Model and create a program to control an automated system.
45.0	Demonstrate an understanding of the cost of manufacturing. – The student will be able to:
45.01	Create a control system that replicates a factory cell.
45.02	Maximize the efficiency of the manufacturing system with respect to time and cost.
45.03	Compare the efficiency of running multiple systems against that of one large system.
46.0	Demonstrate proficiency in designing products for manufacturability. – The student will be able to:
46.01	Use the design process.
46.02	Use knowledge of design to analyze products with flaws.

CTE Standards and Benchmarks

46.03 Use calculated volume, mass, surface area of parts to determine material cost, waste, and packaging requirements.

46.04 Use solid modeling software to improve a flawed design.

46.05 Determine whether a product is safe for a given audience (e.g., children under the age of three).

46.06 Make ethical decisions about manufacturing.

46.07 Create a product using solid modeling software.

47.0 Demonstrate an understanding of manufacturing processes. – The student will be able to:

47.01 Explain the difference between primary and secondary manufacturing processes.

47.02 Analyze a product to propose the manufacturing processes used to create it.

47.03 Explore manufacturing processes via research.

47.04 Explore prototyping processes.

48.0 Demonstrate an understanding of computer numeric control (CNC) as it relates to product design and development. – The student will be able to:

48.01 Identify machines when given a process and identify the process that a given machine performs.

48.02 Determine the appropriate speed rate for a given material using a tool with a given diameter.

48.03 Determine the feed rate for a given material using a tool with a given diameter.

48.04 Read and interpret G & M codes.

48.05 Transfer the drawings made in CAD to a CAM program.

48.06 Create numerical code using a CAM program.

48.07 Verify the creation of a part using simulation software.

48.08 Create parts using the machines demonstrated by the instructor.

48.09 Create a product on the computer using knowledge of manufacturing processes.

49.0 Demonstrate an understanding of automation and robotics relative to the manufacturing process. – The student will be able to:

49.01 Research a topic in automation.

49.02 Identify the advantages and disadvantages of robotic labor versus human labor.

CTE Standards and Benchmarks

49.03 Explore materials handling.

49.04 Create and program virtual robotic work cells with simulation software.

49.05 Program the interface between a robot and another machine.

50.0 Demonstrate an understanding of the elements of power and the associated mathematics. – The student will be able to:

50.01 Identify the three main power types.

50.02 Solve problems involving electrical, pneumatic, and mechanical power.

50.03 Convert power between units.

50.04 Calculate torque and use it to calculate power.

50.05 Solve problems involving fluid power.

50.06 Construct a system to convert pneumatic power into mechanical power.

51.0 Build, program, and configure a robot to perform predefined tasks. – The student will be able to:

51.01 Build a robot.

51.02 Create programs using robotic software that will allow the robot to perform a set of tasks.

51.03 Configure servo motors to operate the robot.

51.04 Formulate a list of tasks in which the robot can be used in a large scale CIM cell operation.

52.0 Demonstrate an understanding of the elements of Computer Integrated Manufacturing (CIM). – The student will be able to:

52.01 Identify the three categories of CIM systems.

52.02 Compare and contrast the benefits and drawbacks of the three categories of CIM systems.

52.03 Identify the components of an FMS.

52.04 Create a process design chart for a manufacturing process.

52.05 Students will explore a manufacturing or automation career of interest and determine the appropriateness and steps required to be a professional in that role.

53.0 Demonstrate proficiency in designing an efficient flexible manufacturing system (FMS) that contains CIM elements. – The student will be able to:

53.01 Identify the potential safety issues with a CIM system and identify solutions for these problems.

CTE Standards and Benchmarks

53.02 Understand the significance of teamwork and communication.

53.03 Design a manufacturing system that contains at least two automated components.

53.04 Complete the construction of each individual component of the miniature FMS and verify that each component works.

53.05 Assemble components into a working miniature FMS.

53.06 Refine each component to improve the total process flow and cycle time.

53.07 Maintain a journal to document daily work.

Course Title: Civil Engineering and Architecture
Course Number: 8600590
Course Credit: 1

Course Description:

This course provides an overview of the fields of Civil Engineering and Architecture, while emphasizing the interrelationship and dependence of both fields on each other. Students use state of the art software to solve real world problems and communicate solutions to hands-on projects and activities. This course covers topics such as the Roles of Civil Engineers and Architects, Project Planning, Site Planning, Building Design, and Project Documentation and Presentation.

CTE Standards and Benchmarks	
54.0	Demonstrate an understanding of civil engineering and architecture, its history, innovations, and evolution of styles and materials. – The student will be able to:
54.01	Connect modern structural and architectural designs to historical architectural and civil engineering achievements.
54.02	Identify three general categories of structural systems used in historical buildings.
54.03	Explain how historical innovations have contributed to the evolution of civil engineering and architecture.
54.04	Identify and explain the application of principles and elements of design to architectural buildings.
54.05	Determine architectural style through identification of building features, components, and materials.
54.06	Create a mock-up model depicting an architectural style or feature using a variety of materials. .
55.0	Demonstrate an understanding of the civil engineering and architecture field. – The student will be able to:
55.01	Identify the primary duties, and attributes of a civil engineer and an architect along with the traditional path for becoming a civil engineer or architect.
55.02	Identify various specialty disciplines associated with civil engineering.
55.03	Participate in a design charrette and recognize the value of using a charrette to develop innovative solutions to support whole building design.
55.04	Understand the relationship among the stakeholders involved in the design and construction of a building project.
56.0	Demonstrate an understanding of residential building structure, elements of design, and associated processes. – The student will be able to:
56.01	Identify typical components of a residential framing system.
56.02	Recognize conventional residential roof designs.
56.03	Model a common residential roof design and detail advantages and disadvantages of that style.

CTE Standards and Benchmarks

56.04	Use 3D architectural software to create a small building.
57.0	Perform mathematical operations associated with cost and efficiency analysis of a residential design. – The student will be able to:
57.01	Apply basic math skills to calculate the quantity and cost of concrete needed to pour the pad for a small building.
57.02	Create a cost estimate for a small construction project, including a detailed cost break-down.
57.03	Calculate the heat loss through one wall of a conditioned building.
57.04	Calculate the heat loss for a building envelope with given conditions appropriate for the project.
57.05	Apply principles of sustainable design to a small project.
58.0	Demonstrate proficiency in designing a residential structure, ascertaining appropriateness of electrical and plumbing elements, and considering site constraints and applicable codes. – The student will be able to:
58.01	Apply elements of good residential design to the design of a basic house to meet the needs of a client.
58.02	Design a home design that complies with applicable codes and requirements.
58.03	Incorporate sustainable building principles and universal design concepts into a residential design.
58.04	Create bubble diagrams and sketch a floor plan.
58.05	Identify residential foundation types and choose an appropriate foundation for a residential application.
58.06	Calculate the head loss and estimate the water pressure for a given water supply system.
58.07	Create sketches to document a preliminary plumbing and a preliminary electrical system layout for a residence that comply with applicable codes.
58.08	Design an appropriate sewer lateral for wastewater management for a building that complies with applicable codes.
58.09	Create a site opportunities map and sketch a project site.
58.10	Choose an appropriate building location on a site based on orientation and other site-specific information.
58.11	Calculate the storm water runoff from a site before and after development.
58.12	Document the design of a home using 3D architectural design software and construction drawings.
59.0	Demonstrate proficiency in designing commercial building structures, including compliance with building and zoning regulations, appropriate wall structures, and appropriate material selection. – The student will be able to:
59.01	Identify applicable building codes and regulations that apply to a given development.

CTE Standards and Benchmarks

59.02	Classify a building according to its use, occupancy, and construction type using the International Building Code.
59.03	Research Land Use regulations to identify zoning designations and allowable uses of property.
59.04	Comply with specifications, regulations, and codes during a design process.
59.05	Compare a variety of commercial wall systems and select an appropriate system for a given commercial application based on materials, strength, aesthetics, durability, and cost.
59.06	Compare a variety of commercial low-slope roof systems and select an appropriate system for a given commercial application based on materials, strength, durability, and cost.
59.07	Incorporate sustainable building practices, especially a green roof, into the design of a commercial building.
59.08	Use 3D architectural design software to incorporate revisions for the redesign of a building.
59.09	Use 3D architectural design software to create appropriate documentation to communicate a commercial building design.
59.10	Calculate the structural efficiency of a structure.
59.11	Use load-span tables to design structural elements.
60.0	Demonstrate proficiency in designing wall, floor, and foundation structures to meet specific load requirements using structural analysis software. – The student will be able to:
60.01	Identify the work of a structural engineer.
60.02	Use building codes and other resources to calculate roof loading to a structure and select appropriate roof beams to safely carry the load.
60.03	Analyze a simply supported beam subjected to a given loading condition to determine reaction forces, sketch shear and moment diagrams, and determine the maximum moment resulting in the beam.
60.04	Use beam formula to calculate end reactions and the maximum moments of a simply supported beam subjected to a given loading condition.
60.05	Use structural analysis software to create shear and moment diagrams of simply supported beams subjected to a given loading condition.
60.06	Calculate the deflection of a simply supported beam subjected to a given loading condition.
60.07	Use building codes and other resources to determine the required floor loading and design a structural steel floor framing system (beams and girders) for a given building occupancy.
60.08	Identify and describe the typical usage of foundation systems commonly used in commercial construction.
60.09	Determine the loads transferred from a steel framed structure to the ground through a foundation.
60.10	Size a spread footing for a given loading condition.
60.11	Check structural calculations created by others for correctness.

CTE Standards and Benchmarks

61.0	Demonstrate proficiency in designing heating, ventilation, and air conditioning services and utilities for a commercial project to achieve energy conservation. – The student will be able to:
61.01	Interpret and apply code requirements and constraints as they pertain to the installation of services and utilities.
61.02	Read and understand HVAC construction drawings for a commercial project.
61.03	Apply criteria and constraints to size and locate the new utility service connections for a commercial facility.
61.04	Modify system designs to incorporate energy conservation techniques.
62.0	Demonstrate proficiency in creating a commercial site design that considers soil characteristics, storm water runoff, and specification/code requirements. – The student will be able to:
62.01	Use differential leveling to complete a control survey to establish a point of known elevation for a project.
62.02	Design appropriate pedestrian access, vehicular access and a parking lot for a commercial facility.
62.03	Analyze a site soil sample to determine the United Soil Classification System designation and predict soil characteristics important to the design and construction of a building on the site.
62.04	Estimate the increase in storm water runoff from a commercial site and create a preliminary design for a storm water storage facility.
62.05	Apply Low Impact Development techniques to a commercial site design reduce the impact of development on storm water runoff quantity and quality.
62.06	Follow specifications and codes during a design process.
62.07	Given 3D architectural design software, document a commercial site design.
63.0	Design a commercial building. – The student will be able to:
63.01	Work individually and in groups to produce a solution to a team project.
63.02	Research codes, zoning ordinances and regulations to determine the applicable requirements for a project.
63.03	Identify the boundaries of a property based on its legal description.
63.04	Perform research and visit a site to gather information pertinent to the viability of a project on the site.
63.05	Identify the criteria and constraints, and gather information to promote viable decisions regarding the development of their solution.
63.06	Create an architectural program, a project organization chart, and a Gantt chart and hold project progress meetings to help manage the team project.
63.07	Communicate ideas while developing a project using various drawing methods, sketches, graphics, or other media collected and documented.
63.08	Investigate the legal, physical, and financial requirements of a project and consider the needs of the community to determine project viability.

CTE Standards and Benchmarks

63.09 Apply current common practices utilized in Civil Engineering and Architecture to develop a viable solution in their project.

63.10 Develop an understanding of how software is used as a tool to aid in the solution and then the communication of a project.

64.0 Create and deliver a presentation of a commercial building design. – The student will be able to:

64.01 Assemble and organize work from a commercial project to showcase the project in an effective and professional manner.

64.02 Create visual aids for a presentation that include the appropriate drawings, renderings, models, documentation, and the rationale for choosing the proposal for project development.

64.03 Conduct an oral presentation to present a proposal for the design and development of a commercial building project.

Course Title: Aerospace Engineering
Course Number: 8600620
Course Credit: 1

Course Description:

This course is intended to engage students in analyzing and designing solutions to engineering design problems related to aerospace information systems, astronautics, rocketry, propulsion, the physics of space science, space life sciences, the biology of space science, principles of aeronautics, structures and materials, and systems engineering. Students work in teams, exploring hands-on projects and activities to learn the characteristics of aerospace engineering and work on major problems to be exposed to the various situations that aerospace engineers face in their careers.

CTE Standards and Benchmarks	
65.0	Demonstrate an understanding of the foundations of flight. – The student will be able to:
65.01	Describe the main components of an aircraft and the forces acting on them.
65.02	Explain and compare the impact of design changes on aircraft performance.
65.03	Describe the factors affecting aircraft performance in flight.
65.04	Analyze the design of an airfoil using simulation software and identify the design changes needed to meet specifications.
65.05	Design and test an airfoil to meet specifications using simulation software.
65.06	Construct an airfoil from a designed template.
65.07	Perform a wind tunnel test of a designed airfoil.
66.0	Demonstrate an understanding of aerodynamics fundamentals and aerodynamic testing. – The student will be able to:
66.01	Synthesize a test plan for performance analysis of an airfoil.
66.02	Analyze performance data from a wind tunnel test.
66.03	Create and present a technical report of the wind tunnel test results.
67.0	Demonstrate an understanding of propulsion systems and their performance factors. – The student will be able to:
67.01	Relate Newton's Three Laws of Motion to propulsion.
67.02	Describe the main forms of propulsion.
67.03	Analyze and compare performance of the different forms of propulsion.

CTE Standards and Benchmarks

67.04 Design and test an engine or propulsion system using simulation software.

68.0 Demonstrate an understanding of propulsionless flight. – The student will be able to:

68.01 Describe the requirements for a glider to be stable in flight.

68.02 Analyze the design of a glider and identify the design changes needed to meet specifications using simulation software.

68.03 Design and construct a glider to meet specifications.

68.04 Evaluate glider design relative to performance.

68.05 Write a proposal to receive “funding” to revise the current design.

69.0 Demonstrate an understanding of technologies used in aerial navigation. – The student will be able to:

69.01 Measure the GPS location of a number of objects.

69.02 Create a navigational chart.

69.03 Create a multi-segment flight plan.

69.04 Compare textual versus visual information relative to situational awareness.

69.05 Describe technological advances in the Global Positioning System.

70.0 Demonstrate an understanding of rocketry and associated performance factors. – The student will be able to:

70.01 Design and build a rocket engine thrust test device.

70.02 Test the thrust of a rocket engine using an engine thrust test device.

70.03 Modify the test to show thrust versus time data.

70.04 Describe the design factors and forces impacting rocket flight and how they interact using simulation software.

70.05 Describe how changes in design characteristics affect rocket performance.

70.06 Work as an engineering team to construct, fly, and create a formal report on a model rocket.

70.07 Estimate the maximum altitude of a model rocket.

70.08 Calculate a rocket’s maximum acceleration and velocity.

70.09 Describe how lift, drag, thrust, and weight are affected by launch angle.

CTE Standards and Benchmarks

71.0 Demonstrate an understanding of rocket/satellite-based aerial photography. – The student will be able to:

71.01 Design and construct an aerial photography project.

71.02 Calculate the scale factor of aerial photographs.

71.03 Calculate rocket altitude using the scale factor of an aerial photograph.

72.0 Demonstrate an understanding of orbital mechanics. – The student will be able to:

72.01 Describe a conic section and explain its relation to orbital theory.

72.02 Describe the orbital parameters associated with earth satellite motion.

73.0 Demonstrate an understanding of gravity and its effects on the human body. – The student will be able to:

73.01 Describe g-force and explain its relationship to gravity.

73.02 Design and conduct a g-force experiment, synthesizing the collected data to real world situations.

73.03 Describe vestibular stimulation and explain its effects in reduced gravity environments.

73.04 Describe microgravity and its importance to space flight environments.

74.0 Demonstrate an understanding of composite materials and their fabrication. – The student will be able to:

74.01 Mold various composite materials into test samples.

74.02 Conduct deflection tests on various test samples and graph the results.

74.03 Describe the role of composite materials in aircraft and spacecraft construction.

75.0 Demonstrate an understanding of thermal protection systems. – The student will be able to:

75.01 Identify the material properties necessary to provide thermal protection.

75.02 Conduct a thermal test on various materials, evaluate the results, and select the best candidate material.

76.0 Demonstrate an understanding of intelligent vehicles. – The student will be able to:

76.01 Describe the role of robotics in space environments.

76.02 Design a computer-controlled robot to deliver a payload to a location by navigating an obstacle course.

76.03 Design, build, and test an intelligent vehicle to meet specifications and pre-defined criteria.

Course Title: Biotechnical Engineering
Course Number: 8600630
Course Credit: 1

Course Description:

This course is intended to expose students to the diverse fields of biotechnology including biomedical engineering, bio-molecular genetics, bioprocess engineering, and agricultural and environmental engineering. Students will be engaged in engineering design problems related to biomechanics, cardiovascular engineering, genetic engineering, agricultural biotechnology, tissue engineering, biomedical devices, human interface, bioprocesses, forensics, and bio-ethics. This course applies and concurrently develops secondary level knowledge and skills in biology, physics, technology, and mathematics.

CTE Standards and Benchmarks	
77.0	Demonstrate an understanding of documentation procedures associated with biotechnical engineering. – The student will be able to:
77.01	Describe the various methods of documentation in biotechnical engineering.
77.02	Compare and contrast various methods of information gathering.
77.03	Follow procedures for ensuring accuracy and precision in measuring solutions.
78.0	Demonstrate an understanding of the evolution of biotechnical engineering. – The student will be able to:
78.01	Research and create a timeline depicting the evolution of biotechnical engineering, describing the impact of individual milestones.
78.02	Describe the fundamental concepts common to all major industries in biotechnical engineering.
78.03	Explain how biotechnical engineered products impact society.
78.04	Describe the relationship between the financial markets and biotechnical engineering.
79.0	Demonstrate an understanding of the role of values, morals, and ethics in the field of biotechnology. – The student will be able to:
79.01	Differentiate among values, morals, and ethics.
79.02	Analyze the bioethical issues arising from options created by technological advancements.
79.03	Create a public opinion survey.
80.0	Demonstrate an understanding of the roles of forensics, reverse engineering, and genetic engineering to biotechnology applications. – The student will be able to:
80.01	Describe molecular techniques used by bioinformaticists.
80.02	Analyze and apply the technologies used in the field of forensics.

CTE Standards and Benchmarks

80.03 Reverse engineer a crime scene.

80.04 Evaluate evidence and justify conclusions.

80.05 Apply practical knowledge of genetic engineering.

80.06 Form a start-up company that expands on previous genetic engineering work.

80.07 Conduct facial reconstruction as would a forensic artist.

81.0 Demonstrate an understanding of fermentation as it relates to the production of renewable energy. – The student will be able to:

81.01 Design a method or instrument for measuring fermentation rate.

81.02 Research and determine ideal conditions for fermentation.

81.03 Design and run a yeast-powered vehicle.

82.0 Demonstrate an understanding of engineering design principles relative to the field of biotechnology. – The student will be able to:

82.01 Apply engineering design principles by improving the design of a hospital or surgical instrument.

82.02 Demonstrate the application of product liability, product reliability, product reusability, and product failure.

83.0 Demonstrate an understanding of engineering as it relates to the design of prosthetic devices. – The student will be able to:

83.01 Design and build a joint model that mirrors human movement.

83.02 Design and model a new joint replacement.

83.03 Synthesize skeletal system concepts with the design process for engineering joints.

84.0 Research heart diseases, disorders, treatment options, and procedures. – The student will be able to:

84.01 Sketch and provide a solid model of heart chambers and valves.

84.02 Research procedures involving artificial heart surgery and present the cost of a proposed noninvasive implant.

84.03 Research and create a set of improvements for imaging techniques.

84.04 Design a portable ECG monitor and study the electrical aspects associated with the heart.

84.05 Research and design improvements in heart implants or instruments.

84.06 Perform a virtual heart surgery to better understand the instruments and implants in need of improving.

Course Title: **Engineering Design and Development**
Course Number: **8600650**
Course Credit: **1**

Course Description:

The purpose of this course is to serve as a capstone course to provide students with the opportunity to develop a solution to a design problem from start to finish. Students work in teams to design, engineer, create a prototype, perform product testing, and then produce a finished product. This would involve using ALL of the knowledge previously learned, not only in technology education, but across the curriculum. Students will be expected to create and deliver a formal report on the project.

CTE Standards and Benchmarks	
85.0	Identify, define, and justify a technical design problem for resolution. – The student will be able to:
85.01	Brainstorm problem statements for unique innovations or inventions.
85.02	Write a concise problem statement using technical writing skills.
85.03	Document research that justifies using the problem statement for the engineering design and development project.
86.0	Conduct research and investigation into the stated problem. – The student will be able to:
86.01	Use a list of specifications and constraints identified in a decision matrix to develop a list of alternative solutions to the stated problem.
86.02	Research and identify patents related to their identified problem.
86.03	Conduct research to investigate and determine the merit of his or her alternative solution based on past solutions to the problem.
86.04	Explain the feasibility of his or her solution based on his or her research.
86.05	Develop research strategies for his or her solution, including the use of surveys, phone interviews, and personal contact with experts related to the field of his or her technical problem.
86.06	Create a matrix table to analyze the data found from the patent research.
86.07	Conduct research to identify the difference between innovation and invention.
86.08	Write a fictional scenario for an innovation of interest.
86.09	Discuss the pros and cons of a decision matrix.
86.10	Conduct research and perform a trend analysis on a technical problem.
86.11	Sketch one invention and one innovation related to the technical problem.

CTE Standards and Benchmarks

87.0 Perform and graphically represent an evaluation of proposed design solutions using specific criteria, including product specifications. – The student will be able to:

87.01 Create a description of the product specifications for the design solution.

87.02 Objectively evaluate proposed design solutions using specific criteria.

87.03 Select the best design solution option using a decision matrix.

87.04 Graphically represent the results of the design solution evaluation.

88.0 Design a solution to the problem and create a working prototype for testing. – The student will be able to:

88.01 Sketch all parts of their design solution including an isometric view of the assembled product.

88.02 Create a set of working drawings for their design solution.

88.03 Interpret and apply the feedback they receive from experts to improve their design solution.

88.04 Refine their design solution, if necessary, based upon expert feedback.

88.05 Document the project's progress in their engineering notebooks.

88.06 Prototype

88.07 Identify safe practices for the use of tools and equipment.

88.08 Create a detailed set of instructions for producing a testable prototype based on the information gained through their research.

88.09 Identify methods and sources for obtaining materials and supplies.

88.10 Compile a materials list that includes vendors and cost for all necessary materials and equipment to build their prototype.

88.11 Write a step-by-step procedure for the assembly of their prototype.

88.12 Build a working prototype that can be tested.

89.0 Evaluate and select appropriate testing methodologies for testing the product, conduct product testing, refine the design as needed, and document the process and results. – The student will be able to:

89.01 Select and describe a valid testing method that will be used to accurately evaluate their design solution's ability to solve their problem.

89.02 Prepare a description of the testing method that will be used to valid the designed solution.

89.03 Create a valid justification for the selected testing method.

CTE Standards and Benchmarks

89.04	Devise a list of testing criteria that will be used to evaluate the success or failure of their prototype testing
89.05	Identify, define, and implement needed modifications to their testing method based on expert feedback and their ongoing research.
89.06	Document their project's progress in their engineer's notebook.
89.07	Create a detailed set of instructions for testing the prototype that will be valid, repeatable, and reliable.
89.08	Apply the appropriate statistical analysis tools to the test results to ensure validity.
89.09	Identify, define, and implement necessary modifications to their design based upon their test results.
89.10	Identify how their solution has removed obsolescence of the original product, if appropriate.
89.11	Evaluate and explain the effectiveness of their design at solving the problem they have defined.
89.12	Document the test results and project progress in their engineering notebooks.
90.0	Create and deliver a formal presentation in a suitable form of the solution to the problem. – The student will be able to:
90.01	Gather data and information compiled throughout the project and create a technical research paper, PowerPoint, and three panel display of the design solution.
90.02	Create a website, if appropriate, in order to depict all aspects of the design solution.
90.03	Choose one of the formats used to depict the design solution, such as technical research paper, PowerPoint, three panel display, or website, if created, for the presentation of the solution to the problem.
90.04	Orally present an effective technical presentation on the design solution.