

2012 – 2013

**Florida Department of Education
Curriculum Framework**

Program Title: Pathways to Engineering
Program Type: Non Career Preparatory
Career Cluster: Engineering & Technology Education

Secondary – Non Career Preparatory	
Program Number	9400300
CIP Number	0821010102
Grade Level	9-12; 30, 31
Standard Length	5 credits
Teacher Certification*	TEC ED 1 @2 ENG 7 G INDUS ARTS @4 @6 I ART-TEC @1 @2
CTSO	FL-TSA
Facility Code	243, Related 808, 810, 849, 851, 852. Refer to http://www.fldoe.org/edfacil/sref.asp (State Requirements for Educational Facilities)
Perkins Technical Skill Attainment Inventory	http://www.fldoe.org/workforce/perkins/perkins_resources.asp
Industry Certifications	http://www.fldoe.org/workforce/fcpea/default.asp
Statewide Articulation	http://www.fldoe.org/workforce/dwdframe/artic_frame.asp

** Note: While not required, when implemented as a Project Lead The Way program, both teachers and the program require special certification. See the Special Notes section below for more information.*

Purpose

The purpose of this program is to provide students with a foundation of knowledge and technically oriented experiences in the study of the applications of engineering and its effect upon our lives and the choosing of an occupation. The content and activities will also include the study of entrepreneurship, safety, and leadership skills. This program focuses on transferable skills and stresses understanding and demonstration of the technological tools, machines, instruments, materials, processes and systems in business and industry.

Program Structure

This program is a planned sequence of instruction based on the Project Lead the Way engineering program of the same title. Although there are variations in course sequence depending on implementation, students typically complete the three foundation courses

(860550, 8600520, and 8600530), at least one of the elective courses, and the capstone course. Listed below are the courses that comprise this program and a sample schedule (Note that this is a sample and may not be reflective of how the program is implemented in your district):

Recommended Grade	Course Number	Course Title	Course Length	Level
9	8600550	Introduction to Engineering Design	1 credit	3
10	8600520	Principles of Engineering	1 credit	3
11	8600530	Digital Electronics	1 credit	3
	8600560*	Computer Integrated Manufacturing or	1 credit	3
	8600590*	Civil Engineering and Architecture or	1 credit	3
	8600620*	Aerospace Engineering or	1 credit	3
	8600630*	Biotechnical Engineering or	1 credit	3
12	8600650**	Engineering Design and Development	1 credit	3

* *Note: Students should select at least one of these courses to take in addition to the Digital Electronics course (8600530).*

** *Note: This course is intended to serve as a capstone course.*

More information about the PLTW Pathways to Engineering program can be found on their website (<http://www.pltw.org/>).

Laboratory Activities

Laboratory activities are an integral part of this program. These activities include instruction in the use of safety procedures, tools, equipment, materials, and processes related to occupations in this industry. Equipment and supplies should be provided to enhance hands-on experiences for students.

Special Notes

Academic Alignment

Some or all of the courses in this program have been aligned to the Next Generation Sunshine State Standards contained in specific math and science core academic courses. This alignment resulted from a collaborative review by Career and Technical Education (CTE) teachers and core academic teachers. The table below contains the results of the alignment efforts. Data shown in the table includes the number of academic standards in the CTE course, the total number of math and science standards contained in the academic course, and the percentage of alignment to the CTE course. The following academic courses were included in the alignment (see code for use in table).

Academic Subject Area	Academic Course
Math	Algebra 1 (ALG1) Algebra 2 (ALG2) Geometry (GEO)

Academic Subject Area	Academic Course
Science	Anatomy/Physiology Honors (APH) Astronomy Solar/Galactic Honors (ASGH) Biology 1 (BIO1) Chemistry 1 (CHM1) Earth-Space Science (ESS) Genetics (GEN) Marine Science 1 Honors (MS1H) Physical Science (PS) Physics 1 (PHY1)

Course	Math			Science								
	ALG1	ALG2	GEO	APH	ASGH	BIO1	CHM1	ESS	GEN	MS1H	PS	PHY1
Introduction to Engineering Design	24/36 67%	4/41 10%	#	**	**	**	**	**	**	**	**	**
Principles of Engineering	**	**	**	**	**	**	**	**	**	**	**	**
Digital Electronics	**	**	**	**	**	**	**	**	**	**	**	**
Computer Integrated Manufacturing	**	**	**	**	**	**	**	**	**	**	**	**
Civil Engineering and Architecture	**	**	**	**	**	**	**	**	**	**	**	**
Aerospace Engineering	**	**	**	**	**	**	**	**	**	**	**	**
Biotechnical Engineering	**	**	**	**	**	**	**	**	**	**	**	**
Engineering Design and Development	**	**	**	**	**	**	**	**	**	**	**	**

** Alignment pending

Alignment attempted, but no correlation to academic course.

PLTW Requirements

Implementation of this program as a PLTW approved program requires each school to be certified by PLTW and teachers to be trained according to PLTW requirements. Curriculum materials for teaching the program are available at no charge. More information on specific PLTW contractual and certification requirements can be found at <http://www.pltw.org/Engineering/engineering.cfm>.

Career and Technical Student Organization (CTSO)

The Florida Technology Student Association (FL-TSA) is the appropriate career and technical student organization for providing leadership training and reinforcing specific career and technical skills. Career and Technical Student Organizations provide activities for students as an integral part of the instruction offered. The activities of such organizations are defined as part of the curriculum in accordance with Rule 6A-6.065, F.A.C.

Cooperative Training

Cooperative training is appropriate but not required for this program. There is a **Cooperative Education Manual** available on-line that has guidelines for students, teachers, employers,

parents and other administrators and sample training agreements. It can be accessed on the DOE website at <http://www.fldoe.org/workforce/programs/doc/coopm.doc>.

Work-Based Experience (8601800) is the appropriate course to provide Engineering & Technology Education students with the opportunity, as Student Learners, to gain real world practical, first-hand exposure in broad occupational clusters or industry sectors through a structured, compensated or uncompensated experience. Work-Based Experience (WBE) is also designed to give student learners an opportunity to apply and integrate the knowledge, skills, and abilities acquired during their School-Based Experience to actual work situations independent of school facilities. At least one credit of an Engineering & Technology Education program consisting of three credits must be completed before enrolling in WBE. See the Work-Based Experience framework for more information.

Essential Skills

Essential skills identified by the Division of Career and Adult Education have been integrated into the standards and benchmarks of this program. These skills represent the general knowledge and skills considered by industry to be essential for success in careers across all career clusters. Students preparing for a career served by this program at any level should be able to demonstrate these skills in the context of this program. A complete list of Essential Skills and links to instructional resources in support of these Essential Skills are published on the CTE Essential Skills page of the FL-DOE website (http://www.fldoe.org/workforce/dwdframe/essential_skills.asp).

Accommodations

Federal and state legislation requires the provision of accommodations for students with disabilities as identified on the secondary student's IEP or 504 plan or postsecondary student's accommodations' plan to meet individual needs and ensure equal access. Postsecondary students with disabilities must self-identify, present documentation, request accommodations if needed, and develop a plan with their counselor and/or instructors. Accommodations received in postsecondary education may differ from those received in secondary education. Accommodations change the way the student is instructed. Students with disabilities may need accommodations in such areas as instructional methods and materials, assignments and assessments, time demands and schedules, learning environment, assistive technology and special communication systems. Documentation of the accommodations requested and provided should be maintained in a confidential file.

In addition to accommodations, some secondary students with disabilities (students with an Individual Educational Plan (IEP) served in Exceptional Student Education or ESE) will need modifications to meet their needs. Modifications change the outcomes or what the student is expected to learn, e.g., modifying the curriculum of a secondary career and technical education course. Note postsecondary curriculum cannot be modified.

Some secondary students with disabilities (ESE) may need additional time (i.e., longer than the regular school year), to master the student performance standards associated with a regular Occupational Completion Point (OCP) or a Modified Occupational Completion Point (MOCP). If needed, a student may enroll in the same career and technical course more than once. Documentation should be included in the IEP that clearly indicates that it is anticipated that the student may need an additional year to complete an OCP/MOCP. The student should work on different competencies and new applications of competencies each year toward completion of

the OCP/MOCP. After achieving the competencies identified for the year, the student earns credit for the course. It is important to ensure that credits earned by students are reported accurately. The district's information system must be designed to accept multiple credits for the same course number (for eligible students with disabilities).

Articulation

For details on articulation agreements which correlate to programs and industry certifications refer to http://www.fldoe.org/workforce/dwdframe/artic_frame.asp.

Bright Futures/Gold Seal Scholarship

Course substitutions as defined in the Comprehensive Course Table for this program area may be used to qualify a student for Florida's Gold Seal Vocational Scholarship, providing all other eligibility requirements are met. Eligibility requirements are available online at https://www.osfaffelp.org/bfiehs/fnbpcm02_CCTMain.aspx.

Fine Arts/Practical Arts Credit

Many courses in CTE programs meet the Fine Arts/Practical Arts credit for high school graduation. For additional information refer to <http://www.fldoe.org/schools/pdf/ListPracticalArtsCourses.pdf>.

Standards

After successfully completing this program, the student will be able to perform the following:

Introduction to Engineering Design Content Standards

- 01.0 Demonstrate an understanding of the characteristics and scope of technology.
- 02.0 Demonstrate an understanding of the core concepts of technology.
- 03.0 Demonstrate an understanding of the relationships among technologies and the connection between technology and other fields of study.
- 04.0 Demonstrate an understanding of the cultural, social, economic, and political effects of technology.
- 05.0 Demonstrate an understanding of the effects of technology on the environment.
- 06.0 Demonstrate an understanding of the role of society in the development and use of technology.
- 07.0 Demonstrate an understanding of the influence of technology on history.
- 08.0 Demonstrate an understanding of the attributes of design.
- 09.0 Demonstrate an understanding of engineering design.
- 10.0 Demonstrate an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
- 11.0 Demonstrate the abilities to apply the design process.
- 12.0 Demonstrate the abilities to use and maintain technological products and systems.
- 13.0 Demonstrate the abilities to assess the impact of products and systems.
- 14.0 Demonstrate an understanding of and be able to select and use energy and power technologies.
- 15.0 Demonstrate an understanding of and be able to select and use information and communication technologies.

- 16.0 Demonstrate an understanding of and be able to select and use transportation technologies.
- 17.0 Demonstrate an understanding of and be able to select and use manufacturing technologies.
- 18.0 Demonstrate an understanding of and be able to select and use construction technologies.
- 19.0 Demonstrate safe and appropriate use of tools and machines in engineering technology.
- 20.0 Demonstrate the ability to properly identify, organize, plan, and allocate resources.
- 21.0 Demonstrate the functional characteristics of the engineering design team.
- 22.0 Demonstrate technical knowledge and skills in the processes and systems related to engineering.
- 23.0 Demonstrate technical knowledge and skills in the designing, engineering, and analysis of constructed works.
- 24.0 Perform advanced study and technical skills related to engineering technology.
- 25.0 Demonstrate an understanding of career opportunities and requirements in the field of engineering technology.
- 26.0 Develop a design portfolio..
- 27.0 Communicate design solutions to an engineering problem.
- 28.0 Apply mathematical concepts in the solution of engineering problems.

Digital Electronics Content Standards

- 29.0 Demonstrate an understanding of the foundations of digital electronics.
- 30.0 Demonstrate an understanding of combinational logic analysis and design.
- 31.0 Demonstrate an understanding of sequential logic analysis and design.
- 32.0 Demonstrate an understanding of the role of microcontrollers in process control.

Principles of Engineering Content Standards

- 33.0 Demonstrate an understanding of the engineering field.
- 34.0 Demonstrate an understanding of engineering complexities ranging from simple machines to compound machine design.
- 35.0 Demonstrate an understanding of energy sources, their characteristics, and their renewability.
- 36.0 Perform mathematical operations specific to electrical systems.
- 37.0 Demonstrate an understanding of the applications of alternative energy solutions.
- 38.0 Demonstrate an understanding of insulation, the suitability of specific materials for use as insulation, and associated mathematics.
- 39.0 Analyze an energy-related problem and design a solution to the problem.
- 40.0 Demonstrate an understanding of machine control systems, logic, and devices.
- 41.0 Demonstrate an understanding of the characteristics, devices, components, limitations, and associated mathematics of hydraulic and pneumatic systems.
- 42.0 Demonstrate an understanding of the analysis of loads on physical systems in static equilibrium (statics).
- 43.0 Demonstrate an understanding of analyzing the material properties of products.
- 44.0 Perform tensile and stress tests on sample material.
- 45.0 Analyze problem related to materials and structures, and design a solution to the problem.
- 46.0 Design and create a control system based on given needs and constraints.

- 47.0 Design, create, test, and present a workable solution to a design problem involving hydraulic and/or pneumatic technology.
- 48.0 Apply principles of statistics to calculate the theoretical probability that an event will occur.
- 49.0 Apply principles of kinematics and statistics to design and present a workable solution to a design problem associated with bodies in motion.

Aerospace Engineering Technical Content Standards

- 50.0 Demonstrate an understanding of the foundations of flight.
- 51.0 Demonstrate an understanding of aerodynamics fundamentals and aerodynamic testing.
- 52.0 Demonstrate an understanding of propulsion systems and their performance factors.
- 53.0 Demonstrate an understanding of propulsionless flight.
- 54.0 Demonstrate an understanding of technologies used in aerial navigation.
- 55.0 Demonstrate an understanding of rocketry and associated performance factors.
- 56.0 Demonstrate an understanding of rocket/satellite-based aerial photography.
- 57.0 Demonstrate an understanding of orbital mechanics.
- 58.0 Demonstrate an understanding of gravity and its effects on the human body.
- 59.0 Demonstrate an understanding of composite materials and their fabrication.
- 60.0 Demonstrate an understanding of thermal protection systems.
- 61.0 Demonstrate an understanding of intelligent vehicles.

Biotechnical Engineering Technical Content Standards

- 62.0 Demonstrate an understanding of documentation procedures associated with biotechnical engineering.
- 63.0 Demonstrate an understanding of the evolution of biotechnical engineering.
- 64.0 Demonstrate an understanding of the role of values, morals, and ethics in the field of biotechnology.
- 65.0 Demonstrate an understanding of the roles of forensics, reverse engineering, and genetic engineering to biotechnology applications.
- 66.0 Demonstrate an understanding of fermentation as it relates to the production of renewable energy.
- 67.0 Demonstrate an understanding of engineering design principles relative to the field of biotechnology.
- 68.0 Demonstrate an understanding of engineering as it relates to the design of prosthetic devices.
- 69.0 Research heart diseases, disorders, treatment options, and procedures.

Computer Integrated Manufacturing Technical Content Standards

- 70.0 Demonstrate an understanding of manufacturing, its history, models, and procedures.
- 71.0 Demonstrate an understanding of control systems and methods to describe or document their processes.
- 72.0 Demonstrate an understanding of the cost of manufacturing.
- 73.0 Demonstrate proficiency in designing products for manufacturability.
- 74.0 Demonstrate an understanding of manufacturing processes.
- 75.0 Demonstrate an understanding of computer numeric control (CNC) as it relates to product design and development.

- 76.0 Demonstrate an understanding of automation and robotics relative to the manufacturing process.
- 77.0 Demonstrate an understanding of the elements of power and the associated mathematics.
- 78.0 Build, program, and configure a robot to perform predefined tasks.
- 79.0 Demonstrate an understanding of the elements of Computer Integrated Manufacturing (CIM).
- 80.0 Demonstrate proficiency in designing an efficient flexible manufacturing system (FMS) that contains CIM elements.

Civil Engineering & Architecture Technical Content Standards

- 81.0 Demonstrate an understanding of civil engineering and architecture, its history, innovations, and evolution of styles and materials.
- 82.0 Demonstrate an understanding of the civil engineering and architecture field.
- 83.0 Demonstrate an understanding of residential building structure, elements of design, and associated processes.
- 84.0 Perform mathematical operations associated with cost and efficiency analysis of a residential design.
- 85.0 Demonstrate proficiency in designing a residential structure, ascertaining appropriateness of electrical and plumbing elements, and considering site constraints and applicable codes.
- 86.0 Demonstrate proficiency in designing commercial building structures, including compliance with building and zoning regulations, appropriate wall structures, and appropriate material selection.
- 87.0 Demonstrate proficiency in designing wall, floor, and foundation structures to meet specific load requirements using structural analysis software.
- 88.0 Demonstrate proficiency in designing heating, ventilation, and air conditioning services and utilities for a commercial project to achieve energy conservation.
- 89.0 Demonstrate proficiency in creating a commercial site design that considers soil characteristics, storm water runoff, and specification/code requirements.
- 90.0 Design a commercial building.
- 91.0 Create and deliver a presentation of a commercial building design.

Engineering Design & Development Technical Content Standards

- 92.0 Identify, define, and justify a technical design problem for resolution.
- 93.0 Conduct research and investigation into the stated problem.
- 94.0 Perform and graphically represent an evaluation of proposed design solutions using specific criteria, including product specifications.
- 95.0 Design a solution to the problem and create a working prototype for testing.
- 96.0 Evaluate and select appropriate testing methodologies for testing the product, conduct product testing, refine the design as needed, and document the process and results.
- 97.0 Create and deliver a formal presentation in a suitable form of the solution to the problem.

Essential Skills

- 98.0 Demonstrate language arts knowledge and skills.
- 99.0 Demonstrate mathematics knowledge and skills.
- 100.0 Demonstrate science knowledge and skills.

- 101.0 Use oral and written communication skills in creating, expressing and interpreting information and ideas.
- 102.0 Solve problems using critical thinking skills, creativity and innovation.
- 103.0 Use information technology tools.
- 104.0 Describe the roles within teams, work units, departments, organizations, inter-organizational systems, and the larger environment.
- 105.0 Describe the importance of professional ethics and legal responsibilities.
- 106.0 Demonstrate the importance of health, safety, and environmental management systems in organizations and their importance to organizational performance and regulatory compliance.
- 107.0 Demonstrate leadership and teamwork skills needed to accomplish team goals and objectives.
- 108.0 Explain the importance of employability skill and entrepreneurship skills.
- 109.0 Demonstrate personal money-management concepts, procedures, and strategies.

2012 – 2013

**Florida Department of Education
Student Performance Standards**

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

Course Description:

This course teaches problem-solving skills using a design development process. Models of product solutions are created, analyzed and communicated using solid modeling computer design software.

Standards included in this course of instruction have been aligned to the academic courses shown below. This table shows the number of aligned benchmarks, the total number of academic benchmarks, and the percentage of alignment.

Math		Science					
Algebra 1	24/36 67%	Biology 1	**	Anatomy/Physiology Honors	**	Astronomy Solar/Galactic Honors	**
Algebra 2	4/41 10%	Chemistry 1	**	Genetics	**	Marine Science 1 Honors	**
Geometry	#	Physics 1	**	Earth-Space Science	**	Physical Science	**

** Alignment pending

Alignment attempted, but no correlation to academic course.

- 01.0 Demonstrate an understanding of the characteristics and scope of technology. – The student will be able to:
- 01.01 Conduct specific goal-directed research related to inventions and innovations.
 - 01.02 Evaluate current technological developments that are/were driven by profit motive and the market.
 - 01.03 Research the chronological development and accelerating rate of change that innovations in tools and materials have brought about over time as it relates to a given consumer product.
 - 01.04 Identify two innovations that have led to improved functionality of that tool.
- 02.0 Demonstrate an understanding of the core concepts of technology. – The student will be able to:
- This standard supports the following Next Generation Sunshine State Standards: [MA.912.A.2.3, MA.912.A.5.1, MA.912.A.5.4, MA.912.10.1]
- 02.01 Apply systems thinking logic and creativity with appropriate compromises in complex real-life problems.
 - 02.02 Assess technological systems, which are the building blocks of technology and are embedded within larger technological, social, and environmental systems.
 - 02.03 Assess the stability of a technological system and its influence by all of the components in the system, especially those in the feedback loop.

- 02.04 Compare resources involving trade-offs between competing values, such as availability, cost, desirability, and waste.
 - 02.05 Identify the criteria and constraints of a product or system and determine how they affect the final design and development.
 - 02.06 Propose strategies for optimizing a technological process or methodology of designing or making a product, dependent on criteria and constraints.
 - 02.07 Discuss new technologies that create new processes.
 - 02.08 Recommend a quality control process to ensure that a product, service or system meets established criteria.
 - 02.09 Organize a management system as the process of planning, organizing, and controlling work.
 - 02.10 Outline complex systems that have many layers of controls and feedback loops to provide information.
- 03.0 Demonstrate an understanding of the relationships among technologies and the connection between technology and other fields of study. – The student will be able to:
- 03.01 Examine technology transfer occurring when a new user applies an existing innovation developed for one purpose in a different function.
 - 03.02 Examine technological innovation resulting when ideas, knowledge, or skills are shared within a technology, among technologies, or across other fields.
 - 03.03 Investigate technological progresses that promote the advancement of science and mathematics.
- 04.0 Demonstrate an understanding of the cultural, social, economic, and political effects of technology. – The student will be able to:
- 04.01 Discuss changes caused by the use of technology ranging from gradual to rapid and from subtle to obvious.
 - 04.02 Evaluate the use of technology involving weighing the trade-offs between the positive and the negative effects.
 - 04.03 Discuss ethical considerations important in the development, selection, and use of technologies.
 - 04.04 Debate the cultural, social, economic, and political changes caused by the transfer of a technology from one society to another.
- 05.0 Demonstrate an understanding of the effects of technology on the environment. – The student will be able to:
- 05.01 Consider trade-offs of developing technologies to reduce the use of resources.
 - 05.02 Compare and contrast the alignment of technological processes with natural processes to maximize performance and reduce negative impacts on the environment.
 - 05.03 Assess technologies devised to reduce the negative consequences of other technologies.
 - 05.04 Make decisions about the implementation of technologies involving the weighing of trade-offs between predicted positive and negative effects on the environment.
- 06.0 Demonstrate an understanding of the role of society in the development and use of technology. – The student will be able to:

- 06.01 Consider societal opinions and demands, as well as corporate cultures to use as a basis for deciding whether or not to develop a technology.
- 06.02 Evaluate a number of different factors, such as advertising, the strength of the economy, the goals of a company, and the latest fads as contributors to shaping the design of and demand for various technologies.
- 06.03 Research how artistic period and style have influenced product and architectural design.

07.0 Demonstrate an understanding of the influence of technology on history. – The student will be able to:

- 07.01 Assess how the evolution of civilization has been directly affected by, and has in turn affected, the development and use of tools and materials.
- 07.02 Discuss the history of technology as a powerful force in reshaping the social, cultural, political, and economic landscape.
- 07.03 Describe the Iron Age as the use of iron and steel as the primary materials for tools.
- 07.04 Discuss the Industrial Revolution and the development of continuous manufacturing, sophisticated transportation and communication systems, advanced construction practices, and improved education and leisure time.
- 07.05 Describe the Information Age and its placement of emphasis on the processing and exchange of information.
- 07.06 Explain how the history of art has influenced innovations in the field of engineering, and the impact of artistic expression as it relates to consumer products.
- 07.07 Explore the evolution of technology and be able to identify engineering achievements through history.

08.0 Demonstrate an understanding of the attributes of design. – The student will be able to:

This standard supports the following Next Generation Sunshine State Standards: [MA .912.A.2.3, MA.912.A.5.1, MA.912.A.5.4, MA.912.10.1]

- 08.01 Apply the design process; including defining a problem, brainstorming, researching and generating ideas, identifying criteria and specifying constraints, exploring possibilities, selecting an approach, developing a design proposal, making a model or prototype, testing and evaluating the design using specifications, refining the design, creating or making it, and communicating processes and results.
- 08.02 Translate design problems that are seldom presented in a clearly defined form.
- 08.03 Evaluate a design continually, and improve and revise the idea of the design as needed.
- 08.04 Analyze competing requirements of a design, such as criteria, constraints, and efficiency.
- 08.05 Explore the design concept of form and function and explain its use in product design.
- 08.06 List the seven steps of the design process and explain activities that occur during each phase.
- 08.07 Explain the importance of focusing on detail during the design process.
- 08.08 List the principles and elements of design and explain where they fit in to the design process.

- 08.09 Identify the use of the principles and elements of design in various products, print media, and art forms.
- 08.10 Collect and display examples of the application of the principles and elements of design utilized in products, print media, and art forms.

09.0 Demonstrate an understanding of engineering design. – The student will be able to:

This standard supports the following Next Generation Sunshine State Standards:
[MA.912.A.5.1, MA.912.A.5.4, MA.912.A.10.1]

- 09.01 Select design principles used to evaluate existing designs, to collect data, and to guide the design process.
- 09.02 Examine the influence of personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly on the Engineering Design process.
- 09.03 Construct a prototype or a working model used to test a design concept by making actual observations and necessary adjustments.
- 09.04 Evaluate factors taken into account in the process of engineering.

10.0 Demonstrate an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving. – The student will be able to:

This standard supports the following Next Generation Sunshine State Standards:
[MA.912.A.5.1, MA.912.A.5.4, MA.912.A.10.1, MA.912.A.2.3]

- 10.01 Employ research and development as a specific problem solving approach that is used intensively in business and industry to prepare devices and systems for the marketplace.
- 10.02 Conduct research needed to solve technological problems.
- 10.03 Differentiate between technological and non-technological problems, and identify which problems can be solved using technology.
- 10.04 Utilize a multidisciplinary approach to solving technological problems.

11.0 Demonstrate the abilities to apply the design process. – The student will be able to:

This standard supports the following Next Generation Sunshine State Standards:
[MA.912.A.2.3, MA.912.A.2.4, MA.912.A.5.1, MA.912.A.2.13, MA.912.A.3.1, MA.912.A.3.3, MA.912.A.3.4, MA.912.A.3.5, MA.912.A.5.4, MA.912.10.1]

- 11.01 Interpret the design problem to solve and decide whether or not to address it.
- 11.02 Evaluate criteria and constraints and determine how these will affect the design process.
- 11.03 Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product.
- 11.04 Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed.
- 11.05 Produce a product or system using a design process.

- 11.06 Evaluate final solutions and communicate observations, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models.
- 11.07 Explain the difference between parametric and adaptive designs and their uses.
- 12.0 Demonstrate the abilities to use and maintain technological products and systems. – The student will be able to:
 - 12.01 Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques.
 - 12.02 Diagnose a system that is malfunctioning and use tools, materials, machines, and knowledge to repair it.
 - 12.03 Troubleshoot, analyze, and maintain systems to ensure safe and proper function and precision.
 - 12.04 Operate systems so that they function in the way they were designed.
 - 12.05 Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate.
- 13.0 Demonstrate the abilities to assess the impact of products and systems. – The student will be able to:
 - 13.01 Collect information and evaluate its quality.
 - 13.02 Synthesize data, analyze trends, and draw conclusions regarding the effect of technology on the individual, society, and the environment.
 - 13.03 Apply assessment techniques, such as trend analysis and experimentation to make decisions about the future development of technology.
 - 13.04 Design forecasting techniques to evaluate the results of altering natural systems.
- 14.0 Demonstrate an understanding of and be able to select and use energy and power technologies. – The student will be able to:
 - 14.01 Discuss how energy cannot be created nor destroyed; however, it can be converted from one form to another.
 - 14.02 Categorize types of energy into major forms: thermal, radiant, electrical, mechanical, chemical, nuclear, and others.
 - 14.03 Classify energy resources as renewable or nonrenewable.
 - 14.04 Construct a power system having a source of energy, a process, and loads.
- 15.0 Demonstrate an understanding of and be able to select and use information and communication technologies. – The student will be able to:
 - 15.01 Discuss information and communication technologies including the inputs, processes, and outputs associated with sending and receiving information.
 - 15.02 Classify information and communication systems that allow information to be transferred as human to human, human to machine, machine to human, or machine to machine.
 - 15.03 Use information and communication systems to inform, persuade, entertain, control, manage, and educate.
 - 15.04 Identify components of a communications system, including source, encoder, transmitter, receiver, decoder, storage, retrieval, and destination.

- 15.05 Identify many ways to communicate information, such as graphic and electronic means.
- 15.06 Communicate technological knowledge and processes using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.
- 16.0 Demonstrate an understanding of and be able to select and use transportation technologies. – The student will be able to:
 - 16.01 Analyze the vital role played by transportation in the operation of other technologies, such as manufacturing, construction, communication, health and safety, and agriculture.
 - 16.02 Define intermodalism as the use of different modes of transportation, such as highways, railways, and waterways as part of an interconnected system that can move people and goods easily from one mode to another.
 - 16.03 Discuss how transportation services and methods have led to a population that is regularly on the move.
 - 16.04 Identify processes and innovative techniques involved in the design of intelligent and non-intelligent transportation systems.
- 17.0 Demonstrate an understanding of and be able to select and use manufacturing technologies. – The student will be able to:
 - 17.01 Service products to keep them in good operating condition.
 - 17.02 Classify materials based on their qualities as natural, synthetic, or mixed.
 - 17.03 Classify goods as durable goods designed to operate for a long period of time, or non-durable goods designed to operate for a short period of time.
 - 17.04 Identify and classify manufacturing systems into types, such as customized production, batch production, and continuous production.
 - 17.05 Discuss the interchangeability of parts to increase the effectiveness of manufacturing processes.
 - 17.06 Employ marketing techniques involving establishing a product's identity, conducting research on its potential, advertising it, distributing it, and selling it.
- 18.0 Demonstrate an understanding of and be able to select and use construction technologies. – The student will be able to:
 - 18.01 Define infrastructure as the underlying base or basic framework of a system.
 - 18.02 Identify a variety of processes and procedures used in constructing structures.
 - 18.03 Identify requirements involved in the design of structures.
 - 18.04 Recommend maintenance, alterations, or renovations to improve a structure or alter its intended use.
 - 18.05 Identify prefabricated materials used in some structures.
- 19.0 Demonstrate safe and appropriate use of tools and machines in engineering technology. – The student will be able to:
 - 19.01 Select appropriate tools, procedures, and/or equipment.
 - 19.02 Demonstrate the safe usage of appropriate tools, procedures, and operation of equipment.
 - 19.03 Follow laboratory safety rules and procedures.

- 19.04 Demonstrate good housekeeping at workstation within total laboratory.
- 19.05 Identify color-coding safety standards.
- 19.06 Explain fire prevention and safety precautions and practices for extinguishing fires.
- 19.07 Identify harmful effects/potential dangers of familiar hazardous substances/devices to people and the environment.

20.0 Demonstrate the ability to properly identify, organize, plan, and allocate resources. – The student will be able to:

This standard supports the following Next Generation Sunshine State Standards:
[MA.912.A.10.1]

- 20.01 Demonstrate the ability to select goal-relevant activities, rank them, allocate time, and prepare and follow schedules.
- 20.02 Use or prepare budgets, make forecasts, keep records, and make adjustments to meet objectives.
- 20.03 Demonstrate the ability to acquire, store, allocate, and use materials or space efficiently.
- 20.04 Display knowledge of the efficient use of human resources.

21.0 Demonstrate the functional characteristics of the engineering design team. – The student will be able to:

- 21.01 Describe work breakdown organization.
- 21.02 Describe work group organization schemes including functional and hierarchical schemes.
- 21.03 Describe the function of management in general and project management in particular.
- 21.04 Describe a typical design project team structure.
- 21.05 Outline a research methodology.
- 21.06 Demonstrate brainstorming techniques.
- 21.07 Explain the value of working well as a team and the benefits associated with such collaboration.

22.0 Demonstrate technical knowledge and skills in the processes and systems related to engineering. – The student will be able to:

- 22.01 Assemble, operate, and identify the parts of a fluid system.
- 22.02 Demonstrate and apply principles of force, work, rate, resistance, energy, power, and force transformers relating to fluid systems.
- 22.03 Assemble, operate, and identify the parts of a thermal system.
- 22.04 Demonstrate and apply principles of force, work, rate, resistance, energy, power, and force transformers relating to thermal systems.
- 22.05 Assemble, operate, and identify the parts of an electrical system.
- 22.06 Demonstrate and apply principles of force, work, rate, resistance, energy, power, and force transformers relating to electrical systems.
- 22.07 Assemble, operate, and identify the parts of a mechanical system.
- 22.08 Demonstrate and apply principles of force, work, rate, resistance, energy, power, and force transformers relating to mechanical systems.

23.0 Demonstrate technical knowledge and skills in the designing, engineering, and analysis of constructed works. – The student will be able to:

This standard supports the following Next Generation Sunshine State Standards:
[MA.912.A.1.8, MA.912.A.10.2, MA.912.A.2.13, MA.912.A.2.4, MA.912.A.3.1, MA.912.A.3.10, MA.912.A.3.11, MA.912.A.3.12, MA.912.A.3.13, MA.912.A.3.14, MA.912.A.3.15, MA.912.A.3.3, MA.912.A.3.4, MA.912.A.3.5, MA.912.A.3.8, MA.912.A.3.9, MA.912.A.7.2, MA.912.A.7.8, MA.912.G.1.4, MA.D.7.2]

- 23.01 Define terminology associated with engineering products, processes, and systems.
- 23.02 Define and describe the experimental method as it is applied to design.
- 23.03 Describe simulation.
- 23.04 Prepare a model of a design solution to an engineering problem.
- 23.05 Prepare a graphical solution to an engineering problem.
- 23.06 Prepare a mathematical solution to an engineering problem (using either a calculator or computer).
- 23.07 Use the correct format of analysis when analyzing a problem's solution.
- 23.08 Present a technical report on an engineering design problem, concept or issue.

24.0 Perform advanced study and technical skills related to engineering technology. – The student will be able to:

This standard supports the following Next Generation Sunshine State Standards:
[MA.912.A.10.2]

- 24.01 Identify an engineering problem or product for improvement using engineering design methodology.
- 24.02 Develop a written plan of work for the engineering team to carry out the project.
- 24.03 Show evidence of technical research in support of the project.
- 24.04 Perform skills related to the engineering project.
- 24.05 Complete the project as planned.
- 24.06 Demonstrate the engineering design solution to a fluid system problem.
- 24.07 Demonstrate the engineering design solution to an electrical system problem.
- 24.08 Demonstrate the engineering design solution to a thermal system problem.
- 24.09 Demonstrate and present the engineering design solution to a mechanical system problem.
- 24.10 Formulate conclusions based on the analysis of engineered products.

25.0 Demonstrate an understanding of career opportunities and requirements in the field of engineering technology. – The student will be able to:

- 25.01 Discuss individual interests related to a career in engineering technology.
- 25.02 Explore career opportunities related to engineering technology.
- 25.03 Explore secondary education opportunities related to engineering technology.
- 25.04 Conduct a job search.
- 25.05 Complete a job application form correctly.
- 25.06 Demonstrate competence in job interview techniques.
- 25.07 Create a professional resume and letter of introduction.
- 25.08 Solicit awards, letters of recommendation and recognition.
- 25.09 Organize work samples in a professional, presentable format.

- 25.10 Research and prepare a report that summarizes a professional organization and the range of services it provides.
 - 25.11 Prepare a report on the career opportunities in a given engineering field, the job functions, and required educational requirements.
- 26.0 Develop a design portfolio. – The student will be able to:
- 26.01 Identify the proper elements of a fully developed portfolio.
 - 26.02 Identify and discuss the ethical issues surrounding portfolio artifacts.
 - 26.03 Create a design portfolio that is well organized and displays their work.
- 27.0 Communicate design solutions to an engineering problem. – The student will be able to:
- 27.01 Sketch solutions to a variety of design problems using the steps in the design process.
 - 27.02 Produce design sketches using proper sketching techniques and styles.
 - 27.03 Draw two-dimensional geometric figures.
 - 27.04 Explain the different pictorial styles of sketching and explain their usage.
 - 27.05 Create sketches that utilize both the additive and subtractive methods.
 - 27.06 Apply appropriate shading techniques in the creation of sketches.
 - 27.07 Evaluate and select the necessary views to graphically communicate design solutions.
 - 27.08 Interpret annotated sketches that accurately convey data in a design solution.
 - 27.09 Integrate annotated sketches in presentations, portfolio, and documentation process.
 - 27.10 Communicate their design ideas in written and verbal formats.
 - 27.11 Analyze and develop appropriate graphical representations of given data.
 - 27.12 Explain different physical modeling techniques.
 - 27.13 Build a scaled three-dimensional model.
 - 27.14 Generate a 3D model of a sketch using a computer CAD software package.
 - 27.15 Draw a 2D sketch using a CAD package.
 - 27.16 Apply geometric and dimensional constraints to a sketch.
 - 27.17 Modify a sketch or 3D model of a design solution.
 - 27.18 Create a 3D design assembly using a CAD program.
 - 27.19 Utilize part libraries during the assembly modeling process.
 - 27.20 Employ sub-assemblies in the production of assembly drawings.
 - 27.21 Apply drive constraints to simulate the motion of parts in assemblies.
 - 27.22 Compile mass properties from solid models.
- 28.0 Apply mathematical concepts in the solution of engineering problems. – The student will be able to:
- 28.01 Define point, line, and line segment.
 - 28.02 Identify major geometric shapes (isosceles triangle, right triangle, scalene triangle, rectangle, square, rhombus, trapezoid, pentagon, hexagon, and octagon).
 - 28.03 Construct geometric shapes using a compass, ruler, and triangle.
 - 28.04 Define the elements and types of angles.
 - 28.05 Construct and bisect various types of angles.
 - 28.06 Define what is meant by geometric constraints.

- 28.07 Define the following terms: horizontal, vertical, parallel, perpendicular, tangent, concentric, collinear, coincident, and equal.
- 28.08 Apply the right hand rule to correctly identify the x, y, and z axes of the Cartesian coordinate system.
- 28.09 Apply a combination of absolute, relative, and polar coordinates to construct a three-dimensional model.
- 28.10 Define the origin planes in the Cartesian coordinate system.
- 28.11 Identify the origin and planar orientations of each side of a three-dimensional model.
- 28.12 Compare and contrast vertical and lateral thinking.
- 28.13 Evaluate a problem using mathematical formulae.
- 28.14 List and explain the following terms usage in the evaluation of parametric models: volume, density, mass, surface area, centroid, moment of inertia, products of inertia, radii of gyration, principal axes, and principal moments.
- 98.0 Demonstrate language arts knowledge and skills. – The student will be able to: AF 2.0
- 98.01 Locate, comprehend and evaluate key elements of oral and written information. AF 2.4
- 98.02 Draft, revise, and edit written documents using correct grammar, punctuation and vocabulary. AF 2.5
- 98.03 Present information formally and informally for specific purposes and audiences. AF 2.9
- 99.0 Demonstrate mathematics knowledge and skills. – The student will be able to: AF 3.0
- 99.01 Demonstrate knowledge of arithmetic operations. AF 3.2
- 99.02 Analyze and apply data and measurements to solve problems and interpret documents. AF 3.4
- 99.03 Construct charts/tables/graphs using functions and data. AF 3.5
- 100.0 Demonstrate science knowledge and skills. – The student will be able to: AF 4.0
- 100.01 Discuss the role of creativity in constructing scientific questions, methods and explanations. AF 4.1
- 100.02 Formulate scientifically investigable questions, construct investigations, collect and evaluate data, and develop scientific recommendations based on findings. AF 4.3

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**Florida Department of Education
Student Performance Standards**

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.

29.0 Demonstrate an understanding of the foundations of digital electronics. – The student will be able to:

- 29.01 Describe and apply three common notational forms of expressing numbers.
- 29.02 Identify and describe the operation of common electronic components.
- 29.03 Perform basic soldering techniques and printed circuit board construction.
- 29.04 Define and apply Ohm's Law and Kirchhoff's Laws in the design of series and parallel electronic circuitry.
- 29.05 Analyze simple analog and digital circuits using common electronic test equipment and tools.
- 29.06 Determine the characteristics of analog and digital signals.
- 29.07 Translate data specifications into truth tables and extract logical expressions.
- 29.08 Use Boolean algebra and DeMorgan's Theorem to simplify logic expressions.

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

- 30.01 Describe the operation of basic logic components, including gates, inverters, and flip-flops.
- 30.02 Design a combinational logic circuit using basic logic gates.
- 30.03 Simulate and prototype a logic circuit.
- 30.04 Design a combinational logic circuit incorporating negative logic.
- 30.05 Simulate and prototype a logic circuit employing negative logic.
- 30.06 Design half-adder, full-adder, and binary adder logic circuits using exclusive logic.
- 30.07 Design a combinational logic circuit using a programmable logic device.
- 30.08 Simulate and prototype a combinational logic circuit employing a programmable logic device.
- 30.09 Analyze and design basic flip-flop applications, including event detection circuits, data synchronizers, shift registers, and frequency dividers.

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

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

- 31.02 Design, simulate, and prototype SSI and MSI asynchronous counters.
- 31.03 Describe the components of a state machine.
- 31.04 Design, simulate, and prototype state machines using discrete or programmable logic.
- 32.0 Demonstrate an understanding of the role of microcontrollers in process control. – The student will be able to:
- 32.01 Program and test an autonomous robot.
- 32.02 Flowchart a microcontroller program to maneuver a robot.
- 32.03 Program a microcontroller to maneuver a robot.
- 101.0 Use oral and written communication skills in creating, expressing and interpreting information and ideas. – The student will be able to:
- 101.01 Select and employ appropriate communication concepts and strategies to enhance oral and written communication in the workplace. CM 1.0
- 101.02 Locate, organize and reference written information from various sources. CM 3.0
- 101.03 Design, develop and deliver formal and informal presentations using appropriate media to engage and inform diverse audiences. CM 5.0
- 101.04 Interpret verbal and nonverbal cues/behaviors that enhance communication. CM 6.0
- 101.05 Apply active listening skills to obtain and clarify information. CM 7.0
- 101.06 Develop and interpret tables and charts to support written and oral communications. CM 8.0
- 101.07 Exhibit public relations skills that aid in achieving customer satisfaction. CM 10.0
- 102.0 Solve problems using critical thinking skills, creativity and innovation. – The student will be able to:
- 102.01 Employ critical thinking skills independently and in teams to solve problems and make decisions. PS 1.0
- 102.02 Employ critical thinking and interpersonal skills to resolve conflicts. PS 2.0
- 102.03 Identify and document workplace performance goals and monitor progress toward those goals. PS 3.0
- 102.04 Conduct technical research to gather information necessary for decision-making. PS 4.0
- 103.0 Use information technology tools. – The student will be able to:
- 103.01 Use personal information management (PIM) applications to increase workplace efficiency. IT 1.0
- 103.02 Employ technological tools to expedite workflow including word processing, databases, reports, spreadsheets, multimedia presentations, electronic calendar, contacts, email, and internet applications. IT 2.0
- 103.03 Employ computer operations applications to access, create, manage, integrate, and store information. IT 3.0
- 103.04 Employ collaborative/groupware applications to facilitate group work. IT 4.0
- 104.0 Describe the roles within teams, work units, departments, organizations, inter-organizational systems, and the larger environment. – The student will be able to:
- 104.01 Describe the nature and types of business organizations. SY 1.0

- 104.02 Explain the effect of key organizational systems on performance and quality.
- 104.03 List and describe quality control systems and/or practices common to the workplace. SY 2.0
- 104.04 Explain the impact of the global economy on business organizations.
- 105.0 Describe the importance of professional ethics and legal responsibilities. – The student will be able to:
 - 105.01 Evaluate and justify decisions based on ethical reasoning. ELR 1.0
 - 105.02 Evaluate alternative responses to workplace situations based on personal, professional, ethical, legal responsibilities, and employer policies. ELR 1.1
 - 105.03 Identify and explain personal and long-term consequences of unethical or illegal behaviors in the workplace. ELR 1.2
 - 105.04 Interpret and explain written organizational policies and procedures. ELR 2.0

2012 – 2013

**Florida Department of Education
Student Performance Standards**

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.

33.0 Demonstrate an understanding of the engineering field. – The student will be able to:

- 33.01 Differentiate between engineering and engineering technology.
- 33.02 Identify and differentiate among different engineering disciplines.

34.0 Demonstrate an understanding of engineering complexities ranging from simple machines to compound machine design. – The student will be able to:

- 34.01 Measure forces and distances related to mechanisms.
- 34.02 Distinguish between the six simple machines, their attributes, and components.
- 34.03 Calculate mechanical advantage and drive ratios of mechanisms.
- 34.04 Design, create, and test gear, pulley, and sprocket systems.
- 34.05 Calculate work and power in mechanical systems.
- 34.06 Determine efficiency in a mechanical system.
- 34.07 Design, create, test, and evaluate a compound machine design.

35.0 Demonstrate an understanding of energy sources, their characteristics, and their renewability. – The student will be able to:

- 35.01 Identify and categorize energy sources as nonrenewable, renewable, or inexhaustible.
- 35.02 Create and deliver a presentation to explain a specific energy source.

36.0 Perform mathematical operations specific to electrical systems. – The student will be able to:

- 36.01 Define the possible types of power conversion.
- 36.02 Calculate work and power.
- 36.03 Demonstrate the correct use of a digital multimeter.
- 36.04 Calculate power in a system that converts energy from electrical to mechanical.

- 36.05 Determine efficiency of a system that converts an electrical input to a mechanical output.
- 36.06 Calculate circuit resistance, current, and voltage using Ohm's law.
- 36.07 Understand the advantages and disadvantages of parallel and series circuit design in an application.

- 37.0 Demonstrate an understanding of the applications of alternative energy solutions. – The student will be able to:
 - 37.01 Test and apply the relationship between voltage, current, and resistance relating to a photovoltaic cell and a hydrogen fuel cell.
 - 37.02 Experiment with a solar hydrogen system to produce mechanical power.

- 38.0 Demonstrate an understanding of insulation, the suitability of specific materials for use as insulation, and associated mathematics. – The student will be able to:
 - 38.01 Design, construct, and test recyclable insulation materials.
 - 38.02 Test and apply the relationship between R-values and recyclable insulation.
 - 38.03 Complete calculations for conduction, R-values, and radiation.

- 39.0 Analyze an energy-related problem and design a solution to the problem. – The student will be able to:
 - 39.01 Brainstorm and sketch possible solutions to the design problem.
 - 39.02 Create a decision-making matrix for the design problem.
 - 39.03 Select an approach that meets or satisfies the constraints provided in the design brief.
 - 39.04 Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon the design team's decision matrix.
 - 39.05 Present a workable solution to the design problem.

- 40.0 Demonstrate an understanding of machine control systems, logic, and devices. – The student will be able to:
 - 40.01 Create detailed flow charts utilizing a computer software application.
 - 40.02 Create control system operating programs utilizing computer software.
 - 40.03 Create system control programs that utilize flowchart logic.
 - 40.04 Choose appropriate inputs and outputs devices based on the need of a technological system.
 - 40.05 Differentiate between the characteristics of digital and analog devices.
 - 40.06 Judge between open and closed loop systems in order to choose the most appropriate system for a given technological problem.
 - 40.07 Design and create a control system based on given needs and constraints.

- 41.0 Demonstrate an understanding of the characteristics, devices, components, limitations, and associated mathematics of hydraulic and pneumatic systems. – The student will be able to:
 - 41.01 Identify devices that utilize fluid power.
 - 41.02 Identify and explain basic components and functions of fluid power devices.

- 41.03 Differentiate between the characteristics of pneumatic and hydraulic systems.
 - 41.04 Distinguish between hydrodynamic and hydrostatic systems.
 - 41.05 Design, create, and test a hydraulic device.
 - 41.06 Design, create, and test a pneumatic device.
 - 41.07 Calculate values in a fluid power system utilizing Pascal's Law.
 - 41.08 Distinguish between pressure and absolute pressure.
 - 41.09 Distinguish between temperature and absolute temperature.
 - 41.10 Calculate values in a pneumatic system utilizing the perfect gas laws.
 - 41.11 Calculate flow rate, flow velocity, and mechanical advantage in a hydraulic system.
- 42.0 Demonstrate an understanding of the analysis of loads on physical systems in static equilibrium (statics). – The student will be able to:
- 42.01 Create free body diagrams of objects, identifying all forces acting on the object.
 - 42.02 Mathematically locate the centroid of structural members.
 - 42.03 Calculate moment of inertia of structural members.
 - 42.04 Differentiate between scalar and vector quantities.
 - 42.05 Identify magnitude, direction, and sense of a vector.
 - 42.06 Calculate the X and Y components given a vector.
 - 42.07 Calculate moment forces given a specified axis.
 - 42.08 Use equations of equilibrium to calculate unknown forces.
 - 42.09 Use the method of joints strategy to determine forces in the members of a statically determinate truss.
- 43.0 Demonstrate an understanding of analyzing the material properties of products. – The student will be able to:
- 43.01 Investigate specific material properties related to a common household product.
 - 43.02 Conduct investigative non-destructive material property tests on selected common household products. Property testing conducted to identify continuity, ferrous metal, hardness, and flexure.
 - 43.03 Calculate weight, volume, mass, density, and surface area of selected common household product
 - 43.04 Identify the manufacturing processes used to create the selected common household product.
 - 43.05 Identify the recycling codes.
- 44.0 Perform tensile and stress tests on sample material. – The student will be able to:
- 44.01 Obtain measurements of material samples.
 - 44.02 Tensile test a material test sample.
 - 44.03 Identify and calculate test sample material properties using a stress strain curve.
- 45.0 Analyze problem related to materials and structures, and design a solution to the problem. – The student will be able to:
- 45.01 Brainstorm and sketch possible solutions to the design problem.
 - 45.02 Create a decision making matrix for the design problem.
 - 45.03 Select an approach that meets or satisfies the constraints given in the design brief.

- 45.04 Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon your team's decision matrix.
 - 45.05 Present a workable design solution.
- 46.0 Design and create a control system based on given needs and constraints. – The student will be able to:
- 46.01 Create detailed flow charts utilizing a computer software application.
 - 46.02 Create control system operating programs utilizing computer software.
 - 46.03 Create system control programs that utilize flowchart logic.
 - 46.04 Choose appropriate inputs and output devices based on the need of a technological system.
 - 46.05 Differentiate between the characteristics of digital and analog devices.
 - 46.06 Judge between open and closed loop systems in order to choose the most appropriate system for a given technological problem.
- 47.0 Design, create, test, and present a workable solution to a design problem involving hydraulic and/or pneumatic technology. – The student will be able to:
- 47.01 Identify devices that utilize fluid power.
 - 47.02 Identify and explain basic components and functions of fluid power devices.
 - 47.03 Differentiate between the characteristics of pneumatic and hydraulic systems.
 - 47.04 Distinguish between hydrodynamic and hydrostatic systems.
 - 47.05 Design, create, and test a hydraulic device.
 - 47.06 Design, create, and test a pneumatic device.
 - 47.07 Calculate values in a fluid power system utilizing Pascal's Law.
 - 47.08 Distinguish between pressure and absolute pressure.
 - 47.09 Distinguish between temperature and absolute temperature.
 - 47.10 Calculate values in a pneumatic system, utilizing the perfect gas laws.
 - 47.11 Calculate flow rate, flow velocity, and mechanical advantage in a hydraulic system.
 - 47.12 Brainstorm and sketch possible solutions to the design problem.
 - 47.13 Create a decision-making matrix.
 - 47.14 Select an approach to satisfy the constraints provided in the design brief.
 - 47.15 Create a detailed pictorial sketch or use 3D modeling software to illustrate the best choice derived from the design team's decision matrix.
- 48.0 Apply principles of statistics to calculate the theoretical probability that an event will occur. – The student will be able to:
- 48.01 Calculate the experimental frequency distribution of an event occurring.
 - 48.02 Apply the Bernoulli process to events that only have two distinct possible outcomes.
 - 48.03 Apply AND, OR, and NOT logic to probability.
 - 48.04 Apply Bayes' theorem to calculate the probability of multiple events occurring.
 - 48.05 Create a histogram to illustrate frequency distribution.
 - 48.06 Calculate the central tendency of a data array, including mean, median, and mode.
 - 48.07 Calculate data variation, including range, standard deviation, and variance.

- 49.0 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:
- 49.01 Calculate distance, displacement, speed, velocity, and acceleration from data.
 - 49.02 Design, build, and test a vehicle that stores and releases potential energy for propulsion.
 - 49.03 Calculate acceleration due to gravity given data from a free fall device.
 - 49.04 Calculate the X and Y components of a projectile motion.
 - 49.05 Determine the needed angle to launch a projectile a specific range given the projectile's initial velocity.
 - 49.06 Brainstorm and sketch possible solutions to an existing design problem.
 - 49.07 Create a decision-making matrix for their design problem.
 - 49.08 Select an approach that meets or satisfies the constraints provided in a design brief.
 - 49.09 Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon the design team's decision matrix.
 - 49.10 Present a workable solution to the design problem.
- 106.0 Demonstrate the importance of health, safety, and environmental management systems in organizations and their importance to organizational performance and regulatory compliance. – The student will be able to:
- 106.01 Describe personal and jobsite safety rules and regulations that maintain safe and healthy work environments. SHE 1.0
 - 106.02 Explain emergency procedures to follow in response to workplace accidents.
 - 106.03 Create a disaster and/or emergency response plan. SHE 2.0
- 107.0 Demonstrate leadership and teamwork skills needed to accomplish team goals and objectives. – The student will be able to:
- 107.01 Employ leadership skills to accomplish organizational goals and objectives. LT 1.0
 - 107.02 Establish and maintain effective working relationships with others in order to accomplish objectives and tasks. LT 3.0
 - 107.03 Conduct and participate in meetings to accomplish work tasks. LT 4.0
 - 107.04 Employ mentoring skills to inspire and teach others. LT 5.0
- 108.0 Explain the importance of employability skill and entrepreneurship skills. – The student will be able to:
- 108.01 Identify and demonstrate positive work behaviors needed to be employable. ECD 1.0
 - 108.02 Develop personal career plan that includes goals, objectives, and strategies. ECD 2.0
 - 108.03 Examine licensing, certification, and industry credentialing requirements. ECD 3.0
 - 108.04 Maintain a career portfolio to document knowledge, skills, and experience. ECD 5.0
 - 108.05 Evaluate and compare employment opportunities that match career goals. ECD 6.0
 - 108.06 Identify and exhibit traits for retaining employment. ECD 7.0
 - 108.07 Identify opportunities and research requirements for career advancement. ECD 8.0
 - 108.08 Research the benefits of ongoing professional development. ECD 9.0

- 108.09 Examine and describe entrepreneurship opportunities as a career planning option. ECD 10.0
- 109.0 Demonstrate personal money-management concepts, procedures, and strategies. –
The student will be able to:
- 109.01 Identify and describe the services and legal responsibilities of financial institutions. FL 2.0
 - 109.02 Describe the effect of money management on personal and career goals. FL 3.0
 - 109.03 Develop a personal budget and financial goals. FL 3.1
 - 109.04 Complete financial instruments for making deposits and withdrawals. FL 3.2
 - 109.05 Maintain financial records. FL 3.3
 - 109.06 Read and reconcile financial statements. FL 3.4
 - 109.07 Research, compare and contrast investment opportunities.

2012 – 2013

**Florida Department of Education
Student Performance Standards**

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.

- 50.0 Demonstrate an understanding of the foundations of flight. – The student will be able to:
- 50.01 Describe the main components of an aircraft and the forces acting on them.
 - 50.02 Explain and compare the impact of design changes on aircraft performance.
 - 50.03 Describe the factors affecting aircraft performance in flight.
 - 50.04 Analyze the design of an airfoil using simulation software and identify the design changes needed to meet specifications.
 - 50.05 Design and test an airfoil to meet specifications using simulation software.
 - 50.06 Construct an airfoil from a designed template.
 - 50.07 Perform a wind tunnel test of a designed airfoil.
- 51.0 Demonstrate an understanding of aerodynamics fundamentals and aerodynamic testing. – The student will be able to:
- 51.01 Synthesize a test plan for performance analysis of an airfoil.
 - 51.02 Analyze performance data from a wind tunnel test.
 - 51.03 Create and present a technical report of the wind tunnel test results.
- 52.0 Demonstrate an understanding of propulsion systems and their performance factors. – The student will be able to:
- 52.01 Relate Newton's Three Laws of Motion to propulsion.
 - 52.02 Describe the main forms of propulsion.
 - 52.03 Analyze and compare performance of the different forms of propulsion.
 - 52.04 Design and test an engine or propulsion system using simulation software.
- 53.0 Demonstrate an understanding of propulsionless flight. – The student will be able to:
- 53.01 Describe the requirements for a glider to be stable in flight.
 - 53.02 Analyze the design of a glider and identify the design changes needed to meet specifications using simulation software.
 - 53.03 Design and construct a glider to meet specifications.
 - 53.04 Evaluate glider design relative to performance.

- 53.05 Write a proposal to receive “funding” to revise the current design.
- 54.0 Demonstrate an understanding of technologies used in aerial navigation. – The student will be able to:
- 54.01 Measure the GPS location of a number of objects.
 - 54.02 Create a navigational chart.
 - 54.03 Create a multi-segment flight plan.
 - 54.04 Compare textual versus visual information relative to situational awareness.
 - 54.05 Describe technological advances in the Global Positioning System.
- 55.0 Demonstrate an understanding of rocketry and associated performance factors. – The student will be able to:
- 55.01 Design and build a rocket engine thrust test device.
 - 55.02 Test the thrust of a rocket engine using an engine thrust test device.
 - 55.03 Modify the test to show thrust versus time data.
 - 55.04 Describe the design factors and forces impacting rocket flight and how they interact using simulation software.
 - 55.05 Describe how changes in design characteristics affect rocket performance.
 - 55.06 Work as an engineering team to construct, fly, and create a formal report on a model rocket.
 - 55.07 Estimate the maximum altitude of a model rocket.
 - 55.08 Calculate a rocket’s maximum acceleration and velocity.
 - 55.09 Describe how lift, drag, thrust, and weight are affected by launch angle.
- 56.0 Demonstrate an understanding of rocket/satellite-based aerial photography. – The student will be able to:
- 56.01 Design and construct an aerial photography project.
 - 56.02 Calculate the scale factor of aerial photographs.
 - 56.03 Calculate rocket altitude using the scale factor of an aerial photograph.
- 57.0 Demonstrate an understanding of orbital mechanics. – The student will be able to:
- 57.01 Describe a conic section and explain its relation to orbital theory.
 - 57.02 Describe the orbital parameters associated with earth satellite motion.
- 58.0 Demonstrate an understanding of gravity and its effects on the human body. – The student will be able to:
- 58.01 Describe g-force and explain its relationship to gravity.
 - 58.02 Design and conduct a g-force experiment, synthesizing the collected data to real world situations.
 - 58.03 Describe vestibular stimulation and explain its effects in reduced gravity environments.
 - 58.04 Describe microgravity and its importance to space flight environments.
- 59.0 Demonstrate an understanding of composite materials and their fabrication. – The student will be able to:

- 59.01 Mold various composite materials into test samples.
- 59.02 Conduct deflection tests on various test samples and graph the results.
- 59.03 Describe the role of composite materials in aircraft and spacecraft construction.

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

- 60.01 Identify the material properties necessary to provide thermal protection.
- 60.02 Conduct a thermal test on various materials, evaluate the results, and select the best candidate material.

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

- 61.01 Describe the role of robotics in space environments.
- 61.02 Design a computer-controlled robot to deliver a payload to a location by navigating an obstacle course.
- 61.03 Design, build, and test an intelligent vehicle to meet specifications and pre-defined criteria.

2012 – 2013

**Florida Department of Education
Student Performance Standards**

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.

- 62.0 Demonstrate an understanding of documentation procedures associated with biotechnical engineering. – The student will be able to:
- 62.01 Describe the various methods of documentation in biotechnical engineering.
 - 62.02 Compare and contrast various methods of information gathering.
 - 62.03 Follow procedures for ensuring accuracy and precision in measuring solutions.
- 63.0 Demonstrate an understanding of the evolution of biotechnical engineering. – The student will be able to:
- 63.01 Research and create a timeline depicting the evolution of biotechnical engineering, describing the impact of individual milestones.
 - 63.02 Describe the fundamental concepts common to all major industries in biotechnical engineering.
 - 63.03 Explain how biotechnical engineered products impact society.
 - 63.04 Describe the relationship between the financial markets and biotechnical engineering.
- 64.0 Demonstrate an understanding of the role of values, morals, and ethics in the field of biotechnology. – The student will be able to:
- 64.01 Differentiate among values, morals, and ethics.
 - 64.02 Analyze the bioethical issues arising from options created by technological advancements.
 - 64.03 Create a public opinion survey.
- 65.0 Demonstrate an understanding of the roles of forensics, reverse engineering, and genetic engineering to biotechnology applications. – The student will be able to:
- 65.01 Describe molecular techniques used by bioinformaticists.
 - 65.02 Analyze and apply the technologies used in the field of forensics.
 - 65.03 Reverse engineer a crime scene.
 - 65.04 Evaluate evidence and justify conclusions.

- 65.05 Apply practical knowledge of genetic engineering.
 - 65.06 Form a start-up company that expands on previous genetic engineering work.
 - 65.07 Conduct facial reconstruction as would a forensic artist.
- 66.0 Demonstrate an understanding of fermentation as it relates to the production of renewable energy. – The student will be able to:
- 66.01 Design a method or instrument for measuring fermentation rate.
 - 66.02 Research and determine ideal conditions for fermentation.
 - 66.03 Design and run a yeast-powered vehicle.
- 67.0 Demonstrate an understanding of engineering design principles relative to the field of biotechnology. – The student will be able to:
- 67.01 Apply engineering design principles by improving the design of a hospital or surgical instrument.
 - 67.02 Demonstrate the application of product liability, product reliability, product reusability, and product failure.
- 68.0 Demonstrate an understanding of engineering as it relates to the design of prosthetic devices. – The student will be able to:
- 68.01 Design and build a joint model that mirrors human movement.
 - 68.02 Design and model a new joint replacement.
 - 68.03 Synthesize skeletal system concepts with the design process for engineering joints.
- 69.0 Research heart diseases, disorders, treatment options, and procedures. – The student will be able to:
- 69.01 Sketch and provide a solid model of heart chambers and valves.
 - 69.02 Research procedures involving artificial heart surgery and present the cost of a proposed noninvasive implant.
 - 69.03 Research and create a set of improvements for imaging techniques.
 - 69.04 Design a portable ECG monitor and study the electrical aspects associated with the heart.
 - 69.05 Research and design improvements in heart implants or instruments.
 - 69.06 Perform a virtual heart surgery to better understand the instruments and implants in need of improving.

2012 – 2013

**Florida Department of Education
Student Performance Standards**

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.

70.0 Demonstrate an understanding of manufacturing, its history, models, and procedures. – The student will be able to:

- 70.01 Explore manufacturing through research and projects.
- 70.02 Understand what the enterprise wheel represents and how it represents the overall manufacturing scheme.
- 70.03 Research a topic in manufacturing, develop a presentation, and present findings to a group.
- 70.04 Explain the different procedures used in manufacturing.

71.0 Demonstrate an understanding of control systems and methods to describe or document their processes. – The student will be able to:

- 71.01 Identify basic flowcharting symbols and discuss their functions.
- 71.02 Create a flowchart that portrays a manufacturing process.
- 71.03 Apply flowcharting to areas other than manufacturing.
- 71.04 Identify a control system and explain its application to manufacturing.
- 71.05 Model and create a program to control an automated system.

72.0 Demonstrate an understanding of the cost of manufacturing. – The student will be able to:

- 72.01 Create a control system that replicates a factory cell.
- 72.02 Maximize the efficiency of the manufacturing system with respect to time and cost.
- 72.03 Compare the efficiency of running multiple systems against that of one large system.

73.0 Demonstrate proficiency in designing products for manufacturability. – The student will be able to:

- 73.01 Use the design process.
- 73.02 Use knowledge of design to analyze products with flaws.
- 73.03 Use calculated volume, mass, surface area of parts to determine material cost, waste, and packaging requirements.
- 73.04 Use solid modeling software to improve a flawed design.

- 73.05 Determine whether a product is safe for a given audience (e.g., children under the age of three).
- 73.06 Make ethical decisions about manufacturing.
- 73.07 Create a product using solid modeling software.

- 74.0 Demonstrate an understanding of manufacturing processes. – The student will be able to:
 - 74.01 Explain the difference between primary and secondary manufacturing processes.
 - 74.02 Analyze a product to propose the manufacturing processes used to create it.
 - 74.03 Explore manufacturing processes via research.
 - 74.04 Explore prototyping processes.

- 75.0 Demonstrate an understanding of computer numeric control (CNC) as it relates to product design and development. – The student will be able to:
 - 75.01 Identify machines when given a process and identify the process that a given machine performs.
 - 75.02 Determine the appropriate speed rate for a given material using a tool with a given diameter.
 - 75.03 Determine the feed rate for a given material using a tool with a given diameter.
 - 75.04 Read and interpret G & M codes.
 - 75.05 Transfer the drawings made in CAD to a CAM program.
 - 75.06 Create numerical code using a CAM program.
 - 75.07 Verify the creation of a part using simulation software.
 - 75.08 Create parts using the machines demonstrated by the instructor.
 - 75.09 Create a product on the computer using knowledge of manufacturing processes.

- 76.0 Demonstrate an understanding of automation and robotics relative to the manufacturing process. – The student will be able to:
 - 76.01 Research a topic in automation.
 - 76.02 Identify the advantages and disadvantages of robotic labor versus human labor.
 - 76.03 Explore materials handling.
 - 76.04 Create and program virtual robotic work cells with simulation software.
 - 76.05 Program the interface between a robot and another machine.

- 77.0 Demonstrate an understanding of the elements of power and the associated mathematics. – The student will be able to:
 - 77.01 Identify the three main power types.
 - 77.02 Solve problems involving electrical, pneumatic, and mechanical power.
 - 77.03 Convert power between units.
 - 77.04 Calculate torque and use it to calculate power.
 - 77.05 Solve problems involving fluid power.
 - 77.06 Construct a system to convert pneumatic power into mechanical power.

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

- 78.02 Create programs using robotic software that will allow the robot to perform a set of tasks.
 - 78.03 Configure servo motors to operate the robot.
 - 78.04 Formulate a list of tasks in which the robot can be used in a large scale CIM cell operation.
- 79.0 Demonstrate an understanding of the elements of Computer Integrated Manufacturing (CIM). – The student will be able to:
- 79.01 Identify the three categories of CIM systems.
 - 79.02 Compare and contrast the benefits and drawbacks of the three categories of CIM systems.
 - 79.03 Identify the components of an FMS.
 - 79.04 Create a process design chart for a manufacturing process.
 - 79.05 Students will explore a manufacturing or automation career of interest and determine the appropriateness and steps required to be a professional in that role.
- 80.0 Demonstrate proficiency in designing an efficient flexible manufacturing system (FMS) that contains CIM elements. – The student will be able to:
- 80.01 Identify the potential safety issues with a CIM system and identify solutions for these problems.
 - 80.02 Understand the significance of teamwork and communication.
 - 80.03 Design a manufacturing system that contains at least two automated components.
 - 80.04 Complete the construction of each individual component of the miniature FMS and verify that each component works.
 - 80.05 Assemble components into a working miniature FMS.
 - 80.06 Refine each component to improve the total process flow and cycle time.
 - 80.07 Maintain a journal to document daily work.

2012 – 2013

**Florida Department of Education
Student Performance Standards**

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.

- 81.0 Demonstrate an understanding of civil engineering and architecture, its history, innovations, and evolution of styles and materials. – The student will be able to:
- 81.01 Connect modern structural and architectural designs to historical architectural and civil engineering achievements.
 - 81.02 Identify three general categories of structural systems used in historical buildings.
 - 81.03 Explain how historical innovations have contributed to the evolution of civil engineering and architecture.
 - 81.04 Identify and explain the application of principles and elements of design to architectural buildings.
 - 81.05 Determine architectural style through identification of building features, components, and materials.
 - 81.06 Create a mock-up model depicting an architectural style or feature using a variety of materials. .
- 82.0 Demonstrate an understanding of the civil engineering and architecture field. – The student will be able to:
- 82.01 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.
 - 82.02 Identify various specialty disciplines associated with civil engineering.
 - 82.03 Participate in a design charrette and recognize the value of using a charrette to develop innovative solutions to support whole building design.
 - 82.04 Understand the relationship among the stakeholders involved in the design and construction of a building project.
- 83.0 Demonstrate an understanding of residential building structure, elements of design, and associated processes. – The student will be able to:
- 83.01 Identify typical components of a residential framing system.
 - 83.02 Recognize conventional residential roof designs.
 - 83.03 Model a common residential roof design and detail advantages and disadvantages of that style.

- 83.04 Use 3D architectural software to create a small building.
- 84.0 Perform mathematical operations associated with cost and efficiency analysis of a residential design. – The student will be able to:
- 84.01 Apply basic math skills to calculate the quantity and cost of concrete needed to pour the pad for a small building.
 - 84.02 Create a cost estimate for a small construction project, including a detailed cost break-down.
 - 84.03 Calculate the heat loss through one wall of a conditioned building.
 - 84.04 Calculate the heat loss for a building envelope with given conditions appropriate for the project.
 - 84.05 Apply principles of sustainable design to a small project.
- 85.0 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:
- 85.01 Apply elements of good residential design to the design of a basic house to meet the needs of a client.
 - 85.02 Design a home design that complies with applicable codes and requirements.
 - 85.03 Incorporate sustainable building principles and universal design concepts into a residential design.
 - 85.04 Create bubble diagrams and sketch a floor plan.
 - 85.05 Identify residential foundation types and choose an appropriate foundation for a residential application.
 - 85.06 Calculate the head loss and estimate the water pressure for a given water supply system.
 - 85.07 Create sketches to document a preliminary plumbing and a preliminary electrical system layout for a residence that comply with applicable codes.
 - 85.08 Design an appropriate sewer lateral for wastewater management for a building that complies with applicable codes.
 - 85.09 Create a site opportunities map and sketch a project site.
 - 85.10 Choose an appropriate building location on a site based on orientation and other site-specific information.
 - 85.11 Calculate the storm water runoff from a site before and after development.
 - 85.12 Document the design of a home using 3D architectural design software and construction drawings.
- 86.0 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:
- 86.01 Identify applicable building codes and regulations that apply to a given development.
 - 86.02 Classify a building according to its use, occupancy, and construction type using the International Building Code.
 - 86.03 Research Land Use regulations to identify zoning designations and allowable uses of property.
 - 86.04 Comply with specifications, regulations, and codes during a design process.

- 86.05 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.
 - 86.06 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.
 - 86.07 Incorporate sustainable building practices, especially a green roof, into the design of a commercial building.
 - 86.08 Use 3D architectural design software to incorporate revisions for the redesign of a building.
 - 86.09 Use 3D architectural design software to create appropriate documentation to communicate a commercial building design.
 - 86.10 Calculate the structural efficiency of a structure.
 - 86.11 Use load-span tables to design structural elements.
- 87.0 Demonstrate proficiency in designing wall, floor, and foundation structures to meet specific load requirements using structural analysis software. – The student will be able to:
- 87.01 Identify the work of a structural engineer.
 - 87.02 Use building codes and other resources to calculate roof loading to a structure and select appropriate roof beams to safely carry the load.
 - 87.03 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.
 - 87.04 Use beam formula to calculate end reactions and the maximum moments of a simply supported beam subjected to a given loading condition.
 - 87.05 Use structural analysis software to create shear and moment diagrams of simply supported beams subjected to a given loading condition.
 - 87.06 Calculate the deflection of a simply supported beam subjected to a given loading condition.
 - 87.07 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.
 - 87.08 Identify and describe the typical usage of foundation systems commonly used in commercial construction.
 - 87.09 Determine the loads transferred from a steel framed structure to the ground through a foundation.
 - 87.10 Size a spread footing for a given loading condition.
 - 87.11 Check structural calculations created by others for correctness.
- 88.0 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:
- 88.01 Interpret and apply code requirements and constraints as they pertain to the installation of services and utilities.
 - 88.02 Read and understand HVAC construction drawings for a commercial project.
 - 88.03 Apply criteria and constraints to size and locate the new utility service connections for a commercial facility.
 - 88.04 Modify system designs to incorporate energy conservation techniques.

- 89.0 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:
- 89.01 Use differential leveling to complete a control survey to establish a point of known elevation for a project.
 - 89.02 Design appropriate pedestrian access, vehicular access and a parking lot for a commercial facility.
 - 89.03 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.
 - 89.04 Estimate the increase in storm water runoff from a commercial site and create a preliminary design for a storm water storage facility.
 - 89.05 Apply Low Impact Development techniques to a commercial site design reduce the impact of development on storm water runoff quantity and quality.
 - 89.06 Follow specifications and codes during a design process.
 - 89.07 Given 3D architectural design software, document a commercial site design.
- 90.0 Design a commercial building. – The student will be able to:
- 90.01 Work individually and in groups to produce a solution to a team project.
 - 90.02 Research codes, zoning ordinances and regulations to determine the applicable requirements for a project.
 - 90.03 Identify the boundaries of a property based on its legal description.
 - 90.04 Perform research and visit a site to gather information pertinent to the viability of a project on the site.
 - 90.05 Identify the criteria and constraints, and gather information to promote viable decisions regarding the development of their solution.
 - 90.06 Create an architectural program, a project organization chart, and a Gantt chart and hold project progress meetings to help manage the team project.
 - 90.07 Communicate ideas while developing a project using various drawing methods, sketches, graphics, or other media collected and documented.
 - 90.08 Investigate the legal, physical, and financial requirements of a project and consider the needs of the community to determine project viability.
 - 90.09 Apply current common practices utilized in Civil Engineering and Architecture to develop a viable solution in their project.
 - 90.10 Develop an understanding of how software is used as a tool to aid in the solution and then the communication of a project.
- 91.0 Create and deliver a presentation of a commercial building design. – The student will be able to:
- 91.01 Assemble and organize work from a commercial project to showcase the project in an effective and professional manner.
 - 91.02 Create visual aids for a presentation that include the appropriate drawings, renderings, models, documentation, and the rationale for choosing the proposal for project development.
 - 91.03 Conduct an oral presentation to present a proposal for the design and development of a commercial building project.

2012 – 2013

**Florida Department of Education
Student Performance Standards**

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.

- 92.0 Identify, define, and justify a technical design problem for resolution. – The student will be able to:
- 92.01 Brainstorm problem statements for unique innovations or inventions.
 - 92.02 Write a concise problem statement using technical writing skills.
 - 92.03 Document research that justifies using the problem statement for the engineering design and development project.
- 93.0 Conduct research and investigation into the stated problem. – The student will be able to:
- 93.01 Use a list of specifications and constraints identified in a decision matrix to develop a list of alternative solutions to the stated problem.
 - 93.02 Research and identify patents related to their identified problem.
 - 93.03 Conduct research to investigate and determine the merit of his or her alternative solution based on past solutions to the problem.
 - 93.04 Explain the feasibility of his or her solution based on his or her research.
 - 93.05 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.
 - 93.06 Create a matrix table to analyze the data found from the patent research.
 - 93.07 Conduct research to identify the difference between innovation and invention.
 - 93.08 Write a fictional scenario for an innovation of interest.
 - 93.09 Discuss the pros and cons of a decision matrix.
 - 93.10 Conduct research and perform a trend analysis on a technical problem.
 - 93.11 Sketch one invention and one innovation related to the technical problem.
- 94.0 Perform and graphically represent an evaluation of proposed design solutions using specific criteria, including product specifications. – The student will be able to:
- 94.01 Create a description of the product specifications for the design solution.
 - 94.02 Objectively evaluate proposed design solutions using specific criteria.
 - 94.03 Select the best design solution option using a decision matrix.

- 94.04 Graphically represent the results of the design solution evaluation.
- 95.0 Design a solution to the problem and create a working prototype for testing. – The student will be able to:
- 95.01 Sketch all parts of their design solution including an isometric view of the assembled product.
 - 95.02 Create a set of working drawings for their design solution.
 - 95.03 Interpret and apply the feedback they receive from experts to improve their design solution.
 - 95.04 Refine their design solution, if necessary, based upon expert feedback.
 - 95.05 Document the project's progress in their engineering notebooks.
 - 95.06 Prototype
 - 95.07 Identify safe practices for the use of tools and equipment.
 - 95.08 Create a detailed set of instructions for producing a testable prototype based on the information gained through their research.
 - 95.09 Identify methods and sources for obtaining materials and supplies.
 - 95.10 Compile a materials list that includes vendors and cost for all necessary materials and equipment to build their prototype.
 - 95.11 Write a step-by-step procedure for the assembly of their prototype.
 - 95.12 Build a working prototype that can be tested.
- 96.0 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:
- 96.01 Select and describe a valid testing method that will be used to accurately evaluate their design solution's ability to solve their problem.
 - 96.02 Prepare a description of the testing method that will be used to valid the designed solution.
 - 96.03 Create a valid justification for the selected testing method.
 - 96.04 Devise a list of testing criteria that will be used to evaluate the success or failure of their prototype testing
 - 96.05 Identify, define, and implement needed modifications to their testing method based on expert feedback and their ongoing research.
 - 96.06 Document their project's progress in their engineer's notebook.
 - 96.07 Create a detailed set of instructions for testing the prototype that will be valid, repeatable, and reliable.
 - 96.08 Apply the appropriate statistical analysis tools to the test results to ensure validity.
 - 96.09 Identify, define, and implement necessary modifications to their design based upon their test results.
 - 96.10 Identify how their solution has removed obsolescence of the original product, if appropriate.
 - 96.11 Evaluate and explain the effectiveness of their design at solving the problem they have defined.
 - 96.12 Document the test results and project progress in their engineering notebooks.
- 97.0 Create and deliver a formal presentation in a suitable form of the solution to the problem. – The student will be able to:

- 97.01 Gather data and information compiled throughout the project and create a technical research paper, PowerPoint, and three panel display of the design solution.
- 97.02 Create a website, if appropriate, in order to depict all aspects of the design solution.
- 97.03 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.
- 97.04 Orally present an effective technical presentation on the design solution.