Revised: 5/9/2016

2014 – 2015

Florida Department of Education
Curriculum Framework

Program Title: **Applied Robotics**
Program Type: **Non Career Preparatory**
Career Cluster: **Engineering & Technology Education**

Secondary – Non Career Preparatory	
Program Number	9410100
CIP Number	0615030330
Grade Level	9-12; 30, 31
Standard Length	4 credits
Teacher Certification	TEC ED 1 @2 ENG 7G ROBOTICS 7G
CTSO	Florida Technology Student Association (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)
Targeted Occupation List	http://www.labormarketinfo.com/wec/TargetOccupationList.htm
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

Purpose

The purpose of this program is to provide students with a foundation of knowledge and technically oriented experiences in the study of the principles and applications of robotics 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 science and mathematics knowledge, technological tools, machines, instruments, materials, processes and systems related to robotics.

Additional Information relevant to this Career and Technical Education (CTE) program is provided at the end of this document.

Program Structure

This program is a planned sequence of instruction. Listed below are the courses that comprise this program. It is recommended that students complete or be concurrently enrolled in advanced science (physics) and mathematics courses (e.g., trigonometry, calculus).

Course Number	Course Title	Length	Level
9410110	Foundations of Robotics	1 credit	3
9410120	Robotic Design Essentials	1 credit	3
9410130	Robotic Systems	1 credit	3
9410140*	Robotic Applications Capstone	1 credit	3

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

Academic Alignment

Some or all of the courses in this program have been aligned to the Next Generation Sunshine State Standards for science and the Florida Standards for mathematics and english/language arts. The table below contains the results of the alignment efforts. Data shown in the table includes: the quantity of academic standards in the CTE course; the total number of standards contained in the academic course; and the percentage of alignment to the CTE course.

Courses	Anatomy/ Physiology Honors	Astronomy Solar/Galactic Honors	Biology 1	Chemistry 1	Earth-Space Science	Genetics Honors	Integrated Science	Marine Science 1 Honors	Physical Science	Physics 1	Environmental Science
9410110	3/87 3%	21/80 26%	11/83 13%	15/69 22%	14/67 21%	6/69 9%	17/82 21%	15/66 23%	26/74 35%	23/72 32%	13/70 19%
9410120	1/87 1%	10/80 13%	6/83 7%	7/69 10%	11/67 16%	2/69 3%	11/82 13%	6/66 9%	16/74 22%	13/72 18%	5/70 7%
9410130	4/87 5%	12/80 15%	1/83 1%	6/69 9%	7/67 10%	5/69 7%	5/82 6%	5/66 8%	8/74 11%	11/72 15%	5/70 7%
9410140	3/87 3%	3/80 4%	#	3/69 4%	#	3/69 4%	#	3/66 5%	#	3/72 4%	3/70 4%

*** Alignment pending review* *# Alignment attempted, but no correlation to academic course*

Courses	Algebra 1	Algebra 2	Geometry	English 1	English 2	English 3	English 4
9410110	12/67 18%	6/75 8%	3/54 6%	12/49 24%	12/48 25%	#	#
9410120	5/67 7%	2/75 3%	5/54 9%	14/49 29%	14/48 29%	#	#
9410130	1/67 6%	3/75 4%	#	#	#	10/45 22%	10/45 22%
9410140	#	2/75 3%	#	#	#	8/45 18%	8/45 18%

Florida Standards for Technical Subjects

Florida Standards (FS) for English Language Arts and Literacy in History/Social Studies, Science, and Technical Subjects are the critical reading and writing literacy standards designed for grade 6 and above. These standards are predicated on teachers of history/social studies, science, and technical subjects using their content area expertise to help students meet the particular challenges of reading, writing, speaking, listening, and language in their respective fields. It is important to note that the 6-12 literacy standards in history/social studies, science, and technical subjects are not meant to replace content standards in those areas but rather to supplement them.

This curriculum framework incorporates the grades 9-10 reading and writing literacy standards in the first two courses of this CTE program and grade 11-12 reading and writing literacy standards in the third and fourth courses of this CTE program. The standards for Mathematical Practices describe varieties of expertise that educators at all levels should seek to develop in their students. These practices rest on important "processes and proficiencies" with longstanding importance in mathematics education. This curriculum framework incorporates the appropriate mathematical practices in the first four courses of this CTE program.

Florida Standards for Mathematics & Language Arts (FS-M/LA)

Some or all of the courses in this program have been aligned to the Florida Standards for Mathematics and Language Arts used in core academic classes. Data shown in the framework table (column 'FS-M/LA') contains the results of these alignment efforts.

Next Generation Sunshine State Standards (NGSSS) - Science

Some or all of the courses in this program have been aligned to the Next Generation Sunshine State Standards (NGSSS) for Science. These standards are listed next to the content standards.

Common Career Technical Core – Career Ready Practices

Career Ready Practices describe the career-ready skills that educators should seek to develop in their students. These practices are not exclusive to a Career Pathway, program of study, discipline or level of education. Career Ready Practices should be taught and reinforced in all career exploration and preparation programs with increasingly higher levels of complexity and expectation as a student advances through a program of study.

1. Act as a responsible and contributing citizen and employee.

2. Apply appropriate academic and technical skills.

3. Attend to personal health and financial well-being.

4. Communicate clearly, effectively and with reason.

5. Consider the environmental, social and economic impacts of decisions.

6. Demonstrate creativity and innovation.

7. Employ valid and reliable research strategies.

8. Utilize critical thinking to make sense of problems and persevere in solving them.

9. Model integrity, ethical leadership and effective management.

10. Plan education and career path aligned to personal goals.

11. Use technology to enhance productivity.

12. Work productively in teams while using cultural/global competence.

Standards

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

01.0 Methods and strategies for using Florida Standards for grades 09-10 reading in Technical Subjects for student success in Applied Robotics.
02.0 Methods and strategies for using Florida Standards for grades 09-10 writing in Technical Subjects for student success in Applied Robotics.
03.0 Methods and strategies for using Florida Standards for grades 09-10 Mathematical Practices in Technical Subjects for student success in Applied Robotics.
04.0 Demonstrate an understanding of robotics, its history, applications, and evolution.
05.0 Describe Artificial Intelligence (AI) and the forms of applied logic.
06.0 Describe the role of sensors in the field of robotics.
07.0 Demonstrate an understanding of the foundations of electronics.
08.0 Describe the operation of basic electronic devices used in robotics.
09.0 Demonstrate an understanding of engineering principles.
10.0 Explain fundamental physics concepts applicable to the field of robotics.
11.0 Demonstrate the safe and proper use of electronic and other lab equipment, tools, and materials.
12.0 Build, program, and configure a robot to perform predefined tasks.
13.0 Solve problems using critical thinking skills, creativity and innovation.
14.0 Correlate elements of artificial intelligence to their functions in robotics.
15.0 Describe the various classification schemes of sensors applicable to robotics.
16.0 Explain how electronic devices are used in the operation of a robotic assembly.
17.0 Demonstrate an understanding of various technologies used in the design of robotic assemblies.
18.0 Demonstrate an understanding of advanced mathematics and physics associated with the design of a robotic assembly.
19.0 Create a program to control a robotic mechanism.
20.0 Describe the operation and use of various forms of electrical motors in robotic assemblies.
21.0 Solve problems using critical thinking skills, creativity and innovation.
22.0 Demonstrate an understanding of basic 3D modeling concepts.
23.0 Design, build, program, and configure a robot to perform predefined tasks.
24.0 Methods and strategies for using Florida Standards for grades 11-12 reading in Technical Subjects for student success in Applied Robotics.
25.0 Methods and strategies for using Florida Standards for grades 11-12 writing in Technical Subjects for student success in Applied Robotics.
26.0 Methods and strategies for using Florida Standards for grades 11-12 Mathematical Practices in Technical Subjects for student success in Applied Robotics.
27.0 Describe the approaches, challenges, and problem-solving methodologies involved with integrating artificial intelligence into robotic systems.
28.0 Describe the role of specialized sensors in the design and operation of robotic systems.
29.0 Describe the use of specialized electronic applications used in robotic systems.
30.0 Demonstrate an understanding of engineering technologies impacted by the evolution of robotics.
31.0 Demonstrate an understanding of underlying principles of environmental physics related to robotic technology.
32.0 Demonstrate an understanding of the impact of robotics on the manufacturing process.
33.0 Demonstrate an understanding of topographical and environmental considerations in robotic assembly design.
34.0 Create a program to control a robotic system.
35.0 Demonstrate an understanding of technologies for communication with and among robotic systems.

36.0 Solve problems using critical thinking skills, creativity and innovation.
37.0 Demonstrate an understanding of static and dynamic modeling and simulation concepts related to the design of robotic systems.
38.0 Design, build, program, and configure a robot to perform predefined tasks.
39.0 Demonstrate an understanding of robotic applications (both stationary and mobile), their environments, and their unique design constraints.
40.0 Design, build, program, and configure an autonomous robot to perform predefined tasks suitable for a particular robotic application.
41.0 Successfully work as a member of a team.
42.0 Plan, organize, and carry out a project plan.
43.0 Manage resources.
44.0 Use tools, materials, and processes in an appropriate and safe manner.

Florida Department of Education
Student Performance Standards

Course Title: **Foundations of Robotics**
Course Number: **9410110**
Course Credit: **1**

Course Description:

This course provides students with a foundation in content and skills associated with robotics and automation, including artificial intelligence, electronics, physics, and principles of engineering.

Florida Standards			Correlation to CTE Program Standard #
01.0	Methods and strategies for using Florida Standards for grades 09-10 reading in Technical Subjects for student success in Applied Robotics.		
	01.01 Key Ideas and Details		
	01.01.1	Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. LAFS.910.RST.1.1	
	01.01.2	Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. LAFS.910.RST.1.2	
	01.01.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. LAFS.910.RST.1.3	
	01.02 Craft and Structure		
	01.02.1	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics. LAFS.910.RST.2.4	
	01.02.2	Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). LAFS.910.RST.2.5	

Florida Standards			Correlation to CTE Program Standard #
	01.02.3	Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address. LAFS.910.RST.2.6	
01.03	Integration of Knowledge and Ideas		
	01.03.1	Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. LAFS.910.RST.3.7	
	01.03.2	Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. LAFS.910.RST.3.8	
	01.03.3	Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts. LAFS.910.RST.3.9	
01.04	Range of Reading and Level of Text Complexity		
	01.04.1	By the end of grade 9, read and comprehend literature [informational texts, history/social studies texts, science/technical texts] in the grades 9–10 text complexity band proficiently, with scaffolding as needed at the high end of the range.	
	01.04.2	By the end of grade 10, read and comprehend literature [informational texts, history/social studies texts, science/technical texts] at the high end of the grades 9–10 text complexity band independently and proficiently. LAFS.910.RST.4.10	
02.0	Methods and strategies for using Florida Standards for grades 09-10 writing in Technical Subjects for student success in Applied Robotics.		
02.01	Text Types and Purposes		
	02.01.1	Write arguments focused on discipline-specific content. LAFS.910.WHST.1.1	
	02.01.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. LAFS.910.WHST.1.2	
02.02	Production and Distribution of Writing		
	02.02.1	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. LAFS.910.WHST.2.4	

Florida Standards			Correlation to CTE Program Standard #
	02.02.2	Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. LAFS.910.WHST.2.5	
	02.02.3	Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically. LAFS.910.WHST.2.6	
	02.03	Research to Build and Present Knowledge	
	02.03.1	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. LAFS.910.WHST.3.7	
	02.03.2	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation. LAFS.910.WHST.3.8	
	02.03.3	Draw evidence from informational texts to support analysis, reflection, and research. LAFS.910.WHST.3.9	
	02.04	Range of Writing	
	02.04.1	Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. LAFS.910.WHST.4.10	
03.0	Methods and strategies for using Florida Standards for grades 09-10 Mathematical Practices in Technical Subjects for student success in Applied Robotics.		
	03.01	Make sense of problems and persevere in solving them. MAFS.K12.MP.1.1	
	03.02	Reason abstractly and quantitatively. MAFS.K12.MP.2.1	
	03.03	Construct viable arguments and critique the reasoning of others. MAFS.K12.MP.3.1	

Florida Standards	Correlation to CTE Program Standard #
03.04 Model with mathematics. MAFS.K12.MP.4.1	
03.05 Use appropriate tools strategically. MAFS.K12.MP.5.1	
03.06 Attend to precision. MAFS.K12.MP.6.1	
03.07 Look for and make use of structure. MAFS.K12.MP.7.1	
03.08 Look for and express regularity in repeated reasoning. MAFS.K12.MP.8.1	

Abbreviations:
FS-M/LA = Florida Standards for Math/Language Arts
NGSSS-Sci = Next Generation Sunshine State Standards for Science

CTE Standards and Benchmarks	FS-M/LA	NGSSS-Sci
04.0 Demonstrate an understanding of robotics, its history, applications, and evolution. – The student will be able to:		SC.912.E.5.7 SC.912.N.1.1, 2, 5, 6, 7; 2.1, 2 , 3, 4, 5; 3.2; 4.1
04.01 Explore robotics history through research of the industry.	LAFS.910.W.3.7, 8	
04.02 Compare and contrast various applications of automation and robotics.	LAFS.910.RI.1.3	
04.03 Describe emerging technologies and their implications on the field of robotics.	LAFS.910.W.3.7, 8 LAFS.910.RI.1.3	
05.0 Describe Artificial Intelligence (AI) and the forms of applied logic. – The student will be able to:		SC.912.N.1.3
05.01 Describe the fundamental elements that comprise artificial intelligence.	LAFS.910.L.3.4, 6	
05.02 Compare and contrast the various types of AI in terms of their application to robotics.	LAFS.910.RI.1.3	
05.03 Describe the role of decision logic in robotics.		
05.04 Describe Boolean logic, its operations and laws, as used in robotics.		
05.05 Translate data specifications into truth tables and extract logical expressions.	MAFS.912.N-Q.1.1	
05.06 Solve simple Boolean algebra problems.	MAFS.912.N-RN.2.3	

CTE Standards and Benchmarks		FS-M/LA	NGSSS-Sci
06.0	Describe the role of sensors in the field of robotics. – The student will be able to:		SC.912.P.10.1, 18, 21
06.01	Define sensor.	LAFS.910.L.3.4, 6	
06.02	Describe the basic operation common to all sensors.	LAFS.910.L.3.4, 6	
06.03	Describe the types of sensors and ways in which they can be categorized.		
06.04	Describe tactile sensors, their operation, and their role in robotics.		
06.05	Describe infrared sensors and their role in robotics.		
06.06	Differentiate between active and passive infrared sensors relative to their use in robotics.		
07.0	Demonstrate an understanding of the foundations of electronics. – The student will be able to:		SC.912.N.3.5 SC.912.P.10.15, 17, 18
07.01	Define voltage, current, resistance, inductance, and capacitance.	LAFS.910.L.3.4, 6	
07.02	Describe the difference between alternating and direct current.	LAFS.910.L.3.4, 6	
07.03	Identify and describe the operation of common electronic components.		
07.04	Compare and contrast series and parallel circuits.		
07.05	Define Ohm's Law and Kirchhoff's Laws.	LAFS.910.L.3.4, 6 MAFS.912.A-SSE.1.1, 2 MAFS.912.A-CED.1.4	
07.06	Perform basic soldering techniques and breadboard construction.		
07.07	Analyze simple analog and digital circuits using common electronic test equipment and tools.		
07.08	Describe the characteristics of analog and digital signals.	LAFS.910.L.3.4, 6	
07.09	Translate logical expressions into schematic or symbolic representation.	MAFS.912.N-CN.3.8	
08.0	Describe the operation of basic electronic devices used in robotics. – The student will be able to:		SC.912.P.10.3, 15
08.01	Describe how DC motors are used in robotics.	LAFS.910.L.3.4, 6	
08.02	Describe how speed and torque are controlled in DC motors.		
08.03	Describe how servos are used in robotics (e.g., robot arms, legs, steering, et al).	LAFS.910.L.3.4, 6	

CTE Standards and Benchmarks		FS-M/LA	NGSSS-Sci
	08.04 Describe how angle and torque are controlled in a servo motor.		
	08.05 Compare and contrast open and closed loop feedback/control systems.		
09.0	Demonstrate an understanding of engineering principles. – The student will be able to:		SC.912.N.1.1, 2; 3.5 SC.912.P.10.3
	09.01 Describe the steps involved in the engineering design process and the activities performed in each step.	LAFS.910.RI.1.3	
	09.02 Create basic schematic drawings of electronic circuitry.	LAFS.910.W.1.2	
	09.03 Name the six simple machines (i.e., lever, inclined plane, wheel and axle, screw, wedge, and pulley) and describe their application to robotics.		
	09.04 Explain and demonstrate how gear ratios are used for increasing or decreasing power or speed.	LAFS.910.SL.2.4 MAFS.912.A-CED.1.1, 2	
	09.05 Discuss Human Computer Interface (HCI) and describe its role in robotics.	LAFS.910.SL.1.1	
	09.06 Describe the role of diagnostics and troubleshooting to the engineering design process.	LAFS.910.RI.1.3	
10.0	Explain fundamental physics concepts applicable to the field of robotics. – The student will be able to:		SC.912.P.8.3; 10.1, 2; 12.1, 3, 5
	10.01 Describe Newton's Laws of Motion (inertia, net force, reaction) and relate their applicability to robotics.	LAFS.910.RI.1.1, 2	
	10.02 Compare and contrast the forms of energy (e.g., thermal, solar, mechanical, kinetic, potential, et al.) employed in robotics.		
	10.03 Relate the concept of time and rate to its application in robotics.		
	10.04 Describe magnetics and its use and implications in robotics.	LAFS.910.L.3.4, 6 MAFS.912.A-REI.1.1	
	10.05 Relate how material properties (e.g., mass, density, strength, et al) have applicability to robotics.		
11.0	Demonstrate the safe and proper use of electronic and other lab equipment, tools, and materials. – The student will be able to:		SC.912.L.17.20 SC.912.P.10.15, 20
	11.01 Use a Volt-Ohm Meter (VOM)/multimeter to obtain accurate measurements of voltage, current, and resistance.		
	11.02 Apply safety rules in the use of electronic instruments and demonstrate proper care and maintenance for the equipment during storage and use.		
	11.03 Set up and use test equipment to observe waveforms and to determine the voltage of the signal presented.		
	11.04 Use testers to determine the condition of electronic components.		

CTE Standards and Benchmarks		FS-M/LA	NGSSS-Sci
	11.05 Demonstrate proper soldering applications.		
	11.06 Identify and use common electrical and electronics hand tools.	LAFS.910.L.3.4, 6	
	11.07 Follow laboratory safety rules and procedures.		
	11.08 Demonstrate good housekeeping at workstation within total laboratory.		
	11.09 Identify color-coding safety standards.		
	11.10 Explain fire prevention and safety precautions and practices for extinguishing fires.	LAFS.910.SL.1.1	
	11.11 Identify harmful effects/potential dangers of familiar hazardous substances/devices to people and the environment.		
12.0	Build, program, and configure a robot to perform predefined tasks. – The student will be able to:		SC.912.N.3.5; 4.2
	12.01 Build a robot.		
	12.02 Create programs as required using robotic software that will allow the robot to perform a set of tasks.	LAFS.910.L.3.6	
	12.03 Create a flow chart that visually describes a basic robotic task.	LAFS.910.W.1.2	
	12.04 Configure servo and motors to operate the robot.		
	12.05 Formulate examples of how the robot might be used or adapted for use in a manufacturing or other environment.		
	12.06 Create and present a proposal, including drawings and specifications, describing the robot, the tasks and rationale, and the results.	LAFS.910.SL.2.4, 5	
13.0	Solve problems using critical thinking skills, creativity and innovation. – The student will be able to:		SC.912.N.1.1, 2, 5, 6, 7; 2.1, 2, 3, 4, 5; 3.2; 4.1
	13.01 Employ critical thinking skills independently and in teams to solve problems and make decisions.	LAFS.910.SL.1.1, 3 MAFS.912.A-REI.1.1; 2.3	
	13.02 Employ critical thinking and interpersonal skills to resolve conflicts.		
	13.03 Identify and document workplace performance goals and monitor progress toward those goals.		
	13.04 Conduct technical research to gather information necessary for decision-making.	LAFS.910.W.3.7, 8	

Florida Department of Education
Student Performance Standards

Course Title: **Robotic Design Essentials**
Course Number: **9410120**
Course Credit: **1**

Course Description:

This course provides students with content and skills essential to the design and operation of robotics, including artificial intelligence, sensors, electronic devices, engineering technologies, motion physics, electrical motors, programming, simulation and modeling, and critical thinking skills.

Florida Standards			Correlation to CTE Program Standard #
01.0	Methods and strategies for using Florida Standards for grades 09-10 reading in Technical Subjects for student success in Applied Robotics.		
	01.01 Key Ideas and Details		
	01.01.1	Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. LAFS.910.RST.1.1	
	01.01.2	Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. LAFS.910.RST.1.2	
	01.01.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. LAFS.910.RST.1.3	
	01.02 Craft and Structure		
	01.02.1	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics. LAFS.910.RST.2.4	
	01.02.2	Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). LAFS.910.RST.2.5	
	01.02.3	Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question	

Florida Standards			Correlation to CTE Program Standard #
		the author seeks to address. LAFS.910.RST.2.6	
	01.03	Integration of Knowledge and Ideas	
	01.03.1	Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. LAFS.910.RST.3.7	
	01.03.2	Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. LAFS.910.RST.3.8	
	01.03.3	Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts. LAFS.910.RST.3.9	
	01.04	Range of Reading and Level of Text Complexity	
	01.04.1	By the end of grade 9, read and comprehend literature [informational texts, history/social studies texts, science/technical texts] in the grades 9–10 text complexity band proficiently, with scaffolding as needed at the high end of the range.	
	01.04.2	By the end of grade 10, read and comprehend literature [informational texts, history/social studies texts, science/technical texts] at the high end of the grades 9–10 text complexity band independently and proficiently. LAFS.910.RST.4.10	
02.0		Methods and strategies for using Florida Standards for grades 09-10 writing in Technical Subjects for student success in Applied Robotics.	
	02.01	Text Types and Purposes	
	02.01.1	Write arguments focused on discipline-specific content. LAFS.910.WHST.1.1	
	02.01.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. LAFS.910.WHST.1.2	
	02.02	Production and Distribution of Writing	
	02.02.1	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. LAFS.910.WHST.2.4	

Florida Standards			Correlation to CTE Program Standard #
	02.02.2	Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. LAFS.910.WHST.2.5	
	02.02.3	Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically. LAFS.910.WHST.2.6	
	02.03	Research to Build and Present Knowledge	
	02.03.1	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. LAFS.910.WHST.3.7	
	02.03.2	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation. LAFS.910.WHST.3.8	
	02.03.3	Draw evidence from informational texts to support analysis, reflection, and research. LAFS.910.WHST.3.9	
	02.04	Range of Writing	
	02.04.1	Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. LAFS.910.WHST.4.10	
03.0	Methods and strategies for using Florida Standards for grades 09-10 Mathematical Practices in Technical Subjects for student success in Applied Robotics.		
	03.01	Make sense of problems and persevere in solving them. MAFS.K12.MP.1.1	
	03.02	Reason abstractly and quantitatively. MAFS.K12.MP.2.1	
	03.03	Construct viable arguments and critique the reasoning of others. MAFS.K12.MP.3.1	

Florida Standards	Correlation to CTE Program Standard #
03.04 Model with mathematics. MAFS.K12.MP.4.1	
03.05 Use appropriate tools strategically. MAFS.K12.MP.5.1	
03.06 Attend to precision. MAFS.K12.MP.6.1	
03.07 Look for and make use of structure. MAFS.K12.MP.7.1	
03.08 Look for and express regularity in repeated reasoning. MAFS.K12.MP.8.1	

Abbreviations:
FS-M/LA = Florida Standards for Math/Language Arts
NGSSS-Sci = Next Generation Sunshine State Standards for Science

CTE Standards and Benchmarks	FS-M/LA	NGSSS-Sci
14.0 Correlate elements of artificial intelligence to their functions in robotics. – The student will be able to:		SC.912.N.3.5 SC.912.P.12.2
14.01 Describe the types of sensor output required for various algorithms used in robotics.		
14.02 Formulate a schema (e.g. logic flow diagram.) for robotic control based on sensor data interpretation.	LAFS.910.W.1.2	
14.03 Explain how artificial intelligence and motion sequences are impacted by controlling sensor data and interpretation.	LAFS.910.SL.1.1	
14.04 Describe polymorphism and its implications on robotic algorithms.	LAFS.910.SL.2.4, 5	
14.05 Describe the design implications and options for sensor data and interpretation algorithms employed for autonomous robotic applications.	LAFS.910.SL.2.4, 5	
15.0 Describe the various classification schemes of sensors applicable to robotics. – The student will be able to:		SC.912.N.1.1, 6; 3.5 SC.912.P.10.1, 20, 21
15.01 Compare and contrast the characteristics, benefits, constraints, and cost implications of analog and digital sensors.	LAFS.910.SL.1.1	
15.02 Differentiate between passive and active sensors relative to their applicability and suitability for various robotic applications.		
15.03 Describe the various ways in which sensors are used in the design of robotic applications.	LAFS.910.SL.1.1	
16.0 Explain how electronic devices are used in the operation of a robotic assembly. – The student will be able to:		SC.912.N.3.5

CTE Standards and Benchmarks		FS-M/LA	NGSSS-Sci
16.01	Design and build breadboard or printed circuit boards for a robotic assembly.		
16.02	Describe the advantages, limitations, and operation of electronic control and feedback systems.	LAFS.910.L.3.4, 6	
16.03	Describe the operation and design considerations of electronic devices used to control robotic assemblies.	LAFS.910.L.3.4, 6	
16.04	Describe the kinds of electronic devices used as input/output devices in a robotic assembly and explain the rationale for their use.	LAFS.910.L.3.4, 6	
17.0	Demonstrate an understanding of various technologies used in the design of robotic assemblies. – The student will be able to:		SC.912.P.10.1, 3, 15
17.01	Describe the underlying principles associated with pneumatic and hydraulic devices used in the design of a robotic assembly.	LAFS.910.SL.2.4, 5	
17.02	Describe the underlying principles of electricity and electrical components, to include power sources, consumption, and heat issues.	LAFS.910.SL.2.4, 5	
17.03	Define various Human Computer Interface (HCI) issues that affect the design of a robotic assembly and elaborate on their role in the design.	LAFS.910.SL.2.4, 5	
17.04	Interpret information on mechanical and electrical diagrams according to the defined scale.	LAFS.910.RI.1.2	
17.05	Compare and contrast the operation, advantages, and constraints of wired and wireless strategies for communicating with robotic assemblies.		
17.06	Identify the design considerations associated with materials used in robotic assemblies and describe how the intended operational environment plays a role in the design.		
17.07	Compare and contrast the use of USB, firewire, Ethernet, serial cabling and wireless (Bluetooth, 802.11x) strategies and technologies in the design of robotic assemblies.	LAFS.910.SL.1.1	
18.0	Demonstrate an understanding of advanced mathematics and physics associated with the design of a robotic assembly. – The student will be able to:		SC.912.P.12.2, 3, 5, 6
18.01	Describe the concepts of acceleration and velocity as they relate to the kinematic design of robotic assemblies.	LAFS.910.SL.2.4, 5	
18.02	Describe the term “degrees of freedom” and relate it to the design of joints used in robotic assemblies.	LAFS.910.SL.2.4, 5	
18.03	Describe angular momentum and its role in the design of robotic joint motion, balance, and mobility.	LAFS.910.SL.2.4, 5	
18.04	Explain impulse-momentum theory and illustrate its applicability to the design of robotic assemblies.	LAFS.910.SL.1.1	
18.05	Explain translational, rotational, and oscillatory motion in terms of their applicability to the design of robotic assemblies.	LAFS.910.SL.1.1	

CTE Standards and Benchmarks		FS-M/LA	NGSSS-Sci
18.06	Describe the relationship between force and deformation as it relates to a robotic system.		
19.0	Create a program to control a robotic mechanism. – The student will be able to:		SC.912.N.1.1
19.01	Demonstrate an understanding of coding languages, syntax, and implementation.		
19.02	Apply programming best practices for commenting and documentation.		
19.03	Describe how logic is infused into a program and used to control the flow of the program.	LAFS.910.SL.1.1	
19.04	Write a program in pseudocode that uses structured programming to solve a problem.		
19.05	Write code for evaluating a condition and performing an appropriate action using If/then statements.		
19.06	Write code for performing actions within a code segment (using do/while statements) for as long as a given condition exists.		
19.07	Write code that loops through a series of actions for a specified increment.		
19.08	Write code that evaluates sensor data as variables to provide feedback control.		
20.0	Describe the operation and use of various forms of electrical motors in robotic assemblies. – The student will be able to:		SC.912.P.10.16; 12.5
20.01	Explain the operation and use of DC motors in robotic controls.	LAFS.910.SL.1.1	
20.02	Explain the operation and use of stepper motors to control or limit movement of a robotic assembly.	LAFS.910.SL.2.4, 5	
20.03	Explain the operation and primary use of AC motors in robotic assemblies.	LAFS.910.SL.1.1	
20.04	Explain the operation, use, and advantages of brushless motors used in robotics.	LAFS.910.SL.1.1	
20.05	Explain the types, use, and advantages of linear actuators used in robotics.	LAFS.910.SL.1.1	
21.0	Solve problems using critical thinking skills, creativity and innovation. – The student will be able to:		SC.912.N.1.1, 6, 7; 2.4
21.01	Employ critical thinking skills independently and in teams to solve problems and make decisions.	LAFS.910.SL.1.1, 3 MAFS.912.A-REI.1.1	
21.02	Employ critical thinking and interpersonal skills to resolve conflicts.	LAFS.910.SL.1.1, 3	
21.03	Identify and document workplace performance goals and monitor progress toward those goals.		

CTE Standards and Benchmarks		FS-M/LA	NGSSS-Sci
21.04	Conduct technical research to gather information necessary for decision-making.	LAFS.910.W.3.7, 8	
22.0	Demonstrate an understanding of basic 3D modeling concepts. – The student will be able to:		SC.912.N.3.5 SC.912.P.12.1
22.01	Compare and contrast 3D modeling software applications that offer a perspective view, an orthographic view, or a combination.		
22.02	Explain how Cartesian coordinate systems are used to locate objects in three dimensional space.	MAFS.912.A-REI.4.11 MAFS.912.G-CO.1.2	
22.03	Describe basic geometric shapes available in 3D modeling software (sphere, cube, cylinder, torus, cone, plane, axis point).	LAFS.910.SL.1.1 MAFS.912.G-GMD.2.4	
22.04	Describe basic shapes available in 2D modeling software (arcs, ellipses, circles, curve, freehand curves, polygons, splines).	LAFS.910.SL.1.1 MAFS.912.G-GMD.2.4	
22.05	Define the parameters used for determining the size, placement, and orientation of a modeling object.	LAFS.910.L.3.4, 6	
22.06	Describe the Boolean modeling operations of union, subtraction, and intersection.	LAFS.910.L.3.4, 6	
22.07	Describe how extrusion or sweeping techniques transform 2D objects into 3D objects.		
22.08	Describe the lofting technique for creating 3D objects.		
22.09	Describe the revolve or lathe techniques for animating a 2D object and give examples of their application.		
22.10	Describe the scale, rotate, and move actions that comprise the transformation technique for animating a 3D object.		
22.11	Describe the object parameters modified using the deformation technique and provide examples of its use.		
22.12	Describe the copy or clone technique.		
22.13	Describe the mirror technique.		
22.14	Compare and contrast the wire frame and solid viewing tools.		
22.15	Describe basic viewing navigation tools such as zoom, rotate, and panning.		
22.16	Define plug-in and describe how it extends the capability of the modeling program.		
22.17	Describe the export function and its value when producing visualizations.		
23.0	Design, build, program, and configure a robot to perform predefined tasks. – The student will be able to:		SC.912.N.1.1

CTE Standards and Benchmarks	FS-M/LA	NGSSS-Sci
23.01 Build a robot.		
23.02 Create programs as required using robotic software that will allow the robot to perform a set of tasks.		
23.03 Configure servo motors to operate the robot.		
23.04 Formulate examples of how the robot might be used or adapted for use in a manufacturing or other environment.		
23.05 Create a portfolio, including drawings and specifications, describing the robot, the tasks and rationale, and the results.	LAFS.910.W.1.2; 2.4, 5, 6; 4.10	

Florida Department of Education
Student Performance Standards

Course Title: **Robotic Systems**
Course Number: **9410130**
Course Credit: **1**

Course Description:

This course provides students with extended content and skills essential to the design and operation of robotic systems, including artificial intelligence, specialized sensors, electronic applications, engineering technologies, environmental physics, manufacturing, topographical considerations, programming, communications, simulation and modeling, and critical thinking skills.

Florida Standards			Correlation to CTE Program Standard #
24.0	Methods and strategies for using Florida Standards for grades 11-12 reading in Technical Subjects for student success in Applied Robotics.		
	24.01 Key Ideas and Details		
	24.01.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. LAFS.1112.RST.1.1	
	24.01.2	Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. LAFS.1112.RST.1.2	
	24.01.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. LAFS.1112.RST.1.3	
	24.02 Craft and Structure		
	24.02.1	Determine the meaning of symbols key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics. LAFS.1112.RST.2.4	
	24.02.2	Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas. LAFS.1112.RST.2.5	

Florida Standards			Correlation to CTE Program Standard #
	24.02.3	Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved. LAFS.1112.RST.2.6	
24.03	Integration of Knowledge and Ideas		
	24.03.1	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g. quantitative data, video, multimedia) in order to address a question or solve a problem. LAFS.1112.RST.3.7	
	24.03.2	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. LAFS.1112.RST.3.8	
	24.03.3	Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. LAFS.1112.RST.3.9	
24.04	Range of Reading and Level of Text Complexity		
	24.04.1	By the end of grade 11, read and comprehend literature [informational texts, history/social studies texts, science/technical texts] in the grades 11–CCR text complexity band proficiently, with scaffolding as needed at the high end of the range.	
	24.04.2	By the end of grade 12, read and comprehend literature [informational texts, history/social studies texts, science/technical texts] at the high end of the grades 11–CCR text complexity band independently and proficiently. LAFS.1112.RST.4.10	
25.0	Methods and strategies for using Florida Standards for grades 11-12 writing in Technical Subjects for student success in Applied Robotics.		
25.01	Text Types and Purposes		
	25.01.1	Write arguments focused on discipline-specific content. LAFS.1112.WHST.1.1	
	25.01.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. LAFS.1112.WHST.1.2	
25.02	Production and Distribution of Writing		

Florida Standards			Correlation to CTE Program Standard #
	25.02.1	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. LAFS.1112.WHST.2.4	
	25.02.2	Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. LAFS.1112.WHST.2.5	
	25.02.3	Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information. LAFS.1112.WHST.2.6	
	25.03	Research to Build and Present Knowledge	
	25.03.1	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. LAFS.1112.WHST.3.7	
	25.03.2	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. LAFS.1112.WHST.3.8	
	25.03.3	Draw evidence from informational texts to support analysis, reflection, and research. LAFS.1112.WHST.3.9	
	25.04	Range of Writing	
	25.04.1	Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. LAFS.1112.WHST.4.10	
26.0	Methods and strategies for using Florida Standards for grades 11-12 Mathematical Practices in Technical Subjects for student success in Applied Robotics.		
	26.01	Make sense of problems and persevere in solving them. MAFS.K12.MP.1.1	
	26.02	Reason abstractly and quantitatively. MAFS.K12.MP.2.1	

Florida Standards	Correlation to CTE Program Standard #
26.03 Construct viable arguments and critique the reasoning of others. MAFS.K12.MP.3.1	
26.04 Model with mathematics. MAFS.K12.MP.4.1	
26.05 Use appropriate tools strategically. MAFS.K12.MP.5.1	
26.06 Attend to precision. MAFS.K12.MP.6.1	
26.07 Look for and make use of structure. MAFS.K12.MP.7.1	
26.08 Look for and express regularity in repeated reasoning. MAFS.K12.MP.8.1	

Abbreviations:
FS-M/LA = Florida Standards for Math/Language Arts
NGSSS-Sci = Next Generation Sunshine State Standards for Science

CTE Standards and Benchmarks	FS-M/LA	NGSSS-Sci
27.0 Describe the approaches, challenges, and problem-solving methodologies involved with integrating artificial intelligence into robotic systems. – The student will be able to:		SC.912.N.1.1; 3.5
27.01 Compare and contrast symbolic and sub-symbolic approaches to integrating artificial intelligence into robotic systems.		
27.02 Describe an intelligent agent and relate its role to the operation of robotic systems.	LAFS.1112.SL.1.1	
27.03 Discuss the classes of intelligent agents and their application in the design of robotic systems.	LAFS.1112.SL.1.1	
27.04 Describe the obstacles to integration of artificial intelligence components in robotic systems.	LAFS.1112.SL.1.1	
27.05 Discuss the methodologies and tools used in resolving systems integration challenges in robotic systems.	LAFS.1112.SL.1.1	
28.0 Describe the role of specialized sensors in the design and operation of robotic systems. – The student will be able to:		SC.912.E.5.10 SC.912.P.10.18, 19, 21; 12.2, 3
28.01 Explain how Global Positioning System (GPS) sensors are used in robotic systems.	LAFS.1112.SL.1.1	
28.02 Discuss the application of laser range finders to the operation of robotic systems.	LAFS.1112.SL.1.1	
28.03 Describe the types and uses of optical sensors in robotic systems.	LAFS.1112.SL.2.4, 5	

CTE Standards and Benchmarks		FS-M/LA	NGSSS-Sci
28.04	Describe the ways in which gyroscopes are used in robotic systems.	LAFS.1112.SL.2.4, 5	
28.05	Describe the operation of an accelerometer and the ways in which accelerometers are used in robotic systems.	LAFS.1112.SL.2.4, 5	
28.06	Discuss the various types of pressure sensors and how they are used in robotic systems.	LAFS.1112.SL.1.1	
28.07	Discuss the various applications of vision and voice activation sensors.	LAFS.1112.SL.1.1	
29.0	Describe the use of specialized electronic applications used in robotic systems. – The student will be able to:		SC.912.E.5.4 SC.912.P.10.15
29.01	Explain the various methods for controlling robotic systems and the form of electronic feedback system needed for the appropriate sensor.	LAFS.1112.SL.1.1	
29.02	Describe the concept of Fail Safe and how such components are integrated into robotic systems.	LAFS.1112.SL.1.1	
29.03	Explain the fundamentals of LC, RC, and LCR circuitry and describe their use in robotic control and feedback systems.	LAFS.1112.SL.1.1	
29.04	Describe the electronic operation and application of electrically, pneumatically, and hydraulically controlled robot systems.		
29.05	Compare and contrast various sources for powering robotic systems, including solar cells, batteries, and radioisotope thermoelectric generators (RTGs).	LAFS.1112.SL.1.1	
30.0	Demonstrate an understanding of engineering technologies impacted by the evolution of robotics. – The student will be able to:		SC.912.N.1.1
30.01	Discuss the robotics aspects of Human Computer Interface (HCI) relative to control, feedback, mobility, and communications.	LAFS.1112.SL.1.1	
30.02	Compare and contrast the operation of reactive, behavior-based, and deliberative robot controllers.		
30.03	Describe the applicability of hybrid systems, in which digital and analog devices and sensors interact over time.	LAFS.1112.SL.2.4, 5	
30.04	Explain the role of Hybrid Control Systems (HCS) in the design and operation of robust robotic systems.	LAFS.1112.SL.1.1	
31.0	Demonstrate an understanding of underlying principles of environmental physics related to robotic technology. – The student will be able to:		SC.912.P.10.4
31.01	Describe thermal dynamics and discuss its practical application to robotics, particularly as it relates to motor and gear selection.	LAFS.1112.SL.1.1	
31.02	Describe the concept of pressure and relate its implications on robotic assemblies, include methods and forms or measurement.		
31.03	Distinguish between tolerance and allowance.		

CTE Standards and Benchmarks		FS-M/LA	NGSSS-Sci
31.04	Explain dimensional and variation tolerance and their applicability to the design and operation of robotic systems.	LAFS.1112.SL.1.1	
31.05	Describe the concept of fault-tolerance as it is related to a robotic assembly's degrees of freedom.	LAFS.1112.SL.1.1	
32.0	Demonstrate an understanding of the impact of robotics on the manufacturing process. – The student will be able to:		SC.912.N.1.1; 3.5
32.01	Describe the essential steps in the conventional manufacturing process, identifying those susceptible to being performed by industrial robots.	LAFS.1112.SL.1.1	
32.02	Describe Computer Integrated Manufacturing (CIM) and its implications on and uses of robotic technologies.		
32.03	Explain the impact of 3D printing on rapid prototyping.	LAFS.1112.SL.1.1	
32.04	Describe the process and methodology for creating a rapid prototype of an interactive robot.		
32.05	Describe the implications of robots on micro-manufacturing processes.	LAFS.1112.SL.1.1	
33.0	Demonstrate an understanding of topographical and environmental considerations in robotic assembly design. – The student will be able to:		SC.912.N.1.1
33.01	Describe various robot design considerations related to the intended operating environment or medium.		
33.02	Explain the correlation between sensor selection and a robot's operating environment, capability, and autonomy.	LAFS.1112.SL.2.4, 5	
33.03	Explain the term obstacle avoidance and relate its importance to the design, mobility, and autonomy of a robot.	LAFS.1112.SL.2.4, 5	
34.0	Create a program to control a robotic system. – The student will be able to:		SC.912.N.1.1
34.01	Compare and contrast the popular programming languages used to program robots and discuss their suitability for particular environments.		
34.02	Distinguish between USB, fire wire, and serial connections and the availability of those connections on robotic assemblies.		
34.03	Distinguish between holonomic and non-holonomic motion planning relative to feedback and control applications.		
34.04	Describe the process of motion planning and the variations in the underlying algorithm or approach.	LAFS.1112.SL.2.4, 5	
35.0	Demonstrate an understanding of technologies for communication with and among robotic systems. – The student will be able to:		SC.912.N.1.1
35.01	Compare and contrast the features, capabilities, obstacles, and suitability of wired and wireless communication technologies for communicating with a variety of robots.	MAFS.912.A-REI.1.1	

CTE Standards and Benchmarks		FS-M/LA	NGSSS-Sci
	35.02 Discuss the methodologies by which static and mobile networked robots communicate with each other.	LAFS.1112.SL.1.1	
	35.03 Describe Bluetooth technology and discuss its applicability to robotics.	LAFS.1112.SL.1.1	
	35.04 Describe the various forms of sensor-based feedback typically obtainable from a robotic assembly and explain their application and associated challenges (e.g., EMI, bandwidth, etc.) in specific robotic applications (e.g., surgery, hazardous environment inspection, low oxygen/underwater).	LAFS.1112.SL.1.1	
	35.05 Troubleshoot an inoperable wireless robotic communication connection.		
36.0	Solve problems using critical thinking skills, creativity and innovation. – The student will be able to:		SC.912.N.1.1
	36.01 Employ critical thinking skills independently and in teams to solve problems and make decisions.		
	36.02 Employ critical thinking and interpersonal skills to resolve conflicts.		
	36.03 Identify and document workplace performance goals and monitor progress toward those goals.		
	36.04 Conduct technical research to gather information necessary for decision-making.	LAFS.1112.W.3.7, 8	
37.0	Demonstrate an understanding of static and dynamic modeling and simulation concepts related to the design of robotic systems. – The student will be able to:		SC.912.N.3.5
	37.01 Differentiate between static and dynamic modeling relative to designing robotic systems.		
	37.02 Explain the role of simulation to the design of mobile and humanoid robots.	LAFS.1112.SL.1.1	
	37.03 Compare and contrast 3D modeling software applications for creating static and dynamic simulations.	LAFS.1112.SL.2.4, 5	
	37.04 Create a static simulation of a stationary robot featuring a single multi-segment manipulator.	LAFS.1112.SL.2.4, 5	
	37.05 Create a simulation of a mobile robot that features obstacle avoidance.	LAFS.1112.SL.2.4, 5	
38.0	Design, build, program, and configure a robot to perform predefined tasks. – The student will be able to:		SC.912.N.3.5
	38.01 Build a mobile robot.		
	38.02 Create programs as required using robotic software that will allow the robot to perform a set of tasks involving obstacle avoidance.		
	38.03 Configure servo motors to operate the robot.		

CTE Standards and Benchmarks		FS-M/LA	NGSSS-Sci
38.04	Formulate examples of how the robot might be used or adapted for use in a manufacturing or other environment.		
38.05	Create a portfolio, including drawings and specifications, describing the robot, the tasks and rationale, and the results.	LAFS.910.W.1.2; 2.4, 5, 6; 4.10	

Florida Department of Education
Student Performance Standards

Course Title: **Robotic Applications Capstone**
Course Number: **9410140**
Course Credit: **1**

Course Description:

This course provides students with extended content and skills essential to the design and operation of autonomous robotic systems in the context of a capstone project.

Florida Standards			Correlation to CTE Program Standard #
24.0	Methods and strategies for using Florida Standards for grades 11-12 reading in Technical Subjects for student success in Applied Robotics.		
24.01	Key Ideas and Details		
24.01.1		Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. LAFS.1112.RST.1.1	
24.01.2		Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. LAFS.1112.RST.1.2	
24.01.3		Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. LAFS.1112.RST.1.3	
24.02	Craft and Structure		
24.02.1		Determine the meaning of symbols key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics. LAFS.1112.RST.2.4	
24.02.2		Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas. LAFS.1112.RST.2.5	

Florida Standards			Correlation to CTE Program Standard #
	24.02.3	Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved. LAFS.1112.RST.2.6	
24.03	Integration of Knowledge and Ideas		
	24.03.1	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g. quantitative data, video, multimedia) in order to address a question or solve a problem. LAFS.1112.RST.3.7	
	24.03.2	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. LAFS.1112.RST.3.8	
	24.03.3	Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. LAFS.1112.RST.3.9	
24.04	Range of Reading and Level of Text Complexity		
	24.04.1	By the end of grade 11, read and comprehend literature [informational texts, history/social studies texts, science/technical texts] in the grades 11–CCR text complexity band proficiently, with scaffolding as needed at the high end of the range.	
	24.04.2	By the end of grade 12, read and comprehend literature [informational texts, history/social studies texts, science/technical texts] at the high end of the grades 11–CCR text complexity band independently and proficiently. LAFS.1112.RST.4.10	
25.0	Methods and strategies for using Florida Standards for grades 11-12 writing in Technical Subjects for student success in Applied Robotics.		
25.01	Text Types and Purposes		
	25.01.1	Write arguments focused on discipline-specific content. LAFS.1112.WHST.1.1	
	25.01.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. LAFS.1112.WHST.1.2	

Florida Standards			Correlation to CTE Program Standard #
	25.02	Production and Distribution of Writing	
	25.02.1	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. LAFS.1112.WHST.2.4	
	25.02.2	Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. LAFS.1112.WHST.2.5	
	25.02.3	Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information. LAFS.1112.WHST.2.6	
	25.03	Research to Build and Present Knowledge	
	25.03.1	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. LAFS.1112.WHST.3.7	
	25.03.2	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. LAFS.1112.WHST.3.8	
	25.03.3	Draw evidence from informational texts to support analysis, reflection, and research. LAFS.1112.WHST.3.9	
	25.04	Range of Writing	
	25.04.1	Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. LAFS.1112.WHST.4.10	
26.0	Methods and strategies for using Florida Standards for grades 11-12 Mathematical Practices in Technical Subjects for student success in Applied Robotics.		
	26.01	Make sense of problems and persevere in solving them. MAFS.K12.MP.1.1	

Florida Standards	Correlation to CTE Program Standard #
26.02 Reason abstractly and quantitatively. MAFS.K12.MP.2.1	
26.03 Construct viable arguments and critique the reasoning of others. MAFS.K12.MP.3.1	
26.04 Model with mathematics. MAFS.K12.MP.4.1	
26.05 Use appropriate tools strategically. MAFS.K12.MP.5.1	
26.06 Attend to precision. MAFS.K12.MP.6.1	
26.07 Look for and make use of structure. MAFS.K12.MP.7.1	
26.08 Look for and express regularity in repeated reasoning. MAFS.K12.MP.8.1	

Abbreviations:
FS-M/LA = Florida Standards for Math/Language Arts
NGSSS-Sci = Next Generation Sunshine State Standards for Science

CTE Standards and Benchmarks		FS-M/LA	NGSSS-Sci
39.0	Demonstrate an understanding of robotic applications (both stationary and mobile), their environments, and their unique design constraints. – The student will be able to:		
39.01	Describe robotic assemblies used in industrial manufacturing, the technologies they employ, their design criteria, and constraints.	LAFS.1112.SL.1.1	
39.02	Describe robotic assemblies used in outer space, the technologies they employ, their design criteria, and constraints.	LAFS.1112.SL.1.1	
39.03	Describe robotic assemblies used in hazardous or dangerous environments (e.g., underground, damaged buildings, et al), the technologies they employ, their design criteria, and constraints.	LAFS.1112.SL.1.1	
39.04	Describe robotic assemblies used in the medical field, the technologies they employ, their design criteria, and constraints.	LAFS.1112.SL.1.1	
39.05	Describe robotic assemblies used in underwater environments, the technologies they employ, their design criteria, and constraints.	LAFS.1112.SL.1.1	
39.06	Describe robotic assemblies used in high speed/repetitive manufacturing or processing environments, the technologies they employ, their design criteria, and constraints.	LAFS.1112.SL.1.1	
40.0	Design, build, program, and configure an autonomous robot to perform predefined tasks suitable for a particular robotic application. – The student will be able to:		

CTE Standards and Benchmarks		FS-M/LA	NGSSS-Sci
40.01	Design and build a stationary or mobile autonomous robot as appropriate to a given robotic purpose.		
40.02	Create programs as required using robotic software that will allow the robot to perform a set of tasks involving obstacle avoidance using a combination of tactile and non-tactile sensors.		
40.03	Incorporate principles of artificial intelligence into the design of an autonomous robot.		
40.04	Incorporate principles of thermodynamics, hydraulics, and pneumatics, as appropriate, into the design of an autonomous robot.		
40.05	Incorporate at least one advanced communication or sensor device (e.g., voice activation/feedback, computer vision, et al) into the design of an autonomous robot.		
40.06	Configure a robot for wireless control and feedback communications.		
40.07	Create a project portfolio describing the project and robot, including drawings and specifications, the tasks and rationale, process journal, budget report, and the results.	LAFS.1112.W.1.2; 2.4, 5, 6; 4.10	
40.08	Demonstrate the operation and capabilities of the robot to a review committee.	LAFS.1112.SL.2.4, 5	
41.0	Successfully work as a member of a team. – The student will be able to:		
41.01	Accept responsibility for specific tasks in a given situation.	LAFS.1112.SL.1.1	
41.02	Maintain a positive relationship with other team members.	LAFS.1112.SL.1.1	
41.03	Document progress, and provide feedback on work accomplished in a timely manner.	LAFS.1112.SL.1.1	
41.04	Complete assigned tasks in a timely and professional manner.	LAFS.1112.SL.1.1	
41.05	Reassign responsibilities when the need arises.	LAFS.1112.SL.1.1	
41.06	Complete daily tasks as assigned on one's own initiative.	LAFS.1112.SL.1.1	
42.0	Plan, organize, and carry out a project plan. – The student will be able to:		
42.01	Determine the scope of a project.		
42.02	Organize the team according to individual strengths.	LAFS.1112.SL.1.1	
42.03	Assign specific tasks within a team.	LAFS.1112.SL.1.1	

CTE Standards and Benchmarks	FS-M/LA	NGSSS-Sci
42.04 Determine project priorities.	LAFS.1112.SL.1.1	
42.05 Identify required resources.	LAFS.1112.W.3.8	
42.06 Record project progress in a process journal.	LAFS.1112.W.1.2	
42.07 Record and account for budget expenses during the life of the project.	LAFS.1112.W.1.2	
42.08 Carry out the project plan to successful completion and delivery.		
43.0 Manage resources. – The student will be able to:		
43.01 Identify required resources and associated costs for each stage of the project plan.		
43.02 Create a project budget based on the identified resources.		
43.03 Determine the methods needed to acquire needed resources.		
43.04 Demonstrate good judgment in the use of resources.		
43.05 Recycle and reuse resources where appropriate.		
43.06 Demonstrate an understanding of proper legal and ethical waste disposal.	LAFS.1112.W.3.9	
44.0 Use tools, materials, and processes in an appropriate and safe manner. – The student will be able to:		
44.01 Identify the proper tool for a given job.		
44.02 Use tools and machines in a safe manner.		
44.03 Adhere to laboratory safety rules and procedures.		
44.04 Identify the application of processes appropriate to the task at hand.		
44.05 Identify materials appropriate to their application.		

Additional Information

Laboratory Activities

Laboratory investigations that include scientific inquiry, research, measurement, problem solving, emerging technologies, tools and equipment, as well as, experimental, quality, and safety procedures are an integral part of this career and technical program/course. Laboratory investigations benefit all students by developing an understanding of the complexity and ambiguity of empirical work, as well as the skills required to manage, operate, calibrate and troubleshoot equipment/tools used to make observations. Students understand measurement error; and have the skills to aggregate, interpret, and present the resulting data. Equipment and supplies should be provided to enhance hands-on experiences for students.

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 – OJT

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/dwdframe/pdf/STEPS-Manual.pdf.

Work-Based Experience (8601800) is the appropriate course to provide Engineering and 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 – The 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.

Accommodations

Federal and state legislation requires the provision of accommodations for students with disabilities as identified on the secondary student's Individual Educational Plan (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 IEP served in Exceptional Student Education (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 and regulated secondary programs 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 (http://www.fldoe.org/articulation/CCD/files/pacourses1314.pdf). A listing of approved CTE courses is published each year as a supplemental resource to the Course Code Directory (http://www.fldoe.org/articulation/CCD/default.asp).

Equivalent Mathematics and Equally Rigorous Science Courses

Equally rigorous science courses are based upon levels of cognitive complexity of content specific benchmarks, depth and breadth of content focus, and required laboratory components.