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.

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	
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.		

CTE Standards and Benchmarks		FS-M/LA	NGSSS-Sci
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	
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	

CTE Standards and Benchmarks		FS-M/LA	NGSSS-Sci
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.		
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.		

CTE Standards and Benchmarks		FS-M/LA	NGSSS-Sci
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	

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.

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
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

CTE Standards and Benchmarks		FS-M/LA	NGSSS-Sci
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	
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.		

CTE Standards and Benchmarks		FS-M/LA	NGSSS-Sci
	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.		
	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	

CTE Standards and Benchmarks		FS-M/LA	NGSSS-Sci
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
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	

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.

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	
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	

CTE Standards and Benchmarks		FS-M/LA	NGSSS-Sci
	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.		
	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	

CTE Standards and Benchmarks		FS-M/LA	NGSSS-Sci
	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	
	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.		

CTE Standards and Benchmarks		FS-M/LA	NGSSS-Sci
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.		
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	

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.

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:		
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.		

CTE Standards and Benchmarks		FS-M/LA	NGSSS-Sci
	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	
	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.		

CTE Standards and Benchmarks	FS-M/LA	NGSSS-Sci
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.		