Robotics 2 Pacing

Scope & Sequence

Course Name: Robotics II TSDS PEIMS Code: 13037050	Course Credit: 1.0 Course Requirements: Recommended for students in Grades 10-12. Prerequisites: Robotics I.
Course Description: In Robotics II, students will explore artificial intelligence and programming in the robotic and automation industry. Through implementation of the design process, students will transfer academic skills to component designs in a project-based environment. Students will build prototypes and use software to test their designs.	
NOTE: This is a suggested scope and sequence for the course content. This content will work with any textbook or instructional materials. If locally adapted, make sure all TEKS are covered.	

Total Number of Periods Total Number of Hours	175 Periods 131.25 Hours	*Schedule calculations based on 175/180 calendar days. For 0.5 credit courses, schedule is calculated out of 88/90 days. Scope and sequence allows additional time for guest speakers, student presentations, field trips, remediation, extended learning activities, etc.
Unit Number, Title, and Brief Description	**# of Class Periods*** (assumes 45-minute periods) Total minutes per unit	**TEKS Covered** **130.409. (c) Knowledge and skills**
Unit 1: Career Exploration This Science, Technology, Engineering, and Mathematics (STEM) Robotics II Overview unit is designed to provide students with the opportunity to explore training, education, employment roles and career opportunities. This unit offers students basic technical skills necessary to fulfill careers in the workforce. Students will their industry certification plans. Upon culmination of the unit, students will present their continued findings of robotic engineering careers and programs to prepare for the field.	15 Periods 675 Minutes	(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to: (A) distinguish the differences among an engineering technician, engineering technologist, and engineer; (B) identify employment and career opportunities; (C) identify industry certifications; (D) recognize the principles of teamwork related to engineering and technology; (E) identify and use appropriate work habits; (F) locate and report on governmental regulations and laws, including health, safety, and labor codes related to engineering; (G) discuss ethical issues related to engineering and technology and incorporate proper ethics in submitted projects; (H) demonstrate respect for diversity in the workplace; (I) demonstrate appropriate actions and identify consequences relating to discrimination, harassment, and inequality; (J) demonstrate effective oral and written communication skills using a variety of software applications and media; and

		(K)		explore robotic engineering careers and preparation programs.
Unit 2: Real-World Mathematical Processes The mathematical process standards describe ways in which students are expected to engage in the content. The process standards weave the other knowledge and skills together so that students may be successful problem solvers and use mathematics efficiently and effectively in daily life. The process standards are integrated at every grade level and course. Students will select appropriate tools and techniques to solve problems and effectively communicate mathematical ideas, reasoning, and their implications. Students will use mathematical relationships to generate solutions and make connections and predictions and analyze mathematical relationships to connect and communicate mathematical ideas. In this unit, students will apply mathematics to problems arising in everyday life, society, and the workplace. The culminating activity will include students creating representations to communicate mathematical ideas.	15 Periods 675 Minutes	(2)		The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:
			(A)	apply mathematics to problems arising in everyday life, society, and the workplace;
			(B)	use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;
			(C)	select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;
			(D)	communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;
			(E)	create and use representations to organize, record, and communicate mathematical ideas;
			(F)	analyze mathematical relationships to connect and communicate mathematical ideas; and
			(G)	display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.
Unit 3: Safety Precautions This unit offers students the opportunity to demonstrate basic technical skills necessary for safety precautions in the STEM field. Students will adhere to and follow all guidelines and regulations to maintain a safe working environment. The culminating activity will have students describe the results of negligent or improper maintenance of tools, equipment, and machines.	10 Periods 450 Minutes	(5)		The student practices safe and proper work habits. The student is expected to:
			(A)	master relevant safety tests;
			(B)	comply with safety guidelines as described in various manuals, instructions, and regulations;
			(C)	identify and classify hazardous materials and wastes according to Occupational Safety and Health Administration (OSHA) regulations;
			(D)	dispose of hazardous materials and wastes appropriately;
			(E)	comply with established guidelines for working in a lab environment;

		(F)	handle and store tools and materials correctly;
		(G)	employ established inventory control and organization procedures; and
		(H)	describe the results of negligent or improper maintenance.
Unit 4: Teamwork in STEM In this unit students will exhibit teambuilding skills to accomplish a mission. Students will use positive attitudes to demonstrate effective teamwork and establish team procedures. The culminating activity will be for the students to work together to solve problems in the field of robotics and complete a competitive and non-competitive goal.	15 Periods 675 Minutes	(3)	The student learns and contributes productively as an individual and as a member of a project team. The student is expected to: (A) demonstrate an understanding of and discuss how teams function; (B) apply teamwork to solve problems; (C) follow directions and decisions of responsible individuals of the project team; (D) participate in establishing team procedures and team norms; and (E) work cooperatively with others to set and accomplish goals in both competitive and non-competitive situations.
Unit 5: Project Management In this unit, students will develop a project management plan including initiating, executing, monitoring, controlling, and closing a real or simulated project. The culminating activity will have students develop a Project Management Plan of a real or simulated project.	15 Periods 675 Minutes	(4)	The student develops skills of project management. The student is expected to: (A) implement project management methodologies, including initiating, planning, executing, monitoring and controlling, and closing a project; (B) develop a project schedule and complete work according to established criteria; (C) participate in the organization and operation of a real or simulated engineering project; and (D) translate and employ a Project Management Plan for production of a product.
Unit 6: Time for Project-Based Learning The Science, Technology, Engineering, and Mathematics (STEM) Career Cluster focuses on planning, managing, and providing scientific research and professional and technical services, including laboratory and testing services, and research and development services. In this unit, students will use tools and laboratory equipment in a safe manner to construct and repair system and use precision measuring instruments to analyze systems and prototypes. The culminating activity for this unit will	15 Periods 675 Minutes	(11)	The student learns the function and application of the tools, equipment, and materials used in robotic and automated systems through specific project-based assessments. The student is expected to: (A) use and maintain tools and laboratory equipment in a safe manner to construct and repair systems; (B) use precision measuring instruments to analyze systems and prototypes; (C) implement a system to identify and track all components of the robotic or automated system and all elements involved with the operation, construction, and manipulative functions; and (D) use multiple software applications to simulate robot behavior and present

be for students to use multiple software applications to build upon their activities from Robotics I and simulate robot behavior to present these concepts.		concepts.	
Unit 7: Advanced Mathematics and Physics in Robotic Systems This exciting unit will have students apply the concepts of acceleration and velocity to robotic systems and use geometry to calculate robot navigation and create a path with sensory movement. The final activity will have students demonstrate how they can program their robot to do such functions such as jump, loop or switch positions.	15 Periods 675 Minutes	(7)	The student demonstrates an understanding of advanced mathematics and physics in robotic and automated systems. The student is expected to: (A) apply the concepts of acceleration and velocity as they relate to robotic and automated systems; (B) describe the term degrees of freedom and apply it to the design of joints used in robotic and automated systems; (C) describe angular momentum and integrate it in the design of robotic joint motion, stability, and mobility; (D) use the impulse-momentum theory in the design of robotic and automated systems; (E) explain translational, rotational, and oscillatory motion in the design of robotic and automated systems; (F) apply the operation of direct current (DC) motors, including control, speed, and torque; (G) apply the operation of servo motors, including control, angle, and torque; (H) interpret sensor feedback and calculate threshold values; (I) apply measurement and geometry to calculate robot navigation; (J) implement movement control using encoders; and (K) implement path planning using geometry and multiple sensor feedback. (I) use selection programming structures such as jumps, loops, switch, and case; and (J) implement subroutines and functions.
Unit 8: Programming a Robot This unit is designed to give students the opportunity to program a robot or automated systems. Students will create a flowchart and write the code to perform an automated operation. Upon culmination of the unit, students will create algorithms that	15 Periods 675 Minutes	(8)	The student creates a program to control a robotic or automated system. The student is expected to: (A) use coding languages and proper syntax; (B) use programming best practices for commenting and documentation; (C) describe how and why logic is used to control the flow of the program; (D) create a program flowchart and write the pseudocode for a program to perform an operation;

evaluate sensor data and use output commands and variables.			(E) create algorithms for evaluating a condition and performing an appropriate action using decisions; (F) create algorithms that loop through a series of actions for a specified increment and for as long as a given condition exists; (G) create algorithms that evaluate sensor data as variables to provide feedback control; (H) use output commands and variables.
Unit 9: Components Required for Robotic Functions Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions. In this unit, students will demonstrate the workings of a robotic arm. The culminating activity will have students demonstrate the relationship between linkages and gearing as they relate to robotic arm operations.	15 Periods 675 Minutes	(9)	The student develops an understanding of the characteristics and scope of manipulators, accumulators, and end effectors required for a robotic or automated system to function. The student is expected to: (A) demonstrate knowledge of robotic or automated system arm construction; (B) demonstrate an understanding and apply the concepts of torque, gear ratio, stability, and weight of payload in a robotic or automated system arm operation; and (C) demonstrate an understanding and apply the concepts of linkages and gearing in end effectors and their use in a robotic or an automated arm system.
Unit 10: Maintain Technological Products, Processes, and Systems Students will use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution. In this unit, students will troubleshoot and maintain systems and subsystems to ensure safe and proper operation. The culminating activity will include having students implement various sensors in robotic systems.	15 Periods 675 Minutes	(6)	The student develops the ability to use and maintain technological products, processes, and systems. The student is expected to: (A) demonstrate the use of computers to manipulate a robotic or automated system and associated subsystems; (B) troubleshoot and maintain systems and subsystems to ensure safe and proper function and precision operation; (C) implement feedback control loops used to provide information; and (D) implement different types of sensors used in robotic or automated systems and their operations.
Unit 11: Design Methodologies In this unit, students will perform such functions such as applying testing and reiteration strategies to develop or improve a product	15 Periods 675 Minutes	(10)	The student uses engineering design methodologies. The student is expected to: (A) implement the design process; (B) demonstrate critical thinking, identify the system constraints, and make

and applying Six Sigma to analyze the quality of products and how this affects engineering decisions. Students will use an engineering notebook to document the project design process as a legal document.			fact-based decisions; (C) apply formal testing and reiteration strategies to develop or improve a product; (D) apply and defend decision-making strategies when developing solutions; (E) identify and improve quality-control issues in engineering design and production; (F) apply Six Sigma to analyze the quality of products and how it affects engineering decisions; (G) use an engineering notebook to document the project design process as a legal document; and (H) create and interpret industry standard system schematics.
Unit 12: Extended Learning Experience This unit will have students design a robotic or automated system. Students are encouraged to expand their learning experiences through avenues such as STEM organizations and other leadership or extracurricular organizations. By connecting with these networks and/or their peers in the previous unit, students will have an audience to present their final project, which may lead to future career opportunities.	15 Periods 675 Minutes	(12)	The student produces a product using the appropriate tools, materials, and techniques. The student is expected to: (A) use the design process to design a robotic or automated system that meets pre-established criteria and constraints; (B) identify and use appropriate tools, equipment, machines, and materials to produce the prototype; (C) implement sensors in the robotic or automated system; (D) construct the robotic or automated system; (E) use the design process to evaluate and formally test the design; (F) refine the design of the robotic or automated system to ensure quality, efficiency, and manufacturability of the final robotic or automated system; and (G) present the final product using a variety of media.