

**Newport-Mesa Unified School District**  
**Office of Secondary Curriculum and Instruction**  
**High School Course of Study**

|                                     |   |  |                 |                               |                  |
|-------------------------------------|---|--|-----------------|-------------------------------|------------------|
| <b>Course Title</b>                 | <i>Robotics and Artificial Intelligence</i>   |  |                 | <b>Course Code</b>            | <i>KT370-371</i> |
| <b>Transcript Title:</b>            | <i>Robotics and Art 1A/1B</i>   | <b>Grades Levels:</b>  | <i>11-12</i>    | <b>Board Adoption Date:</b>   | <i>6/09/2020</i> |
| <b>Content Area:</b>                | <i>CTE</i>  | <b>GPA Scale:</b>  | <i>4.0</i>      | <b>Date Course Submitted:</b> | <i>3/13/20</i>   |
| <b>Credential Required:</b>         | <i>CTE / Single Subject IndusTech/IndusArts</i>   | <b>Graduation Subject Areas:</b>                               | <i>Elective</i> | <b>CALPADS Code:</b>          | <i>7730</i>      |
| <b>UC/CSU "A-G" Area Approvals:</b> | <i>TBD</i>  | <b>School Site/person that wrote and submitted the course:</b> |                 | <i>C Darnall/CDM</i>          |                  |
| <b>Recommend Skills:</b>            | Introduction to Design/CAD skills and Principles of Engineering (Mechanical & Electrical Engineering) |  |                 |                               |                  |
| <b>Next course(s):</b>              | <i>Capstone course - TBD</i>  |  |                 |                               |                  |
| <b>Textbook to be used:</b>         | <i>Software and industry publications and scholarly articles.</i>                                     |  |                 |                               |                  |

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**Robotics and Artificial Intelligence**

**DATE:** March 6, 2020

**INDUSTRY SECTOR:** Engineering & Architecture

**PATHWAY:** Engineering Design (152)

**CALPADS TITLE:** Intermediate Engineering Design (Concentrator)

**CALPADS CODE:** 7730

**HOURS:**

| Total      | Classroom | Laboratory/CC/CVE |
|------------|-----------|-------------------|
| <b>180</b> | <b>60</b> | <b>120</b>        |

| JOB TITLE                            | ONET CODES | JOB TITLE              | ONET CODES |
|--------------------------------------|------------|------------------------|------------|
| Electronics Engineering Technologist | 17-3029.04 | Mechatronics Engineers | 17-2199.05 |
| Robotics Technicians                 | 17-3024.01 |                        |            |
| Software Developers                  | 15-1132.00 |                        |            |

**COURSE DESCRIPTION:**

The Robotics and Artificial Intelligence (AI) course will introduce students to the growing field of mechatronics, advanced robotics systems and machine learning or artificial intelligence. Students will research and design "intelligent" robotic systems that solve real world problems by learning and refining their skills in mechanization and control, sensors, machine learning programming and data collection that leads to logic and predictive outcomes. Students will complete at least 4 mechatronic/robotics projects per school year, with their final project culminating in a presentation of how the machines will be used in real world scenarios.

**PREREQUISITES:**

| <b>High School Name:</b>   | <b>Site Prerequisite:</b>                                  |
|----------------------------|--|
| Corona del Mar High School | Principles of Engineering - 2 <sup>nd</sup> pathway course |
|                            |  |
|                            |  |

**A – G APPROVAL:**  Yes  No  Desired

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**ARTICULATION: TBD**

|                          |                      |                              |
|--------------------------|----------------------|------------------------------|
| <b>High School Name:</b> | <b>College Name:</b> | <b>College Course Title:</b> |
|                          |                      |                              |

**LEVEL:**  **Introductory**     **Concentrator**     **Capstone**

**CERTIFICATION: TBD**

|                          |                           |                     |
|--------------------------|---------------------------|---------------------|
| <b>High School Name:</b> | <b>Embedded/Leads to:</b> | <b>Description:</b> |
|                          |                           |                     |

**METHOD OF STUDENT EVALUATION:**

- ✓ Pre and Post test
- ✓ Student Projects
- ✓ Written work
- ✓ Observation record of student performance
- ✓ Completion of assignments and assessments

**METHOD OF INSTRUCTION:**

- ✓ Lecture and Discussion
- ✓ Group and individual applied projects
- ✓ Demonstration
- ✓ Field Trips
- ✓ Guest Speaker

**RECOMMENDED TEXTS:**

No textbooks  
 Industry Scholarly Articles  
 Required software: **Canvas** to deliver the curriculum, **Anaconda** and **Arduino** for Python and C/C++ programming

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**MODEL CTE PATHWAY:**

| Grade | Fall Semester                           | Spring Semester                         |
|-------|---|---|
| 9     | Introduction to Design Engineering 1A   | Introduction to Design Engineering 1B   |
| 10    | Principles of Engineering 1A            | Principles of Engineering 1B            |
| 11    | Robotics and Artificial Intelligence 1A | Robotics and Artificial Intelligence 1B |
| 12    | Capstone – TBD, 21/22                   | Capstone – TBD, 21/22                   |

**CALIFORNIA CAREER TECHNICAL EDUCATION MODEL CURRICULUM STANDARDS**

California Department of Education CTE Standards website: <http://www.cde.ca.gov/ci/ct/sf/ctemcstandards.asp>  
 Engineering and Architecture: <https://www.cde.ca.gov/ci/ct/sf/documents/enginearchit.pdf>  
 Information and Communication Technologies: <https://www.cde.ca.gov/ci/ct/sf/documents/infocomtech.pdf>

**INDUSTRY SECTOR**

**KNOWLEDGE AND PERFORMANCE ANCHOR STANDARDS**

- 1.0 Academics:** Analyze and apply appropriate academic standards required for successful industry sector pathway completion leading to postsecondary education and employment. Refer to the Engineering and Architecture and Information and Communication Technologies academic alignment matrix for identification of standards.
- 2.0 Communications:** Acquire and accurately use Engineering and Architecture and Information and Communication Technologies sector terminology and protocols at the career and college readiness level for communicating effectively in oral, written, and multimedia formats. (Direct alignment with LS 9-10, 11-12.6)
- 2.1 Recognize the elements of communication using a sender–receiver model.
  - 2.2 Identify barriers to accurate and appropriate communication.
  - 2.3 Interpret verbal and nonverbal communications and respond appropriately.
  - 2.4 Demonstrate elements of written and electronic communication such as accurate spelling, grammar, and format.
  - 2.5 Communicate information and ideas effectively to multiple audiences using a variety of media and formats.
  - 2.6 Advocate and practice safe, legal, and responsible use of digital media information and communications technologies.
  - 2.7 Use technical writing and communication skills to work effectively with diverse groups of people.
  - 2.8 Understand the principles of a customer-oriented service approach to users.
- 3.0 Career Planning and Management:** Integrate multiple sources of career information from diverse formats to make informed career decisions, solve problems, and manage personal career plans. (Direct alignment with SLS 11-12.2)
- 3.1 Identify personal interests, aptitudes, information, and skills necessary for informed career decision making.
  - 3.2 Evaluate personal character traits such as trust, respect, and responsibility and understand the impact they can have on career success.
  - 3.3 Explore how information and communication technologies are used in career planning and decision making.
  - 3.4 Research the scope of career opportunities available and the requirements for education, training, certification, and licensure.
  - 3.5 Integrate changing employment trends, societal needs, and economic conditions into career planning.
  - 3.6 Recognize the role and function of professional organizations, industry associations, and organized labor in a productive society.
  - 3.7 Recognize the importance of small business in the California and global economies.
  - 3.8 Understand how digital media are used by potential employers and postsecondary agencies to evaluate candidates.
  - 3.9 Develop a career plan that reflects career interests, pathways, and postsecondary options.

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**4.0 Technology:** Use existing and emerging technology to investigate, research, and produce products and services, including new information, as required in the Engineering and Architecture and Information and Communication Technologies sector workplace environments. (Direct alignment with WS 11-12.6)

- 4.1 Use electronic reference materials to gather information and produce products and services.
- 4.2 Employ technology based communications responsibly and effectively to explore complex systems and issues.
- 4.3 Use information and communication technologies to synthesize, summarize, compare, and contrast information from multiple sources.
- 4.4 Discern the quality and value of information collected using digital technologies, and recognize bias and intent of the associated sources.
- 4.5 Research past, present, and projected technological advances as they impact a particular pathway.
- 4.6 Assess the value of various information and communication technologies to interact with constituent populations as part of a search of the current literature or in relation to the information task.

**5.0 Problem Solving and Critical Thinking:** Conduct short, as well as more sustained, research to create alternative solutions to answer a question or solve a problem unique to the Engineering and Architecture and Information and Communication Technologies sectors using critical and creative thinking, logical reasoning, analysis, inquiry, and problem-solving techniques. (Direct alignment with WS 11-12.7)

- 5.1 Identify and ask significant questions that clarify various points of view to solve problems.
- 5.2 Solve predictable and unpredictable work-related problems using various types of reasoning (inductive, deductive) as appropriate.
- 5.3 Use systems thinking to analyze how various components interact with each other to produce outcomes in a complex work environment.
- 5.4 Interpret information and draw conclusions, based on the best analysis, to make informed decisions.
- 5.5 Use a logical and structured approach to isolate and identify the source of problems and to resolve problems.
- 5.6 Know the available resources for identifying and resolving problems.
- 5.7 Work out problems iteratively and recursively.
- 5.8 Create and use algorithms and solve problems.
- 5.9 Deconstruct large problems into components to solve.
- 5.10 Use multiple layers of abstraction.
- 5.11 Understand the concept of base systems, including binary and hexadecimal.
- 5.12 Apply the concepts of Boolean logic to decision making and searching.

**6.0 Health and Safety:** Demonstrate health and safety procedures, regulations, and personal health practices and determine the meaning of symbols, key terms, and domain-specific words and phrases as related to the Engineering and Architecture and Information and Communication Technologies sector workplace environments. (Direct alignment with RSTS 9-10, 11-12.4)

- 6.1 Locate, and adhere to, Material Safety Data Sheet (MSDS) instructions.
- 6.2 Interpret policies, procedures, and regulations for the workplace environment, including employer and employee responsibilities.
- 6.3 Use health and safety practices for storing, cleaning, and maintaining tools, equipment, and supplies.
- 6.4 Practice personal safety when lifting, bending, or moving equipment and supplies.
- 6.5 Demonstrate how to prevent and respond to work-related accidents or injuries; this includes demonstrating an understanding of ergonomics.
- 6.6 Maintain a safe and healthful working environment.
- 6.7 Be informed of laws/acts pertaining to the Occupational Safety and Health Administration (OSHA).
- 6.8 Maintain a safe and healthful working environment.
- 6.9 Dispose of e-waste properly, understanding the health, environmental, and legal risks of improper disposal.
- 6.10 Act

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conscientiously regarding the use of natural resources (e.g., paper, ink, etc.)

6.11 Conserve energy while computing (e.g., turn off equipment at night, power-saving settings, etc.)

**7.0 Responsibility and Flexibility:** Initiate, and participate in, a range of collaborations demonstrating behaviors that reflect personal and professional responsibility, flexibility, and respect in the Engineering and Architecture and Information and Communication Technologies sector workplace environments and community settings. (Direct alignment with SLS 9-10, 11-12.1)

7.1 Recognize how financial management impacts the economy, workforce, and community.

7.2 Explain the importance of accountability and responsibility in fulfilling personal, community, and workplace roles.

7.3 Understand the need to adapt to changing and varied roles and responsibilities.

7.4 Practice time management and efficiency to fulfill responsibilities.

7.5 Apply high-quality techniques to product or presentation design and development.

7.6 Demonstrate knowledge and practice of responsible financial management.

7.7 Demonstrate the qualities and behaviors that constitute a positive and professional work demeanor, including appropriate attire for the profession.

7.8 Explore issues of global significance and document the impact on the Engineering and Architecture and Information and Communication Technologies sectors.

**8.0 Ethics and Legal Responsibilities:** Practice professional, ethical, and legal behavior, responding thoughtfully to diverse perspectives and resolving contradictions when possible, consistent with applicable laws, regulations, and organizational norms. (Direct alignment with SLS 11-12.1d)

8.1 Access, analyze, and implement quality assurance standards of practice.

8.2 Identify local, district, state, and federal regulatory agencies, entities, laws, and regulations related to the Engineering and Architecture and Information and Communication Technologies industry sectors.

8.3 Demonstrate ethical and legal practices consistent with Information and Communication Technologies sector workplace standards.

8.4 Explain the importance of personal integrity, confidentiality, and ethical behavior in the workplace.

8.5 Analyze organizational culture and practices within the workplace environment.

8.6 Adhere to copyright and intellectual property laws and regulations, and use and appropriately cite proprietary information.

8.7 Conform to rules and regulations regarding sharing of confidential information, as determined by Engineering and Architecture and Information and Communication Technologies sector laws and practices.

8.8 Identify legal and ethical issues that have proliferated with increased technology adoption, including hacking, scamming, and breach of privacy.

**9.0 Leadership and Teamwork:** Work with peers to promote divergent and creative perspectives, effective leadership, group dynamics, team and individual decision making, benefits of workforce diversity, and conflict resolution such as those practiced in the Future Business Leaders of America and SkillsUSA career technical student organization. (Direct alignment with SLS 11-12.1b)

9.1 Define leadership and identify the responsibilities, competencies, and behaviors of successful leaders.

9.2 Identify the characteristics of successful teams, including leadership, cooperation, collaboration, and effective decision-making skills as applied in groups, teams and career technical student organization activities.

9.3 Understand the characteristics and benefits of teamwork, leadership, and citizenship in the school, community, and workplace setting.

9.4 Explain how professional associations and organizations and associated leadership development and competitive career development activities enhance academic preparation, promote career choices, and contribute to employment opportunities.

9.5 Understand that the modern world is an international community and requires an expanded global view.

9.6 Respect individual and cultural differences and recognize the importance of diversity in the workplace.

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9.7 Participate in interactive teamwork to solve real Engineering and Architecture and Information and Communication Technologies sector issues and problems.

**10.0 Technical Knowledge and Skills:** Apply essential technical knowledge and skills common to all pathways in the Engineering and Architecture and Information and Communication Technologies sectors, following procedures when carrying out experiments or performing technical tasks.(Direct alignment with WS 11-12.6)

10.1 Interpret and explain terminology and practices specific to the Engineering and Architecture and Information and Communication Technologies sectors.

10.2 Comply with the rules, regulations, and expectations of all aspects of the Engineering and Architecture and Information and Communication Technologies sectors.

10.3 Construct projects and products specific to the Engineering and Architecture and Information Communication Technologies sector requirements and expectations.

10.4 Collaborate with industry experts for specific technical knowledge and skills.

10.5 Understand the major software and hardware components of a computer and a network and how they relate to each other.

10.6 Understand data sizes of various types of information (text, pictures, sound, video, etc.) and data capacity of various forms of media.

10.7 Understand the SI (metric) prefixes commonly used in computing including, at least, kilo, mega, giga, and tera.

10.8 Understand security concepts including authorization, rights, and encryption.

10.9 Use common industry-standard software and their applications including word processing, spreadsheets, databases, and multimedia software.

10.10 Manage files in a hierarchical system.

10.11 Know multiple ways in which to transfer information and resources (e.g., text, data, sound, video, still images) between software programs and systems.

10.12 Know appropriate search procedures for different types of information, sources, and queries.

10.13 Evaluate the accuracy, relevance, and comprehensiveness of retrieved information.

10.14 Analyze the effectiveness of online information resources to support collaborative tasks, research, publications, communications, and increased productivity.

**11.0 Demonstration and Application:** Demonstrate and apply the knowledge and skills contained in the Engineering and Architecture and Information and Communication Technologies anchor standards, pathway standards, and performance indicators in classroom, laboratory, and workplace settings, and through career technical student organizations such as Future Business Leaders of America and SkillsUSA.

11.1 Utilize work-based/workplace learning experiences to demonstrate and expand upon knowledge and skills gained during classroom instruction and laboratory practices specific to the Engineering and Architecture and Information and Communication Technologies sector program of study.

11.2 Demonstrate proficiency in a career technical pathway that leads to certification, licensure, and/or continued learning at the postsecondary level.

11.3 Demonstrate entrepreneurship skills and knowledge of self-employment options and innovative ventures. 11.4 Employ entrepreneurial practices and behaviors appropriate to Engineering and Architecture and Information and Communication Technologies sector opportunities.

11.5 Create a portfolio, or similar collection of work, that offers evidence through assessment and evaluation of skills and knowledge competency as contained in the anchor standards, pathway standards, and performance indicators.

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CR = Classroom      LAB/CC = Laboratory/Shop/Community Classroom

| I.  | Introduction to Mechatronics and Physical Computing  | CR | LAB/<br>CC | STANDARDS  |
|-----|--|----|------------|--|
|     | <p>A. Why this class?</p> <ul style="list-style-type: none"> <li>● Mechatronics systems and their impact</li> <li>● Bridging physical hardware with computational frameworks or coding</li> <li>● Overview of modern sensor technology</li> <li>● Artificial Intelligence (AI) in mechatronics</li> </ul> <p>B. Team Project #1: Design a mechatronics system on paper and articulate its impact, pros and cons, and safety/ethics considerations. Specify the physical hardware, computational framework, sensor technology, and AI features involved in your system.</p> <p>C. Syllabus and Classroom Expectations</p> | 2  | 4          | <p><b>Academic:</b><br/>           HS-PS3-3, HS-ETS1-1,<br/>           N-Q.A, A-CED.A,<br/>           G-CO.B, S-ID.C<br/>           RLST 11-12.7, RLST<br/>           11-12.10, PE-12.6,<br/>           US11.11</p> <p><b>CTE Anchor:</b><br/>           1.0, 2.0, 4.0, 5.0, 6.0,<br/>           7.0,<br/>           8.0, 9.0, 10.0</p> <p><b>CTE Pathway:</b><br/>           B6.0<br/>           B9.0<br/>           B8.0<br/>           B.10</p> |
| II. | Physical Computing 1: Using Data Types and Operators in Python + LocoArm Mapped Mode   | CR | LAB/<br>CC | STANDARDS  |
|     | <p>A. Robotic Manipulators: Students will learn about the anatomy of robotic manipulators (arms)</p> <ul style="list-style-type: none"> <li>● Physical Construction</li> <li>● Degrees of Freedom</li> <li>● Sensorization</li> <li>● Motor Technologies</li> <li>● Python programming to move different LocoArm joints</li> </ul> <p>B. Students will use the LocoArm to reinforce computational concepts with Python</p> <ul style="list-style-type: none"> <li>● Data Types and Variables</li> <li>● Data Structures and Math</li> </ul>  | 4  | 8          | <p><b>Academic:</b><br/>           HS-PS3-3, HS-ETS1-1,<br/>           N-Q.A, A-CED.A,<br/>           G-CO.B, S-ID.C<br/>           N-VM6-10</p> <p><b>CTE Anchor:</b><br/>           2.0, 4.0, 5.0, 6.0, 7.0,<br/>           8.0, 9.0, 10.0</p> <p><b>CTE Pathway:</b><br/>           B9.0</p>  |



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| III. | Physical Computing 2: Perform Input and Output Operations in Python + LocoArm Mapped Mode   | CR | LAB/<br>CC | STANDARDS  |
|------|---|----|------------|--|
|      | <p>A. Automation and Controls: Students will explore several control methods using the LocoArm</p> <ul style="list-style-type: none"> <li>● Basic Control</li> <li>● Mapped Bounds</li> <li>● Path Planning</li> <li>● Gripper Control</li> </ul> <p>B. Students will start using Python functionalities to code automated arm behavior</p> <ul style="list-style-type: none"> <li>● Python Input and String Manipulation</li> <li>● Module Imports</li> <li>● Python Built-in Functions</li> </ul> <p>C. Team Project #2: Gripper calibration and LocoArm pose challenge.</p> <ul style="list-style-type: none"> <li>● Students will have to design different mapping algorithms and path planning techniques to get the LocoArm in particular poses.</li> <li>● Students will employ an engineering design process to solve the pose challenge. <ul style="list-style-type: none"> <li>○ Design a step-by-step path-planning algorithm</li> <li>○ Code and Test</li> <li>○ Evaluate Solution</li> </ul> </li> </ul> | 7  | 14         | <p><b>Academic:</b><br/> HS-PS3-3, HS-ETS1-2,<br/> N-Q.A, G-CO.B, S-ID.A,<br/> S-ID.C, S-ID1-6a-c,<br/> SEP1-8, CC1-7,<br/> PS2A-C, PS3A-,<br/> ETS1A-C, ETS2A-B</p> <p><b>CTE Anchor:</b><br/> 2.0, 4.0, 5.0, 6.0, 7.0,<br/> 8.0, 9.0, 10.0</p> <p><b>CTE Pathway:</b><br/> B6.0<br/> B8.0<br/> B10.0</p> |

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| IV. | Physical Computing 3: Control Flow with Decisions and Loops in Python + LocoArm Mapped Mode   | CR | LAB/<br>CC | STANDARDS   |
|-----|---|----|------------|---|
|     | <p>A. Students will explore loops and conditionals in Python by creating data-driven LocoArm Behavior</p> <ul style="list-style-type: none"> <li>● Loops and conditionals with LocoArm</li> </ul> <p>B. Team Project #3: LocoArm Pick-and-Place challenge.<br/>           Students will synthesize all physical computing concepts covered so far to design, code, and test a pick-and-place automation system.</p> <ul style="list-style-type: none"> <li>● Students will account for LocoArm’s physics and geometry to identify feasible path-planning and speed control parameters for a successful pick-and-place operation.</li> <li>● They will code the operation in Python to test repeatedly.</li> <li>● They will perform basic statistics to quantify errors in the operation.</li> <li>● Student reflection: Students individually write a reflective essay covering what they enjoyed, challenges they overcame, and what they learned about themselves through the pick-and-place challenge.</li> </ul> | 8  | 14         | <p><b>Academic:</b><br/>           HS-PS3-3, HS-ETS1-2<br/>           HS-ETS1-3, N-Q.A<br/>           A-CED.A, A-REI.A, S-ID.A<br/>           G-MG3, G-SRT1A-1B<br/>           N-Q1-3, N-VM1-3, S-ID1-6a-c, SEP1-8, CC1-7, PS2A-C, PS3A-, ETS1A-C, ETS2A-B</p> <p><b>CTE Anchor:</b><br/>           2.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0</p> <p><b>CTE Pathway:</b><br/>           B6.0<br/>           B8.0<br/>           B10.0</p> |

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| V.  | <b>Physical Computing 4: Functions and visualizations in Python + LocoArm Mapped Mode</b>   | CR | LAB/<br>CC | STANDARDS   |
|-----|---|----|------------|---|
|     | <p>A. Students will practice writing custom Python functions for LocoArm automation.</p> <ul style="list-style-type: none"> <li>● Custom Python Functions</li> <li>● Variable Scope</li> </ul> <p>B. Students will use LocoArm’s sensors and solar cell to understand the dependence of the power output to ambient conditions.</p> <ul style="list-style-type: none"> <li>● Temperature Sensor Introduction</li> <li>● Light Sensor Introduction</li> <li>● Solar Cell Introduction</li> </ul>   | 5  | 10         | <p><b>Academic:</b><br/>           HS-PS3-3, HS-ETS1-2<br/>           HS-ETS1-3, N-Q.A<br/>           A-CED.A, A-REI.A<br/>           S-ID.A, S-IC.B, SEP1-8, CC1-7, PS2A-C, PS3A-, ETS1A-C, ETS2A-B</p> <p><b>CTE Anchor:</b><br/>           2.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0</p> <p><b>CTE Pathway:</b><br/>           B6.0<br/>           B8.0<br/>           B.10</p>                                |
| VI. | <b>Advanced Robotics 1: LocoArm Spherical Mode</b>  | CR | LAB/<br>CC | STANDARDS   |
|     | <p>A. Students will study advanced robotics concepts by reimagining the 3D space in which robots and humans operate.</p> <ul style="list-style-type: none"> <li>● Cartesian and Spherical representation of the 3D workspace of LocoArm</li> </ul> <p>B. Students will study advanced path planning algorithms and Python techniques to implement these planning algorithms.</p> <ul style="list-style-type: none"> <li>● Object manipulation algorithms</li> <li>● Point Grids</li> <li>● File Output (Saving Data to Files)</li> <li>● File Input (Loading Data from Files)</li> <li>● Calibration and Override</li> </ul> <p>C. Team Project #4: Advanced path-planning algorithm for sensor-based decision making.</p> <ul style="list-style-type: none"> <li>● Students will use the engineering design process to perform temperature and light sweeps to create a 2D map of optimal grid points for maximum solar power generation.</li> <li>● Students will demonstrate their solutions for the class.</li> </ul> | 6  | 12         | <p><b>Academic:</b><br/>           HS-PS3-3, HS-ETS1-2, N-Q.A,<br/>           A-CED.A, A-REI.A, G-GMD.B,<br/>           S-ID.A, S-IC.B, S-ID.C, SEP1-8, CC1-7, PS2A-C, PS3A-, ETS1A-C, ETS2A-, PE-12.6, US11.11</p> <p><b>CTE Anchor:</b><br/>           2.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0</p> <p><b>CTE Pathway:</b><br/>           B6.0<br/>           B9.0<br/>           B8.0<br/>           B.10</p> |

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| VII | Sensor Technology 1: LocoIoT Inputs and Outputs with Product Design  | CR | LAB/<br>CC | STANDARDS  |
|-----|--|----|------------|--|
|     | <p>A. Students will dive into modern sensors that power advanced robotics systems.</p> <ul style="list-style-type: none"> <li>● Technical challenges of sensor selection</li> <li>● Sensor errors</li> <li>● Input sensors</li> </ul> <p>B. Students will use Python code to study real-time sensor data analytics. They will write Python code to</p> <ul style="list-style-type: none"> <li>● Acquire raw sensor data</li> <li>● Transform data in a usable form</li> <li>● Analyze data using basic statistics</li> <li>● Visualize results using charts and graphical tools</li> </ul> <p>C. Students will explore modern output devices that make human-robot interaction feasible in a safe and ethical manner.</p> <p>D. Team Project #5: Real world product development 1: Students will design and prototype a product that solves a real-world need. Specifically, they will follow the following engineering and product design steps:</p> <ul style="list-style-type: none"> <li>● Identify and define a real-world problem that needs to be solved</li> <li>● Generate solution concepts using sensors and outputs</li> <li>● Design sensor data analytics based decision-making algorithm</li> <li>● Code and Test</li> <li>● Evaluate Solution</li> </ul> <p>Students will create a Kickstarter/Crowdsourcing type marketing video to showcase the innovation of their product and share it with everyone in the class.</p> | 8  | 16         | <p><b>Academic:</b><br/> HS-PS3-3, HS-ETS1-1, HS-ETS1-2, HS-ETS1-3<br/> N-Q.A, A-CED.A, A-REI.A<br/> S-ID.A, S-IC.B, SEP1-8,<br/> CC1-7, PS2A-C, PS3A-,<br/> ETS1A-C, ETS2A-B, PE-12.6, US11.11</p> <p><b>CTE Anchor:</b><br/> 2.0, 4.0, 5.0, 6.0, 7.0,<br/> 8.0, 9.0, 10.0</p> <p><b>CTE Pathway:</b><br/> B6.0<br/> B9.0<br/> B8.0<br/> B.10</p> |

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| VIII. | Advanced Robotics 2: LocoIoT Internet Connected Systems -- Cloud Robotics   | CR | LAB/CC | STANDARDS   |
|-------|---|----|--------|---|
|       | <p>A. Students will study modern cloud technology history and outlook.</p> <p>B. Students will learn how to code a local server that can transfer sensor data to a webpage via the internet.</p> <p>C. Students will learn how to host this server on Amazon Web Services (AWS) cloud platform and build a dashboard to visualize sensor data.</p> <p>D. Team Project #6: Real-world product development 2: Students will build on their previous product design from Unit VII. to design a webpage that is hosted in the cloud. This webpage will provide a user-friendly dashboard to the customer showing real-time sensor data behavior and the ability for users to affect the product state remotely.</p> <p>Students will edit their earlier Kickstarter/Crowdsourcing type marketing video to showcase the dashboard and user interface of their product and share it with everyone in the class.</p> | 8  | 16     | <p><b>Academic:</b><br/>           HS-PS3-3, HS-ETS1-1,<br/>           HS-ETS1-2, HS-ETS1-3,<br/>           N-Q.A,A-CED.A,<br/>           A-REI.A, S-ID.A,<br/>           S-IC.B ,SEP1-8, CC1-7, PS2A-C, PS3A-, ETS1A-C, ETS2A-B, PE-12.6, US11.11,</p> <p><b>CTE Anchor:</b><br/>           2.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0</p> <p><b>CTE Pathway:</b><br/>           B6.0<br/>           B9.0<br/>           B8.0<br/>           B.10</p> |
| IX.   | Artificial Intelligence (AI): AI in real world  | CR | LAB/CC | STANDARDS   |
|       | <p>A. Students will learn about the history and the current state of AI</p> <ul style="list-style-type: none"> <li>● The AI timeline</li> <li>● Modern AI frameworks</li> </ul> <p>B. Students will learn about the technologies powering AI</p> <ul style="list-style-type: none"> <li>● AI hardware + software</li> <li>● Machine Learning and Neural Networks (NN)</li> </ul> <p>C. Students will code and explore Neural Networks (NN)</p> <ul style="list-style-type: none"> <li>● Coding a simple NN using Python</li> <li>● Training the NN with sensor data</li> <li>● Testing the NN</li> </ul>  | 8  | 18     | <p><b>CTE Anchor:</b><br/>           2.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0</p> <p><b>CTE Pathway:</b><br/>           B6.0<br/>           B9.0<br/>           B8.0<br/>           B.10</p>   |

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| X. | Employment Portfolio   | CR | LAB/CC | STANDARDS  |
|----|--|----|--------|--|
|    | Students will prepare a professional portfolio.<br>1. Portfolio showcases best professional level work<br>2. Portfolio is organized<br>3. Preparation for industry recognized certification exam<br>4. Job application<br>5. Resume<br>6. References | 2  | 10     | <b>Academic:</b><br>LS 9-10, 11-12.6<br>SLS 11-12.2<br><br><b>CTE Anchor:</b><br>2.0, 3.0<br><br><b>CTE Pathway:</b><br>C4.0, C7.0 |