

**CURRICULUM MAPPING TEMPLATE**

**Program: Mechatronics CIP CODE: 14.4201**

| Segment  | CTE Segments/Performance Elements  | CTE Concepts   | Math Concepts  | Common Core Math Standards Middle School  | Common Core Math Standards High School  |
|----------|--|--|--|---|---|
| <b>1</b> | <b>Systems Integration/ Mechatronics</b>   |  |  |   |   |
|          | <p><b>1 - Systems Integration/ Mechatronics</b></p> <p><b>III. Problem-Solving and Critical Thinking</b></p> <p><b>A. Effectively develop and apply the skills inherent in systems engineering where requirements, configuration, integration, project management, quality assurance, and process applications are necessary.</b></p> <p>2. Use the skills required in project management to track and assess the progress of a plan, process, or project as assigned.</p> <p>3. Apply the skills in quality assurance as well as those in process management and development for appropriate applications of systems integration techniques to an assigned project.</p> <p>4. Employ critical thinking and interpersonal skills to resolve conflicts with staff and/or customers.</p> | <p>A.3 Measurement<br/>SPC<br/>Control charts<br/>Gage R&amp;R</p> | <p>A.3 Customary measure<br/>Metric measure<br/>Statistics (I)</p> | <p>6.SP.4; 6.SP.5;<br/>7.SP.2; 7.SP.3;<br/>7.SP.4; 7.SP.5;<br/>8.SP.1; 8.SP.3;<br/>8.SP.4; 6.RP.3;<br/>7.RP.1</p> | <p>S.ID.1; S.ID.2; S.ID.3;<br/>S.ID.5; S.ID.6; S.IC.1;<br/>S.IC.3; S.IC.4; S.IC.6;<br/>S.MD.1; S.CP.1</p> |
|          | <p><b>IX. Employability and Career Development</b></p> <p><b>A. Know and understand the importance of employability skills.</b></p> <p>1. Identify and demonstrate positive work behaviors and personal qualities needed to be employable.</p> <p>2. Manage resources in relation to the position (i.e. budget, supplies, computer, etc).</p>  | <p>Work habits<br/>A.2 Time management</p>                         | <p>Whole numbers and fractions (I)</p>                             | <p>6.NS.2; 6.NS.3;<br/>6.NS.1; 6.EE.2;<br/>7.NS.1; 7.NS.2;<br/>7.NS.3; 7.EE.3</p>                                 | <p>A.APR.1; A.APR.7;<br/>N.RN.3; N.Q.1</p>  |
|          | <p><b>B. Explore, plan, and effectively manage careers.</b></p> <p>1. Develop a personal career plan to meet career goals and objectives.</p> <p>2. Identify and explore career opportunities in one or more career pathways to build an understanding of the opportunities available in the cluster.</p>  | <p>A.2 Work Study<br/>Job shadowing<br/>Field trips</p>            |  |   |   |

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|         | <ul style="list-style-type: none"> <li>3. Recognize and act upon requirements for career advancement to plan for continuing education and training.</li> <li>4. Continue professional development to keep current on relevant trends and information within the industry.</li> <li>5. Examine licensing, certification and credentialing requirements at the national, state and local levels to maintain compliance with industry requirements.</li> <li>6. Examine employment opportunities in entrepreneurship to consider entrepreneurship as an option for career planning.</li> </ul>  |  |               |  |  |
|         | <p><b>C. Demonstrate skills related to seeking and applying for employment to find and obtain a desired job.</b></p> <ul style="list-style-type: none"> <li>1. Use multiple resources to locate job opportunities.</li> <li>2. Prepare a résumé.</li> <li>3. Prepare a letter of application.</li> <li>4. Complete an employment application.</li> <li>5. Interview for employment.</li> <li>6. List the standards and qualifications that must be met in order to enter a given industry.</li> <li>7. Employ critical thinking and decision-making skills to exhibit qualifications to a potential employer.</li> <li>8. Maintain a career portfolio to document knowledge, skills and experience in a career field.</li> <li>9. Demonstrate skills in evaluating and comparing employment opportunities in order to accept employment positions that match career goals.</li> <li>10. Identify and exhibit traits for retaining employment to maintain employment once secured.</li> <li>11. Engage experiences in STEM where an individual can identify personal interests and expectations for career and personal development.</li> </ul> | <p>C.1,2,3,4,5,6,8<br/> Work Study<br/> Job shadowing<br/> Field trips<br/> Portfolio development<br/> Mock interviews</p> |               |  |  |
|         | <p><b>V. SYSTEMS</b></p> <p><b>A. Describe the nature and types of business organizations to build an understanding of the scope of organizations.</b></p> <ul style="list-style-type: none"> <li>1. Describe the types and functions of businesses.</li> <li>2. Explain the functions and interactions of common departments within a business.</li> </ul>  | <p>A.1. Reading in the content &amp; research</p>  |               |  |  |

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|         | <p><b>B. Implement quality control systems and practices to ensure quality products and services.</b></p> <p>2. Diagnose and make necessary corrections or improvements to a technical system in a business, industry, or simulated work place setting.</p>   | B.2. Diagnose and troubleshoot electrical systems |                            |  |  |
|         | <p><b>C. Electrical components and systems</b></p> <p>7. Understand what a mechatronic system is, and the inter-relationships of components and modules with a system</p>   | 7.C. Mechatronic power and gearing systems.       | Ratios and proportions (I) | 6.RP.1; 6.RP.2; 6.RP.3; 7.RP.1; 7.RP.2; 7.RP.3; 7.EE.3 | G.MG.3                                 |
|         | <p><b>D. Mechanical components and systems</b></p> <p>9. Explain the role of various mechanical components within a given system or module.</p>   | D.9. Mechatronic power and gearing systems.       | Ratios and proportions (I) | 6.RP.1; 6.RP.2; 6.RP.3; 7.RP.1; 7.RP.2; 7.RP.3; 7.EE.3 | G.MG.3                                 |
|         | <p><b>VI. SAFETY, HEALTH AND ENVIRONMENTAL</b></p> <p><b>A. Apply safety practices in the environment where science, technology, engineering, and/or mathematical principles are appropriate to ensure a safe workplace.</b></p> <p>1. Assess workplace conditions with regard to safety and health.</p> <p>2. Select appropriate personal protective equipment as needed for a safe workplace/jobsite.</p> <p>3. Employ a safety hierarchy and communication system within the workplace/jobsite.</p> <p>4. Implement safety precautions to maintain a safe worksite.</p> <p>5. Use appropriate safety techniques, equipment, and processes in planning and /or project applications.</p> <p>6. Follow workplace electrical safety guidelines (NEC) (lock-out/tag-out)</p> <p>7. Identify safety and emergency equipment in the workplace, including fire protection, emergency exit plans, eyewash stations, shower facilities, telephone, master power switches, etc.</p> <p>8. Demonstrate safe dress and use of relevant safety gear and personal protective equipment (PPE), including wrist rests, adjustable workspaces and equipment, gloves, boots, earplugs, eye protection, and</p> | A.1-22. Safe Schools                              |                            |  |  |

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|         | breathing apparatus<br>9. Perform machine guarding procedures<br>10. Properly use hand and power tools<br>11. Perform proper hazcom operations (perform proper hazardous waste disposal)<br>12. Follow workplace mechanical safety guidelines (e.g., energy isolation, potential energy)<br>13. Use proper techniques to navigate workplace (walking and working surfaces)<br>14. Understand, apply and implement safety regulations required for operation of the system.<br>15. Illustrate appropriate safe body mechanics, including proper lifting techniques and ergonomics<br>16. Demonstrate the safe use, storage, and maintenance of every piece of equipment in the lab, shop, and classroom<br>17. Identify practices used to avoid accidents<br>18. Describe fire prevention and fire fighting techniques.<br>19. Identify, describe and effectively demonstrate health and safety regulations (e.g., OSHA, EPA, Right-To-Know, and Material Safety Data Sheets (MSDS))<br>20. Discuss relationship between health, safety and productivity<br>21. Illustrate procedures used to handle emergency situations and accidents, including identification, reporting, response, evacuation plans, and follow-up procedures<br>22. Identify existing or potential hazards to existing or assigned plans, projects, or processes where safety, health, or environment might be in play. |  |               |  |  |
|         | <b>B. Employ emergency procedures as necessary to provide aid in workplace accidents.</b><br>1. Use knowledge of First Aid procedures as necessary.<br>2. Use knowledge of CPR procedures as necessary.<br>3. Use safety equipment as necessary.   | B.1-3 Safe Schools                           |               |  |  |
|         | <b>C. Employ knowledge of response techniques to create a disaster and/or emergency response plan.</b><br>1. Complete an assessment of an emergency and/or disaster situation.<br>2. Create an emergency and/or disaster plan.   | C.1-3 Fire and Tornado and lock down drills. |               |  |  |
|         | <b>VII. LEADERSHIP &amp; TEAMWORK</b><br><b>A. Use leadership and teamwork skills in</b>   | A.5. Teamwork and design reviews for         |               |  |  |

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|         | <p>collaborating with others to accomplish organizational goals and objectives.</p> <p>5. Conduct and participate in meetings to accomplish work tasks.</p>   | teams.  |   |   |  |
|         | <p><b>VIII. ETHICS AND LEGAL RESPONSIBILITIES</b></p> <p><b>A. Develop the knowledge and abilities to comprehend ethical and legal standards as they apply to STEM where plans, processes, and projects will be dependent upon them.</b></p> <p>1. Apply ethical reasoning to a variety of workplace situations in order to make ethical decisions.</p> <p>2. Interpret and explain written organizational policies and procedures to help employees perform their jobs according to employer rules and expectations.</p> | A.1-2, School student handbook.                     |   |   |  |
|         | <p><b>X. TECHNICAL SKILLS</b></p> <p><b>D. MECHATRONIC CONCEPTS AND PRINCIPLES</b></p> <p>7. Understand troubleshooting, maintenance and safety issues within a mechatronic system.</p> <p>10. Verbalize instructions and communicate problems</p> <p>11. Transfer the knowledge learned from one system to another system.</p> <p>12. Create an integrated system of various technologies</p>  | D.7-12 Perform experiments on mechatronic apparatus | Ratios, linear equations, whole numbers, fractions, decimals, percents, length. (I) | 6.RP.1; 6.RP.2; 6.RP.3; 7.RP.1; 7.RP.2; 7.RP.3; 6.EE.6; 6.EE.7; 6.EE.8; 6.EE.9; 7.EE.1; 7.EE.2; 7.EE.3; 7.EE.4; 8.EE.7; 8.EE.8; 8.F.4; 6.NS.2; 6.NS.3; 6.NS.1; 6.EE.2; 7.NS.1; 7.NS.2; 7.NS.3; 6.NS.2; 6.NS.3; 6.NS.5 | G.MG.3; A.CED.1; A.CED.2; A.CED.3; A.CED.4; A.REI.3; A.REI.4; A.REI.10; F.LE.1; F.LE.2; F.LE.5; F.IF.5; A.SSE.1; F.BF.1; S.ID.6; A.APR.1; A.APR.7; N.RN.3; N.Q.1 |
|         | <p><b>F. DIGITAL FUNDAMENTALS AND PROGRAMMABLE LOGIC CONTROLLERS (PLCs)</b></p> <p>2. Understand and apply troubleshooting, maintenance and safety rules.</p>   | F.2. PLC training labs. Ladder logic.               | Logic terms, if then statements (I).  |   | S.CP.1   |
|         | <p><b>XI. ENGINEERING &amp; TECHNOLOGY PATHWAY</b></p> <p><b>A. Know the elements of the processes and concepts for understanding the design process.</b></p> <p>1. Explain why and how the contributions of</p>  | A.1. Reports and presentations.                     |   |   |  |

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|          | great innovators are important to society.   |   |   |   |   |
| <b>2</b> | <b>System Design/Prototype/CADD</b>  |   |   |   |   |
|          | <b>2 - System Design/Prototype/CADD</b><br><b>I. Academic Foundations</b><br><b>A. Demonstrate language arts knowledge and skills required to pursue the full range of post-secondary education and career opportunities.</b><br>3. Locate, organize and reference written information from various sources to communicate with co-workers and clients/participants.<br>5. Use correct grammar, punctuation and terminology to write and edit documents.<br>6. Develop and deliver formal and informal presentations using appropriate media to engage and inform audiences. | A3-6 Report writing and presentations.  | Charts and tables (I)   | 6.EE.2; 6.EE.3;<br>6.SP.4; 6.SP.5;<br>7.SP.2; 7.SP.3;<br>7.SP.4; 8.SP.3;<br>8.SP.4  | S.IC.1; S.IC.2; S.IC.3;<br>S.IC.4; S.IC.5; S.IC.6;<br>S.ID.1  |
|          | <b>E. Demonstrate the ability to use Newton's Laws of Motion to analyze static and dynamic systems with and without the presence of external forces.</b><br>1. Use the laws of conservation of energy, charge, and momentum, to solve a variety of problems involving mechanical, fluid, chemical, biological, electrical, and thermal systems.  | E.1. Fluid power labs. Mechanical power to electrical power conversion via electric motor labs. | Ratios, linear equations, substituting data into equations, length. (I) | 6.RP.1; 6.RP.2;<br>6.RP.3; 7.RP.1;<br>7.RP.2; 7.RP.3;<br>6.EE.2; 6.EE.6;<br>6.EE.7; 6.EE.8;<br>6.EE.9; 7.EE.1;<br>7.EE.2; 7.EE.3;<br>7.EE.4; 8.EE.7;<br>8.EE.8; 8.F.4 | G.MG.3; A.CED.1;<br>A.CED.2; A.CED.3;<br>A.CED.4; A.REI.3;<br>A.REI.4; A.REI.10;<br>F.LE.1; F.LE.2; F.LE.5;<br>F.IF.5; A.SSE.1;<br>F.BF.1; S.ID.6 |
|          | <b>II. COMMUNICATIONS</b><br><b>D. Apply active listening skills to obtain or clarify information pertaining to plans, processes, projects, or designs.</b><br>1. Interpret messages or information provided that clarifies issues, ideas, plans, projects, or processes.<br>2. Respond and/or restate information that will clarify STEM techniques to be used and/or information to be applied to projects, plans, or processes.   | D.1-2, Lectures, presentations, and videos, and demos.  |   |   |   |
|          | <b>E. Prepare STEM material in oral, written, or visual formats that provide information to</b>  | E.1-2, Lectures,  |   |   |   |

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|         | <p><b>an intended audience to fulfill specific communication need of an audience.</b></p> <ol style="list-style-type: none"> <li>1. Use effective methods to communicate concepts of STEM to a broadly represented audience.</li> <li>2. Apply the ability to read, interpret, and analyze STEM materials discerning the information and concepts.</li> </ol>  | presentations, and videos, and demos.                                  |               |  |  |
|         | <p><b>F. Exhibit public relations skills to increase internal and external customer/client satisfaction.</b></p> <ol style="list-style-type: none"> <li>2. Use correct grammar to communicate verbally.</li> <li>3. Listen to a presentation and record important information. Report back identifying central themes and use key points to explain how the message applies to a similar situation.</li> </ol>   | F.2-3. Guest speakers, lectures, presentations, and videos, and demos. |               |  |  |
|         | <p><b>III. PROBLEM-SOLVING AND CRITICAL THINKING</b></p> <p><b>A. Effectively develop and apply the skills inherent in systems engineering where requirements, configuration, integration, project management, quality assurance, and process applications are necessary.</b></p> <ol style="list-style-type: none"> <li>1. Employ critical thinking skills independently and in teams to solve problems and make decisions (e.g., analyze, synthesize and evaluate).</li> </ol>   | A.1. All CTE skills in CIP code.                                       |               |  |  |
|         | <p><b>B. Use mathematics, science, and technology concepts and processes to solve problems in projects involving design and/or production (e.g. medical, agricultural, biotechnological, energy and power, information and communication, transportation, manufacturing, and construction).</b></p> <ol style="list-style-type: none"> <li>1. Apply the core concepts of technology and recognize the relationships with STEM systems (e.g. systems, resources, criteria and constraints, optimization and trade-off, and controls).</li> <li>2. Develop the active use of information technology applications.</li> <li>3. Use computer applications to solve problems by creating and using algorithms, and through simulation and modeling techniques.</li> </ol> | B.1-3. All CTE skills in CIP code.                                     |               |  |  |
|         | <p><b>IV. INFORMATION TECHNOLOGY</b></p> <p><b>A. Use Personal Information Management (PIM) applications to increase workplace efficiency.</b></p> <ol style="list-style-type: none"> <li>1. Manage personal schedules and contact</li> </ol>  | A.1-2. Job shadowing, daily planners, binders.                         | Time (I)      |  |  |

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|         | <p>information.</p> <p>2. Create memos and notes.</p>  |   |  |   |  |
|         | <p><b>B. Employ technological tools to expedite workflow.</b></p> <ol style="list-style-type: none"> <li>1. Use information technology tools to manage and perform work responsibilities.</li> <li>2. Use email to share files and documents.</li> <li>3. Identify the functions and purpose of email systems.</li> <li>4. Use email to communicate within and across organizations.</li> <li>5. Access and navigate Internet (e.g., use a web browser).</li> <li>6. Search for information and resources.</li> <li>7. Evaluate Internet resources for reliability and validity.</li> <li>8. Prepare simple documents and other business communications.</li> <li>9. Prepare reports and other business communications by integrating graphics and other non-text elements.</li> <li>10. Prepare complex multi-media publications.</li> <li>11. Prepare presentations for training, sales and information sharing.</li> <li>12. Deliver presentations with supporting materials.</li> <li>13. Create a spreadsheet.</li> <li>14. Perform calculations and analyses on data using a spreadsheet.</li> <li>15. Manipulate data elements.</li> <li>16. Manage interrelated data elements.</li> <li>17. Analyze interrelated data elements.</li> <li>18. Generate reports showing interrelated data elements.</li> <li>19. Facilitate group work through management of shared schedule and contact information.</li> <li>20. Facilitate group work through management of shared files and online information.</li> <li>21. Facilitate group work through instant messaging or virtual meetings.</li> <li>22. Manage computer operations.</li> <li>23. Manage file storage.</li> <li>24. Compress or alter files.</li> <li>25. Operate computer driven equipment and machines.</li> <li>26. Use installation and operation manuals.</li> <li>27. Troubleshoot computer driven equipment and machines.</li> <li>28. Access support as needed to maintain operation of computer driven equipment and machines.</li> </ol> | <p>B.1-28. Project research and status reports.</p> | <p>Charts and tables</p> <p>Writing equations in spreadsheets. (I)</p> | <p>6.EE.2; 6.EE.3;<br/>6.SP.4; 6.SP.5;<br/>7.SP.2; 7.SP.3;<br/>7.SP.4; 8.SP.3;<br/>8.SP.4; 7.EE.3</p> | <p>S.IC.1; S.IC.2; S.IC.3;<br/>S.IC.4; S.IC.5; S.IC.6;<br/>S.ID.1; A.CED.4</p> |



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|         | <p><b>C. Demonstrate Digital Citizenship</b></p> <ol style="list-style-type: none"> <li>1. Identify legal and ethical issues related to the use of information and communication technologies (e.g., properly selecting and citing resources)</li> <li>2. Discuss possible long-range effects of unethical uses of technology (e.g., virus spreading, file pirating, hacking) on cultures and society</li> <li>3. Discuss and demonstrate proper netiquette in online communications</li> <li>4. Identify ways that individuals can protect their technology systems from unethical or unscrupulous users</li> <li>5. Create appropriate citations for resources when presenting research findings</li> <li>6. Discuss and adhere to fair use policies and copyright guidelines</li> </ol> | C.1-6. Use computers ethically to solve mechatronics problems. |                                     |   |   |
|         | <p><b>D. Evaluate and use skills relating to the differing technological tools used to manipulate, report, or operate with data acquisition.</b></p> <ol style="list-style-type: none"> <li>2. Use modeling, simulation, or visual reproduction to effectively analyze, create, and/or communicate to others regarding plans, projects, problems, issues or processes.</li> <li>5. Apply a technological, scientific, or mathematical concept (use of algorithms) when communicating with others on issues, plans, processes, problems, or concepts.</li> </ol>  | D.2, 5 CAD design and report writing                           | Measure, geometry,(I)               | 7.G.5   | G.CO.9; G.CO.12; G.CO.13  |
|         | <p><b>V. SYSTEMS</b></p> <p><b>D. MECHANICAL COMPONENTS AND SYSTEMS</b></p> <ol style="list-style-type: none"> <li>14. Understand the role of mechanical components and electrical drives in complex mechatronic systems, modules and subsystems.</li> </ol>   | D.14 Perform experiments on mechatronic apparatus.             | Linear equations, Substitution (I). | 6.EE.6; 6.EE.7; 6.EE.8; 6.EE.9; 7.EE.1; 7.EE.2; 7.EE.3; 7.EE.4; 8.EE.7; 8.EE.8; 8.F.4 | A.CED.1; A.CED.2; A.CED.3; A.CED.4; A.REI.3; A.REI.4; A.REI.10; F.LE.1; F.LE.2; F.LE.5; F.IF.5; A.SSE.1; F.BF.1; S.ID.6 |
|         | <p><b>E. HYDRAULIC &amp; PNEUMATIC COMPONENTS AND SYSTEMS</b></p> <ol style="list-style-type: none"> <li>29. Design various pneumatic circuits using simulation software</li> </ol>  | E.29. Fluid simulation software.                               |                                     |   |   |
|         | <p><b>VIII. ETHICS AND LEGAL RESPONSIBILITIES</b></p> <ol style="list-style-type: none"> <li>A. Develop the knowledge and abilities to comprehend ethical and legal standards as they apply to STEM where plans, processes,</li> </ol>   | A.3. Be a good steward of the planet.                          |                                     |   |   |

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|         | <p>and projects will be dependent upon them.</p> <p>3. Demonstrate the skill of application to ethical and legal standards as they apply to the plans, processes, and projects as assigned in simulated environments.</p>  |  |                      |  |  |
|         | <p><b>X. TECHNICAL SKILLS</b></p> <p><b>A. Employ information management techniques and strategies in the workplace to assist in decision-making.</b></p> <p>1. Use information literacy skills when accessing, evaluating and disseminating information.</p> <p>2. Describe the nature and scope of information management.</p> <p>3. Maintain records to facilitate ongoing business operations.</p>   | A.1-3 Report writing. Portfolios. Attendance.                          |                      |  |  |
|         | <p><b>B. Employ planning and time management skills and tools to enhance results and complete work tasks.</b></p> <p>1. Develop goals and objectives.</p> <p>2. Prioritize tasks to be completed.</p> <p>3. Develop timelines using time management knowledge and skills.</p> <p>4. Use project-management skills to improve workflow and minimize costs.</p>  | B.1-4. Develop career ready skills via assessments and design reviews. | Time management (I). |  |  |
|         | <p><b>C. Apply concepts and processes for the application of technology to engineering.</b></p> <p>1. Use knowledge, techniques, skills, and modern tools necessary for engineering practice.</p> <p>2. Describe the elements of good engineering practice (e.g. understanding customer needs, planning requirements analysis, using appropriate engineering tools, prototyping, test, evaluation, and verification).</p> <p>3. Demonstrate the ability to characterize a plan and identify the necessary engineering tools that will produce a technical solution when given a problem statement.</p> | C.1-3. All aspects of CTE CIP codes.                                   |                      |  |  |
|         | <p><b>D. MECHATRONIC CONCEPTS AND PRINCIPLES</b></p> <p>1. Describe what comprises a mechatronic system or module.</p> <p>2. Understand and explain the principal operations of the mechatronic system and its subsystems, and the inter-relationships of components and modules within a system.</p> <p>13. Create a multiple system device that communicates and operates simultaneously to create an action or component</p>  | D.1,2,13. All aspects of CTE CIP codes.                                |                      |  |  |
|         | <p><b>I. COMPUTER AIDED DESIGN</b></p> <p>1. Demonstrate the ability to use a computer aided design software to create simple</p>  | I.1-9. Use 2D and 3D Cad programs                                      | Geometry (II).       | 7.G.5                                    | G.CO.9; G.CO.12; G.CO.13               |

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|----------|---|--|---|--|--|
|          | <p>shapes.</p> <ol style="list-style-type: none"> <li>Demonstrate the ability to create a 2D and 3D drawing of an object or part.</li> <li>Demonstrate the ability to create multiview projections</li> <li>Demonstrate the ability to create sectional and auxiliary projections.</li> <li>Understand the concept of dimensioning and tolerancing</li> <li>Interpret and create design and working drawings</li> <li>Interpret, create and design assembly drawings including bill of materials, balloons, etc.</li> <li>Demonstrate understanding of a simulated motion study</li> <li>Create a prototype of a model</li> </ol>                                     | to create drawings, solid models, and prototype parts.       |   |  |  |
|          | <p><b>XI. ENGINEERING &amp; TECHNOLOGY PATHWAY</b></p> <p><b>A. Know the elements of the processes and concepts for understanding the design process.</b></p> <ol style="list-style-type: none"> <li>Explain the elements and steps of the design process and tools or techniques that can be used for each step.</li> <li>Describe design constraints, criteria, and trade-offs in regard to variety of conditions (e.g. technology, cost, safety, society, the environment, time, human resources, manufacturability).</li> </ol>   | A.2-3 Conduct design reviews for projects and presentations. | Equations. Ratio.(II)<br>Customary Measure (I). | 6.EE.2; 6.RP.1;<br>6.RP.2; 6.RP.3;<br>7.RP.1; 7.RP.2;<br>7.RP.3; 6.NS.2;<br>6.NS.3; 7.NS.1;<br>6.EE.6; 6.EE.7;<br>6.EE.8; 6.EE.9;<br>7.EE.1; 7.EE.2;<br>7.EE.3; 7.EE.4;<br>8.EE.7; 8.EE.8; 8.F.4 | A.CED.4; G.MG.3;<br>A.APR.1; A.APR.7;<br>N.RN.3; N.Q.1;<br>A.CED.1; A.CED.2;<br>A.CED.3; A.CED.4;<br>A.REI.3; A.REI.4;<br>A.REI.10; F.LE.1;<br>F.LE.2; F.LE.5; F.IF.5;<br>A.SSE.1; F.BF.1;<br>S.ID.6 |
|          | <p><b>B. Develop processes and concepts to apply the design process.</b></p> <ol style="list-style-type: none"> <li>Apply the design process, including understanding customer needs, interpreting and producing design constraints and criteria, planning and requirements analysis, brainstorming and idea generation, using appropriate modeling and prototyping, testing, verification, and implementation.</li> <li>Demonstrate the ability to evaluate a design or product and improve the design using testing, modeling, and research.</li> <li>Demonstrate the ability to record and organize information and test data during design evaluation.</li> </ol> | B.1-3 Conduct design reviews for projects                    | Equations. Ratio.(II)<br>Customary Measure (I). | 6.EE.2; 6.RP.1;<br>6.RP.2; 6.RP.3;<br>7.RP.1; 7.RP.2;<br>7.RP.3;; 6.EE.6;<br>6.EE.7; 6.EE.8;<br>6.EE.9; 7.EE.1;<br>7.EE.2; 7.EE.3;<br>7.EE.4; 8.EE.7;<br>8.EE.8; 8.F.4                           | G.MG.3; A.CED.1;<br>A.CED.2; A.CED.3;<br>A.CED.4; A.REI.3;<br>A.REI.4; A.REI.10;<br>F.LE.1; F.LE.2; F.LE.5;<br>F.IF.5; A.SSE.1;<br>F.BF.1; S.ID.6  |
| <b>3</b> | <b>Electrical /Motor Controls/<br/>VFD/Servo/Sensor Driven</b>  | A.1 Conduct design reviews for projects                      |   |  |  |

| Segment | CTE Segments/Performance Elements  | CTE Concepts   | Math Concepts   | Common Core Math Standards Middle School   | Common Core Math Standards High School   |
|---------|--|--|---|--|--|
|         | <p><b>I. ACADEMIC FOUNDATIONS</b></p> <p><b>A. Demonstrate language arts knowledge and skills required to pursue the full range of post-secondary education and career opportunities.</b></p> <p>1. Select and employ appropriate reading and communication strategies to learn and use technical concepts and vocabulary in practice.</p>   | and presentations.   |   |  |  |
|         | <p><b>C. Demonstrate science knowledge and skills required to pursue the full range of post-secondary and career education opportunities.</b></p> <p>3. Explain the relationships between scientific theory, scientific principles and laws, in technology, and engineering.</p>   | C. 3 Conduct design reviews for projects and presentations.  |   |  |  |
|         | <p><b>D. Demonstrate the ability to select, apply, and convert systems of measurement to solve problems.</b></p> <p>1. Apply scalar and vector quantities as applied to physical systems, such as the relationship between position, velocity, and acceleration.</p> <p>2. Apply fundamental laws and principles relevant to engineering and technology.</p>   | D1,2. Specific mechatronic labs such as a mechanical drive lab for shaft torque and belt force and velocity. | Trigonometry, algebra, geometry, ratio, mass, weight, (II).                         | 6.RP.1; 6.RP.2; 6.RP.3; 7.RP.1; 7.RP.2; 7.RP.3; 6.EE.6; 6.EE.7; 6.EE.8; 6.EE.9; 7.EE.1; 7.EE.2; 7.EE.3; 7.EE.4; 8.EE.7; 8.EE.8; 8.F.4; 7.G.5 | G.MG.3; A.CED.1; A.CED.2; A.CED.3; A.CED.4; A.REI.3; A.REI.4; A.REI.10; F.LE.1; F.LE.2; F.LE.5; F.IF.5; A.SSE.1; F.BF.1; S.ID.6; G.CO.9; G.CO.12; G.CO.13; G.SRT.8; G.SRT.10; F.TF.1; F.TF.3 |
|         | <p><b>V. SYSTEMS</b></p> <p><b>C. ELECTRICAL COMPONENTS AND SYSTEMS</b></p> <p>4. Carry out measurements on electrical components in a mechatronic system.</p> <p>15. Explain the relationship between voltage, current, and resistance using formulas such as Ohm's and Kirchoff's Law</p> <p>16. Understand role of magnetism and electromagnetism</p> <p>17. Describe series and parallel circuits</p> <p>19. Select proper wire size for a circuit's (NEC) load</p> <p>20. Describe power supply (transformers, inverters, and generators (24 volts)</p> <p>21. Describe inductance and capacitance</p> <p>22. Explain the difference between conductors and insulators.</p> <p>23. Using the power formula, calculate the</p> | C.4-23. Electrical training labs.  | Equations. Substitution. Solving Equations (I) Trigonometry angles. Graphing. (II). | 6.EE.6; 6.EE.7; 6.EE.8; 6.EE.9; 7.EE.1; 7.EE.2; 7.EE.3; 7.EE.4; 8.EE.7; 8.EE.8; 8.F.4; 6.SP.4  | A.CED.1; A.CED.2; A.CED.3; A.CED.4; A.REI.3; A.REI.4; A.REI.10; F.LE.1; F.LE.2; F.LE.5; F.IF.5; A.SSE.1; F.BF.1; S.ID.6; G.SRT.6; G.SRT.8; F.TF.1; F.TF.2; F.TF.7                            |

| Segment  | CTE Segments/Performance Elements  | CTE Concepts                           | Math Concepts  | Common Core Math Standards Middle School   | Common Core Math Standards High School   |
|----------|--|--|--|--|--|
|          | amount of power used by a circuit.   |  |  |  |  |
|          | <b>X. TECHNICAL SKILLS</b><br><b>D. MECHATRONIC CONCEPTS AND PRINCIPLES</b><br>6. Understand the role of electrical components in complex mechatronic system and subsystems.<br>9. Interpret equipment test, operating, and failure logs   | D.6-9. Electrical training labs.       | Equations.<br>Substitution. Solving Equations (I).<br>Graphing. (II).                | 6.EE.6; 6.EE.7;<br>6.EE.8; 6.EE.9;<br>7.EE.1; 7.EE.2;<br>7.EE.3; 7.EE.4;<br>8.EE.7; 8.EE.8;<br>8.F.4; 6.SP.4 | A.CED.1; A.CED.2;<br>A.CED.3; A.CED.4;<br>A.REI.3; A.REI.4;<br>A.REI.10; F.LE.1;<br>F.LE.2; F.LE.5; F.IF.5;<br>A.SSE.1; F.BF.1;<br>S.ID.6; |
|          | <b>E. INSTRUMENTATION AND MEASUREMENT</b><br>1. Properly operate and calibrate various electrical test equipment, such as, voltmeter, multimeter, and ammeter to measure current, voltage, and resistance<br>7. Measure input and output impedance<br>8. Read sensors<br>9. Diagnose electrical equipment<br>14. Explain the importance of proper meter polarity.<br>15. Define frequency and explain the use of a frequency meter.<br>16. Explain the difference between digital and analog meters. | E.1-16. Electrical training labs.      | Measurement<br>Equations.<br>Substitution. Solving Equations (I).<br>Graphing. (II). | 6.EE.6; 6.EE.7;<br>6.EE.8; 6.EE.9;<br>7.EE.1; 7.EE.2;<br>7.EE.3; 7.EE.4;<br>8.EE.7; 8.EE.8;<br>8.F.4; 6.SP.4 | A.CED.1; A.CED.2;<br>A.CED.3; A.CED.4;<br>A.REI.3; A.REI.4;<br>A.REI.10; F.LE.1;<br>F.LE.2; F.LE.5; F.IF.5;<br>A.SSE.1; F.BF.1;<br>S.ID.6; |
|          | <b>G. EQUIPMENT CONTROLS AND SENSORS</b><br>6. Install/maintain/troubleshoot servo motors<br>7. Install/maintain/troubleshoot VFD drives (Variable Frequency Drive)  | G.6,7 AC motor control and monitoring. | Trigonometric functions (III).   |  | G.SRT.6; G.SRT.8;<br>G.SRT.9; G.SRT.10;<br>G.SRT.11; F.TF.3;<br>F.TF.5; F.TF.7   |
| <b>4</b> | <b>Mechanical</b><br><b>I. ACADEMIC FOUNDATIONS</b><br><b>E. Demonstrate the ability to use Newton's Laws of Motion to analyze static and dynamic systems with and without the presence of external forces.</b><br>2. Use the relationships between energy, work, and power to solve a variety of problems involving mechanical, fluid, electrical, and  | E.2 Mechanical drive labs              | Linear equations (I).  | 6.EE.6; 6.EE.7;<br>6.EE.8; 6.EE.9;<br>7.EE.1; 7.EE.2;<br>7.EE.3; 7.EE.4;<br>8.EE.7; 8.EE.8; 8.F.4            | A.CED.1; A.CED.2;<br>A.CED.3; A.CED.4;<br>A.REI.3; A.REI.4;<br>A.REI.10; F.LE.1;<br>F.LE.2; F.LE.5; F.IF.5;<br>A.SSE.1; F.BF.1;            |

| Segment | CTE Segments/Performance Elements   | CTE Concepts                                  | Math Concepts  | Common Core Math Standards Middle School  | Common Core Math Standards High School  |
|---------|---|---|--|---|---|
|         | thermal systems.  |   |  |   | S.ID.6  |
|         | <b>V. Systems</b><br><b>C. ELECTRICAL COMPONENTS AND SYSTEMS</b><br>8. Understand the flow of energy, mass and information in the system.   | C.8 Mechanical drive labs                     | Linear equations (I).  | 6.EE.6; 6.EE.7;<br>6.EE.8; 6.EE.9;<br>7.EE.1; 7.EE.2;<br>7.EE.3; 7.EE.4;<br>8.EE.7; 8.EE.8; 8.F.4   | A.CED.1; A.CED.2;<br>A.CED.3; A.CED.4;<br>A.REI.3; A.REI.4;<br>A.REI.10; F.LE.1;<br>F.LE.2; F.LE.5; F.IF.5;<br>A.SSE.1; F.BF.1;<br>S.ID.6         |
|         | <b>D. MECHANICAL COMPONENTS AND SYSTEMS</b><br>2. Vibration and noise control (ergonomics)<br>3. Understand mechanical valve operation (shut-off)<br>4. Understand bearing properties and uses<br>5. Perform alignment on shafts, sprockets, and pulleys<br>6. Describe drive systems (chains and belts; conveyor system) including gear reduction, apply gear ratios and direction, and perform speed calculations on gears, sprockets, and pulleys<br>8. Describe proper mounting of components (using proper fasteners)<br>10. Describe the basic physical properties of mechanical components including materials, lubrication requirements, selecting the type of lubrication and surface properties.<br>11. Carry out adjustments on mechanical components in a mechatronic system.<br>15. Understand troubleshooting, preventive maintenance and safety issues revolving around mechanical components and electrical drives within a mechatronic system. | D.2-10 Mechanical drive labs. VEX robot labs. | Linear equations, Ratio and proportions. Direct and inverse variation (I). | 6.EE.6; 6.EE.7;<br>6.EE.8; 6.EE.9;<br>7.EE.1; 7.EE.2;<br>7.EE.3; 7.EE.4;<br>8.EE.7; 8.EE.8;<br>8.F.4; 6.RP.1;<br>6.RP.2; 6.RP.3;<br>7.RP.1; 7.RP.2;<br>7.RP.3 | A.CED.1; A.CED.2;<br>A.CED.3; A.CED.4;<br>A.REI.3; A.REI.4;<br>A.REI.10; F.LE.1;<br>F.LE.2; F.LE.5; F.IF.5;<br>A.SSE.1; F.BF.1;<br>S.ID.6; G.MG.3 |
|         | <b>X. Technical Standards</b><br><b>D. MECHATRONIC CONCEPTS AND PRINCIPLES</b><br>5. Trace the flow of energy, mass, and information in a given mechatronic system or subsystem.  | D.5. Mechanical drive labs                    | Linear equations (I).  | 6.EE.6; 6.EE.7;<br>6.EE.8; 6.EE.9;<br>7.EE.1; 7.EE.2;<br>7.EE.3; 7.EE.4;<br>8.EE.7; 8.EE.8; 8.F.4   | A.CED.1; A.CED.2;<br>A.CED.3; A.CED.4;<br>A.REI.3; A.REI.4;<br>A.REI.10; F.LE.1;<br>F.LE.2; F.LE.5; F.IF.5;<br>A.SSE.1; F.BF.1;<br>S.ID.6         |

| Segment | CTE Segments/Performance Elements   | CTE Concepts                     | Math Concepts                 | Common Core Math Standards Middle School  | Common Core Math Standards High School  |
|---------|---|----------------------------------|-------------------------------|---|---|
|         | E. INSTRUMENTATION AND MEASUREMENT<br>2. Properly use a torque wrench   |                                  |                               |   |   |
| 5       | <b>Control Systems/Electrical controls</b>  |                                  |                               |   |   |
| 5       | <b>Control Systems/Electrical Controls</b><br><b>V. SYSTEMS</b><br><b>C. ELECTRICAL COMPONENTS AND SYSTEMS</b><br>1. Explain the role of various electrical components within a given system or module.<br>2. Describe the basic physical properties of electrical components.  | C.1-2 Electrical training labs.  |                               |   |   |
|         | <b>F. COMPUTER AND CONTROL SYSTEMS</b><br>1. Identify components of a computer network<br>2. Describe various discrete logic input/output devices<br>3. Differentiate between analog and digital converters<br>6. Download a program to input information into a computer system<br>7. Describe system control and monitoring interfaces<br>8. Identify different types of communication cabling<br>9. Describe wireless versus hardwired systems   | F.1-9 PLC trainers.              | Logic terms (I).              |   | S.CP.1  |
| 6       | <b>PLC/Diagnostics</b>  |                                  |                               |   |   |
|         | <b>6 - PLC/Diagnostics</b><br><b>V. SYSTEMS</b><br><b>C. ELECTRICAL COMPONENTS AND SYSTEMS</b><br>5. Correctly localize, identify and document causes of malfunctions in electrical components, based upon the technical documentation.<br>6. Where possible correct malfunctions, or correctly identify the expertise required to correct a malfunction.<br>10. Understand troubleshooting, maintenance and safety issues within a mechatronic system.<br>18. Analyze and troubleshoot simple and complex circuits | C.5-18<br>Mechatronics CIP code. | Logic. Linear equations. (II) | 6.EE.6; 6.EE.7;<br>6.EE.8; 6.EE.9;<br>7.EE.1; 7.EE.2;<br>7.EE.3; 7.EE.4;<br>8.EE.7; 8.EE.8; 8.F.4 | A.CED.1; A.CED.2;<br>A.CED.3; A.CED.4;<br>A.REI.3; A.REI.4;<br>A.REI.10; F.LE.1;<br>F.LE.2; F.LE.5; F.IF.5;<br>A.SSE.1; F.BF.1;<br>S.ID.6; S.CP.1 |
|         | <b>D. MECHANICAL COMPONENTS AND SYSTEMS</b><br>13. Correctly identify and document causes of malfunctions in mechanical components or electrical drives, based upon the technical documentation, and where possible correct the malfunctions or correctly identify the expertise required to correct the malfunction  | D.13. Mechanical drive labs.     | Measurement (I).              | 6.NS.2; 6.NS.3;<br>7.NS.1; 7.EE.3   | A.APR.1; A.APR.7;<br>N.RN.3; N.Q.1  |

| Segment | CTE Segments/Performance Elements  | CTE Concepts                   | Math Concepts                    | Common Core Math Standards Middle School | Common Core Math Standards High School |
|---------|--|--------------------------------|----------------------------------|--|--|
|         | <p><b>E. HYDRAULIC AND PNEUMATIC COMPONENTS AND SYSTEMS</b><br/>           7. Correctly identify and document causes of malfunctions in pneumatic and hydraulic circuits, based upon the technical documentation, and where possible correct the malfunctions or correctly identify the expertise required to correct the malfunction</p>  | E.7. Fluid power training labs | Measurement (I).                 | 6.NS.2; 6.NS.3;<br>7.NS.1; 7.EE.3        | A.APR.1; A.APR.7;<br>N.RN.3; N.Q.1     |
|         | <p><b>F. COMPUTER AND CONTROL SYSTEMS</b><br/>           4. Understand truth tables and logic control circuits<br/>           5. Understand basics of computer programming<br/>           10. Create and operate a logic circuit given a ladder diagram<br/>           11. Create and operate a sequence control circuit<br/>           12. Create and operate a time-driven circuit<br/>           13. Create and operate a counter circuit</p>   | F.4-13 PLC labs.               | Logic. Time driven circuits (I). |  | S.CP.1                                 |
|         | <p><b>X. Technical Standards</b><br/> <b>F. DIGITAL FUNDAMENTALS AND PROGRAMMABLE LOGIC CONTROLLERS (PLCs)</b><br/>           1. Explain the role of programmable logic controllers in complex mechatronic systems, modules and subsystems.<br/>           3. Describe the flow of information and the control function of a PLC in a mechatronic system<br/>           4. Describe the basic functions and design of PLCs.<br/>           6. Correctly locate, identify and document system malfunctions in or caused by PLC hardware, based upon the technical documentation.<br/>           7. Demonstrate a PLC program that uses a count up/down instruction.<br/>           8. Design a PLC program that controls a conveyor queue station.<br/>           9. Design a PLC program that uses a time-driven sequence to control a device<br/>           10. Explain how to interface a PLC to a machine controller.<br/>           11. Design a PLC program to operate two motors.<br/>           12. Create and test a limit switch to a discrete input module<br/>           13. Design an event-driven sequencing operation<br/>           14. Develop instructions for a PLC to control time-driven sequence<br/>           15. Develop instruction for a PLC to control count up/down sequence</p> | F.1-15 PLC labs.               | Logic. Time driven circuits (I). |  | S.CP.1                                 |



| Segment | CTE Segments/Performance Elements   | CTE Concepts                      | Math Concepts                       | Common Core Math Standards Middle School  | Common Core Math Standards High School   |
|---------|---|-----------------------------------|-------------------------------------|---|--|
| 7       | <b>Fluid Power/Pneumatics</b>   |                                   |                                     |   |  |
|         | <p><b>7 - Fluid Power/Pneumatics</b></p> <p><b>V. SYSTEMS</b></p> <ol style="list-style-type: none"> <li>1. Describe the role of (electro) pneumatic and hydraulic systems in a complex mechatronic system and its subsystems</li> <li>2. Understand troubleshooting, maintenance and safety issues revolving around (electro) pneumatic and hydraulic circuits within a mechatronic system.</li> <li>3. Explain the role of various (electro) pneumatic and hydraulic components within a given system or module.</li> <li>4. Describe the basic physical properties of pneumatic and hydraulic components.</li> <li>5. Carry out measurements and adjustments on pneumatic and hydraulic components in a mechatronic system.</li> <li>8. Differentiate between hydraulic and pneumatic system components</li> <li>9. Identify types of valve (pressure, flow, directional)</li> <li>10. Apply working knowledge of types of cylinders</li> <li>11. Identify and explain hydraulic fluids.</li> <li>12. Identify different hydraulic and pneumatic conductors</li> <li>13. Understand essentials of system filtration</li> <li>14. Identify and explain hydraulic pumps.</li> <li>15. Identify and explain hydraulic motors.</li> <li>17. Demonstrate correct installation and maintenance as well as preventive maintenance techniques for fluid power systems using service manuals.</li> <li>18. Demonstrate correct troubleshooting and repair methods for fluid power systems using service manuals and gauges.</li> <li>19. Identify and explain types of compressors.</li> <li>20. Explain compressed-air treatment.</li> <li>21. Identify and explain pneumatic system components and symbols.</li> <li>22. Describe the operation of pneumatic motors</li> <li>23. Connect a pneumatic circuit given a schematic</li> <li>24. Describe principles of pneumatic pressure and flow</li> <li>25. Describe pneumatic speed control circuits</li> <li>26. Describe operation of pneumatic Directional</li> </ol> | V.1-32. Fluid power training labs | Linear equations, measurement, (I). | 6.NS.2; 6.NS.3;<br>7.NS.1; 6.EE.6;<br>6.EE.7; 6.EE.8;<br>6.EE.9; 7.EE.1;<br>7.EE.2; 7.EE.3;<br>7.EE.4; 8.EE.7;<br>8.EE.8; 8.F.4 | A.APR.1; A.APR.7;<br>N.RN.3; N.Q.1;<br>A.CED.1; A.CED.2;<br>A.CED.3; A.CED.4;<br>A.REI.3; A.REI.4;<br>A.REI.10; F.LE.1;<br>F.LE.2; F.LE.5; F.IF.5;<br>A.SSE.1; F.BF.1;<br>S.ID.6 |

| Segment  | CTE Segments/Performance Elements   | CTE Concepts                                 | Math Concepts                               | Common Core Math Standards Middle School | Common Core Math Standards High School                            |
|----------|---|--|---|--|---|
|          | Control Valves (DCV) application<br>27. Analyze the construction and operation of pneumatic and hydraulic components, equipment and plants<br>28. Describe application of air logic<br>30. Perform basic maintenance on pneumatic equipment (e.g., filters, lubrication, etc.)<br>31. Disassemble, inspect and service pneumatic cylinder<br>32. Repair air leaks on pneumatic equipment  |  |   |  |   |
| <b>8</b> | <b>Robotics</b>   |  |   |  |   |
|          | <b>8 - Robotics</b><br><b>X. TECHNICAL SKILLS</b><br><b>J. Robotics</b><br>1. Define basic robotic operations<br>2. Demonstrate the operation of a teach pendant<br>3. Program a robot using a computer<br>4. Design a robot program for a flexible manufacturing cell<br>7. Describe the function of a loop command<br>8. Use robot simulation software<br>9. Install/maintain robot systems<br>10. Design, program, and edit robot software<br>11. Explain basic safety of robotics systems.<br>12. Explain practical applications of robotics systems.<br>13. Explain the different types and functions of robots (e.g., welding, pick and place, material handling, gantry, etc.)<br>14. Identify the different parts of a robot.<br>15. Demonstrate the ability to service, maintain, and troubleshoot a simple robot. | J.1-15 VEX robotics, Pegasus, Fanuc. Charts. | Geometry. Logic. Symbols and sequences (I). | 7.G.1; 7.G.2                             | G.CO.5; G.MG.1; G.MG.3; G.CO.12; G.CO.13; G.GMD.4; F.BF.2; S.CP.1 |
| <b>9</b> | <b>Electronics/Sensors</b>  |  |   |  |   |
|          | <b>9 - Electronics/Sensors</b><br><b>I. ACADEMIC FOUNDATIONS</b><br><b>E. Demonstrate the ability to use Newton's Laws of Motion to analyze static and dynamic systems with and without the presence of external forces.</b><br>3. Use the principles of ray optics to describe reflection and refraction of light.   | E3. Sensor lab                               |   |  |   |
|          | <b>V. SYSTEMS</b><br><b>C. ELECTRICAL COMPONENTS AND SYSTEMS</b><br>9. Understand the role of electrical components   | C.9-14. Electrical lab and various           | Linear equations. Powers of 10.             | 6.EE.6; 6.EE.7; 6.EE.8; 6.EE.9;          | A.CED.1; A.CED.2; A.CED.3; A.CED.4;                               |

| Segment   | CTE Segments/Performance Elements   | CTE Concepts   | Math Concepts                      | Common Core Math Standards Middle School   | Common Core Math Standards High School  |
|-----------|---|--|------------------------------------|--|---|
|           | in complex mechatronic system and subsystems.<br>11. Apply circuit terminology<br>12. Describe relationships between circuit components<br>13. Describe types of switches (e.g., limit, potentiometer)<br>14. Read resistor color bands   | online software.                                     | Variance. Standard deviation (II). | 7.EE.1; 7.EE.2;<br>7.EE.3; 7.EE.4;<br>8.EE.7; 8.EE.8;<br>8.F.4; 6.EE.1;<br>8.EE.1; 8.EE.2;<br>8.EE.3 | A.REI.3; A.REI.4;<br>A.REI.10; F.LE.1;<br>F.LE.2; F.LE.5; F.IF.5;<br>A.SSE.1; F.BF.1;<br>F.BF.5; S.ID.6; F.LE.3;<br>S.ID.1; S.ID.2; S.ID.4;<br>S.IC.6 |
|           | <b>X. TECHNICAL SKILLS</b><br><b>E. INSTRUMENTATION AND MEASUREMENT</b><br>4. Describe and identify sensors of various functions (e.g., pressure, flow)<br>5. Describe and identify transducers (thermocouples, photoelectric cell)   | E.4.-5 Electrical lab, Fluid power lab, CAD printer. |                                    |  |   |
|           | <b>G. EQUIPMENT CONTROLS AND SENSORS</b><br>1. Demonstrate basic understanding of electronic sensors<br>2. Explain types of and applications of various sensors<br>3. Measure and analyze types of electronic sensors (e.g., magnetic reed, hall effect, photoelectric, etc.)<br>4. Troubleshoot/replace/install circuit boards<br>5. Install/maintain/troubleshoot photo eyes<br>8. Install/maintain/troubleshoot limit and proximity switches<br>9. Troubleshoot/calibrate/adjust and replace sensors and input devices<br>10. Calibrate process control loop (PID)<br>11. Troubleshoot/replace transducers | G.1-11 Electrical lab.                               | Measurement (I).                   | 6.NS.2; 6.NS.3;<br>7.NS.1; 7.EE.3  | A.APR.1; A.APR.7;<br>N.RN.3; N.Q.1  |
| <b>10</b> | <b>Manufacturing/Machining/<br/>CNC</b>   |  |                                    |  |   |
|           | <b>10 - Manufacturing/Machining/<br/>CNC</b><br><b>I. Academic Foundations</b><br><b>A. Demonstrate language arts knowledge and skills required to pursue the full range of post-secondary education and career opportunities.</b><br>2. Demonstrate use of the concepts, strategies, and systems for obtaining and conveying ideas and information to enhance communication in the workplace.<br>4. Evaluate and use information resources to accomplish specific occupational tasks.<br>7. Interpret verbal and nonverbal cues/behaviors to enhance communication with co-workers and                       | A.2-7 Career ready habits.                           |                                    |  |   |

| Segment | CTE Segments/Performance Elements  | CTE Concepts  | Math Concepts  | Common Core Math Standards Middle School   | Common Core Math Standards High School   |
|---------|--|---|--|--|--|
|         | clients/participants.  |   |  |  |  |
|         | <p><b>B. Apply and use algebraic, geometric and trigonometric relationships, characteristics, and properties to solve problems.</b></p> <ol style="list-style-type: none"> <li>1. Identify whole numbers, decimals, and fractions.</li> <li>2. Demonstrate knowledge of basic arithmetic operations such as addition, subtraction, multiplication, and division.</li> <li>3. Demonstrate use of relational expressions such as equal to, not equal, greater than, less than, etc.</li> <li>4. Apply data and measurements to solve a problem.</li> <li>5. Analyze Mathematical problem statements for missing and/or irrelevant data.</li> <li>6. Construct charts/tables/graphs from functions and data.</li> <li>7. Analyze data when interpreting operational documents.</li> </ol> | B.1-7 CAD, CNC, manual machining                        | Addition, subtraction, decimals, whole numbers, fractions, inequalities. Multiply, divide, trigonometry, charts, tables, graphs (I). | 6.NS.1; 7.NS.1; 7.NS.2; 7.NS.3; 6.NS.2; 6.NS.3; 6.NS.5; 7.EE.3; 6.EE.2; 6.EE.3; 6.SP.4; 6.SP.5; 7.SP.2; 7.SP.3; 7.SP.4; 8.SP.3; 8.SP.4 | A.APR.1; A.APR.7; N.RN.3; N.Q.1; S.IC.1; S.IC.2; S.IC.3; S.IC.4; S.IC.5; S.IC.6; S.ID.1; G.SRT.6; G.SRT.8; G.SRT.9; G.SRT.10; G.SRT.11; F.TF.3; F.TF.5; F.TF.7 |
|         | <p><b>II. Communications</b></p> <p><b>B. Apply active listening skills to obtain and clarify information.</b></p> <ol style="list-style-type: none"> <li>1. Interpret a given verbal message/information.</li> <li>2. Respond with restatement and clarification techniques to clarify information.</li> <li>3. Model behaviors that demonstrate active listening.</li> </ol>   | B.1. Teaching. Come to work. Stay involved and on task. |  |  |  |
|         | <p><b>C. Listen to and speak with diverse individuals to enhance communication skills.</b></p> <ol style="list-style-type: none"> <li>1. Apply factors and strategies for communicating with a diverse workforce.</li> <li>2. Demonstrate ability to communicate and resolve conflicts within a diverse workforce.</li> </ol>  | C.1-2. Career ready habits.                             |  |  |  |
|         | <p><b>F. Exhibit public relations skills to increase internal and external customer/client satisfaction.</b></p> <ol style="list-style-type: none"> <li>1. Communicate effectively when developing positive customer/client relationships.</li> </ol>  | F.1. Career ready habits.                               |  |  |  |

| Segment | CTE Segments/Performance Elements  | CTE Concepts                                | Math Concepts        | Common Core Math Standards Middle School  | Common Core Math Standards High School  |
|---------|--|---|----------------------|---|---|
|         | <p><b>IV. Information Technology Applications</b></p> <p>D. Evaluate and use skills relating to the differing technological tools used to manipulate, report, or operate with data acquisition.</p> <p>3. Apply a currently applicable computer programming language to a process, project, plan, or issue as assigned.</p>  | D.3. VEX, PLC, Robot programming.           | Logic (I).           |   | S.CP.1  |
|         | <p><b>V. Systems</b></p> <p>D. MECHANICAL COMPONENTS AND SYSTEMS</p> <p>1. Differentiate between different types of materials and their properties (plastic, stainless)</p>  | D.1. Machining. Sensor kit.                 |                      |   |   |
|         | <p><b>VII. LEADERSHIP AND TEAMWORK</b></p> <p>A. Use leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.</p> <p>1. Employ leadership skills to accomplish organizational goals and objectives.</p> <p>2. Employ organizational and staff development skills to foster positive working relationships and accomplish organizational goals.</p> <p>3. Employ teamwork skills to achieve collective goals and use team members' talents effectively.</p> <p>4. Establish and maintain effective working relationships with all levels of personnel and other departments in order to accomplish objectives and tasks.</p> <p>6. Employ mentoring skills to inspire and teach others.</p>                                   | A.1-6. Career ready habits. Design reviews. |                      |   |   |
|         | <p><b>X. Technical Standards</b></p> <p>C. Apply concepts and processes for the application of technology to engineering.</p> <p>4. Effectively use project management techniques (e.g. working in teams, appropriate time management practices, effective organizational skills, conduct analysis of cost, resources, and production capacity, and quality practices with continuous improvement).</p> <p>7. Safely operate a variety of tools, machines, and equipment (e.g. milling machines, rapid prototyping machines, drill press, band saw, CNC machines, and hand tools).</p> <p>8. Use, handle, and store tools and materials correctly, perform preventative maintenance, understanding the results of negligence and improper maintenance or improper calibration.</p> | C.4-8. Safe schools. Machine shop.          | Time. Equations (I). | 6.EE.6; 6.EE.7; 6.EE.8; 6.EE.9; 7.EE.1; 7.EE.2; 7.EE.3; 7.EE.4; 8.EE.7; 8.EE.8; 8.F.4 | A.CED.1; A.CED.2; A.CED.3; A.CED.4; A.REI.3; A.REI.4; A.REI.10; F.LE.1; F.LE.2; F.LE.5; F.IF.5; A.SSE.1; F.BF.1; S.ID.6 |

| Segment   | CTE Segments/Performance Elements   | CTE Concepts                 | Math Concepts          | Common Core Math Standards Middle School              | Common Core Math Standards High School                       |
|-----------|---|------------------------------|------------------------|---|--|
|           | <b>D. MECHATRONIC CONCEPTS AND PRINCIPLES</b><br>4. Work effectively as a team-member and to coordinate their activities with upstream and downstream operations, and   | D.4. Design reviews.         |                        |   |  |
|           | <b>J. ROBOTICS</b><br>5. Explain the Cartesian coordinate system  | J.5. Pegasus Robot.          | Geometry (I).          | 7.G.5   | G.CO.9; G.CO.12;<br>G.CO.13                                  |
|           | <b>K. BASIC MACHINING</b><br>1. Explain basic safety of machining systems.<br>2. Explain practical applications of machining systems.<br>3. Explain the different types of machining systems (Lathe, Mill, Drill Press, etc.).<br>4. Identify the different parts of a machining system.<br>5. Demonstrate the ability to set up and operate shop machinery: lathe, mill, drill press, and grinder according to handbook.   | K.1-5. Machine shop.         |                        |   |  |
|           | <b>L. NC/CNC EQUIPMENT</b><br>1. Setup CNC equipment<br>2. Troubleshoot tooling/quality problem<br>3. Modify CNC programming language<br>4. Replace components on NC/CNC equipment<br>5. Modify NC/CNC system parameters<br>6. Operate a CNC mill and/or lathe<br>7. Program a CNC mill and/or lathe<br>8. Optimize a CNC mill and/or lathe program by controlling speeds and feeds<br>9. Perform CNC cutter compensation routine<br>10. Design a CNC program that uses subprograms and canned cycles   | L.1-10. CNC Machining.       | Subtraction (I)        | 6.NS.2; 6.NS.3;<br>7.NS.1; 7.EE.3                     | A.APR.1; A.APR.7;<br>N.RN.3; N.Q.1                           |
| <b>11</b> | <b>Quality/Measurements</b>   |                              |                        |   |  |
|           | <b>11 – Quality/Measurements</b><br><b>I. Academic Foundations</b><br><b>C. Demonstrate science knowledge and skills required to pursue the full range of post-secondary and career education opportunities.</b><br>1. Evaluate scientific constructs including conclusions, conflicting data, controls, data, inferences, limitations, questions, sources of errors, and variables.<br>2. Apply scientific methods in qualitative and quantitative analysis, data gathering, direct and indirect observation, predictions, and problem identification. | C.2 Quality Assurance        |                        |   |  |
|           | <b>II. COMMUNICATIONS</b><br><b>A. Develop and interpret tables, charts, and figures to support written and oral communications.</b><br>1. Create tables, charts, and figures to support  | A1.2 Project design reviews. | Charts and tables (I). | 6.EE.2; 6.EE.3;<br>6.SP.4; 6.SP.5;<br>7.SP.2; 7.SP.3; | S.IC.1; S.IC.2; S.IC.3;<br>S.IC.4; S.IC.5; S.IC.6;<br>S.ID.1 |

| Segment | CTE Segments/Performance Elements  | CTE Concepts  | Math Concepts                             | Common Core Math Standards Middle School  | Common Core Math Standards High School                                       |
|---------|--|---|---|---|--|
|         | written and oral communications.<br>2. Interpret tables, charts, and figures used to support written and oral communication.   |   |   | 7.SP.4; 8.SP.3;<br>8.SP.4   |  |
|         | <b>III. PROBLEM-SOLVING AND CRITICAL THINKING</b><br><b>A. Effectively develop and apply the skills inherent in systems engineering where requirements, configuration, integration, project management, quality assurance, and process applications are necessary.</b><br>5. Identify, write and monitor workplace performance goals to guide progress in assigned areas of responsibility and accountability.<br>6. Conduct technical research to gather information necessary for decision-making. | A.5-6.Design review.                                      | Charts and tables (I).                    | 6.EE.2; 6.EE.3;<br>6.SP.4; 6.SP.5;<br>7.SP.2; 7.SP.3;<br>7.SP.4; 8.SP.3;<br>8.SP.4                    | S.IC.1; S.IC.2; S.IC.3;<br>S.IC.4; S.IC.5; S.IC.6;<br>S.ID.1                 |
|         | <b>IV. INFORMATION TECHNOLOGY APPLICATIONS</b><br><b>B. Employ technological tools to expedite workflow.</b><br>29. Use IT in support of gathering, storage, and transfer of data or results in appropriate formats to support assigned projects.<br>30. Select and use assorted forms of IT to meet the requirements of a plan, process, project, report, issue, or problem.  | B.29-30. Computer use to facilitate student project work. | Charts and tables (I).                    | 6.EE.2; 6.EE.3;<br>6.SP.4; 6.SP.5;<br>7.SP.2; 7.SP.3;<br>7.SP.4; 8.SP.3;<br>8.SP.4                    | S.IC.1; S.IC.2; S.IC.3;<br>S.IC.4; S.IC.5; S.IC.6;<br>S.ID.1                 |
|         | <b>D. Evaluate and use skills relating to the differing technological tools used to manipulate, report, or operate with data acquisition.</b><br>1. Use IT tools to manipulate data creating reports, plans, processes, or projects from data provided.<br>4. Apply statistical tools that verify the reliability or validity of the data used or collected in the plan, project, process, or problem.   | D.1-4 Computer use to facilitate student project work.    | Charts and tables.<br>Mean, std dev. (II) | 6.EE.2; 6.EE.3;<br>6.SP.4; 6.SP.5;<br>7.SP.2; 7.SP.3;<br>7.SP.4; 8.SP.3;<br>8.SP.4; 6.SP.1;<br>6.SP.2 | S.IC.1; S.IC.2; S.IC.3;<br>S.IC.4; S.IC.5; S.IC.6;<br>S.ID.1; S.ID.2; S.ID.4 |
|         | <b>E. Select and use different forms of communications technology including word processing, spreadsheets, database, presentation software, email to communicate, and use of the internet to search for and display information.</b><br>1. Select and use information technology tools to collect, analyze, synthesize, and display data to solve problems.  | E.1 All CTE CIP codes.                                    |   |   |  |
|         | <b>V. Systems</b><br><b>B. Implement quality control systems and practices to ensure quality products and services.</b><br>1. Describe quality control standards and   | B.1. Quality control lab.                                 |   |   |  |

| Segment   | CTE Segments/Performance Elements  | CTE Concepts                                     | Math Concepts   | Common Core Math Standards Middle School                               | Common Core Math Standards High School                             |
|-----------|--|--|---|--|--|
|           | practices common to the workplace.   |  |   |  |  |
|           | <b>X. Technical Standards</b><br><b>C. Apply concepts and processes for the application of technology to engineering.</b><br>5. Use and calibrate probes, sensors, measuring systems, and devices to collect data using traceable standards.<br>6. Explain the impact of error in measurement, predict the effect of error propagation in calculations, and record data with the correct number of significant digits. | C.5 Machine shop.                                | Measurement.<br>Percentage. (I)                       | 6.NS.2; 6.NS.3;<br>7.NS.1; 6.RP.2;<br>6.RP.3; 7.EE.2;<br>7.EE.3        | A.APR.1; A.APR.7;<br>N.RN.3; N.Q.1                                 |
|           | <b>E. INSTRUMENTATION AND MEASUREMENT</b><br>3. Read and interpret results from various gauges<br>10. Measure angles, square, level and plumb<br>11. Determine appropriate measurement tool<br>12. Demonstrate proper care and handling of measurement instruments<br>13. Explain how to read and convert from one scale to another using the above test equipment   | E.5 Machine shop, quality assurance.             | Measurement.<br>Percentage. Angles.<br>Conversion.(I) | 6.NS.2; 6.NS.3;<br>7.NS.1; 6.RP.2;<br>6.RP.3; 7.EE.2;<br>7.EE.3; 7.G.5 | A.APR.1; A.APR.7;<br>N.RN.3; N.Q.1;<br>G.CO.9; G.CO.12;<br>G.CO.13 |
|           | <b>J. ROBOTICS</b><br>6. Develop a program to inspect parts  | J.6. Robot labs.                                 |   |  |  |
| <b>12</b> | <b>Blueprint/Schematics/Drafting</b>   |  |   |  |  |
|           | <b>12- Blueprint/Schematics/Drafting</b><br><b>IV. INFORMATION TECHNOLOGY</b><br><b>E. Select and use different forms of communications technology including word processing, spreadsheets, database, presentation software, email to communicate, and use of the internet to search for and display information.</b><br>2. Read and create basic computer aided engineering drawings.                                 | E.2. CAD.  |   |  |  |
|           | <b>V. SYSTEMS</b><br><b>C. ELECTRICAL COMPONENTS AND SYSTEMS</b><br>3. Interpret wiring, schematics, and ladder diagrams   | C.3. PLC labs                                    | Logic (II).   |  | S.CP.1   |
|           | <b>D. MECHANICAL COMPONENTS AND SYSTEMS</b><br>7. Read and interpret drawings of mechanical parts (sectional and scale views)<br>12. Read, analyze and utilize the technical data sheets for the mechanical components and electrical drives within a mechatronics systems   | D.7,12. CAD, Mechanical Drive Lab. Machine Shop. |   |  |  |
|           | <b>E. HYDRAULIC AND PNEUMATIC COMPONENTS AND SYSTEMS</b><br>6. Read, analyze and utilize the technical   | E.6,16 Fluid power, CAD.                         |   |  |  |



| Segment | CTE Segments/Performance Elements  | CTE Concepts             | Math Concepts    | Common Core Math Standards Middle School | Common Core Math Standards High School |
|---------|--|--------------------------|------------------|--|--|
|         | documents such as data sheets, circuit diagrams, displacement step diagrams, timing diagrams and function charts for the pneumatic and hydraulic components within a mechatronic system.<br>16. Demonstrate the ability to read and interpret fluid power symbols as well as fluid power diagrams.   |                          |                  |  |  |
|         | <b>X. TECHNICAL SKILLS</b><br><b>D. MECHATRONIC CONCEPTS AND PRINCIPLES</b><br>3. Read and understand the technical documents, reports and outlines specific to the system and subsystems, and be able to consult with experts<br>8. Use operating documents and work instructions   | D3,8. All CTE CIP codes. |                  |  |  |
|         | <b>E. INSTRUMENTATION AND MEASUREMENT</b><br>6. Read and convert a standard and metric ruler   | E.6. Quality.            | Conversions (I). |  |  |
|         | <b>F. DIGITAL FUNDAMENTALS AND PROGRAMMABLE LOGIC CONTROLLERS (PLCs)</b><br>5. Read, analyze and utilize the technical documents such as data sheets, timing diagrams, operation manuals, schematics, and ladder diagrams.   | F.5. PLC trainer.        | Logic (I).       |  | S.CP.1                                 |
|         | <b>H. BLUEPRINT READING/SCHEMATICS/CAD</b><br>1. Relate layout information on blueprints to actual locations on the print.<br>2. Describe the information included in the title block of a blueprint.<br>3. Identify the types of lines used on blueprints.<br>4. Understand the use of architect's and engineer's scales.<br>5. Interpret electrical drawings, including site plans, floor plans, and detail drawings.<br>6. Read equipment schedules found on electrical blueprints.<br>7. Describe the type of information included in electrical specifications.<br>8. Recognize and identify common symbols and components on blueprints<br>9. Recognize different classifications of drawings.<br>10. Interpret and use drawing dimensions.<br>11. Interpret mechanical drawings<br>12. Interpret pneumatic and hydraulic drawings<br>13. Interpret electrical schematics<br>14. Interpret piping and instrumentation diagram (P&ID) | H.1. All CTE CIP codes.  |                  |  |  |