

# Unit 5: Computer Numerical Control and Computer Assisted Machinery with Robotics.

Content Area: **Industrial Technology**  
Course(s): **Manufacturing Technology II**  
Time Period: **4th Marking Period**  
Length: **10 Weeks**  
Status: **Published**

## Unit Overview

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SWBAT program and operate a CNC Milling Machine, Computer Controlled Laser cutter and a 3D Printer

## Transfer

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Students will be able to independently use their learning to...

Explain different methods of controlling machine tools.

Describe numerical and computer numerical control and how they are used.

Define automation and its application in manufacturing

Discuss the use of robotics in manufacturing.

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For more information, read the following article by Grant Wiggins.

[http://www.authenticeducation.org/ae\\_bigideas/article.lasso?artid=60](http://www.authenticeducation.org/ae_bigideas/article.lasso?artid=60)

## Meaning

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SWBAT program CNC Initial Project and identify how the CNC machine works with the PLC and code transfer. SWBAT program a basic robot arm with the teach pendant to describe how it works. Student will have the opportunity to operate the 3D Printer and Laser Cutter to make an Individual Project.

## **Understandings**

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Students will understand how most of the Computer Numerical Controlled Machines operate on the Cartesian Coordinate system using the Absolute, Relative or Polar Coordinate system.

Students will understand how the Computer Numerical Controlled Machines speed up the Manufacturing process and the quality control is increased due to the machines accuracy.

Students will understand the importance of human input to program and maintain the CNC equipment.

Students will understand the impact automation has on the workforce and how employment skills have changed due to the implementation.

## **Essential Questions**

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Students will keep considering...

What is the method of control that uses coded alphanumeric instructions to automatically direct the operation of a machine tool?

What is an open loop?

What is a closed?

What is CAD/CAM?

How does the CNC machine use the Absolute Coordinate System?

What is a Part program?

What is Automation?

What is the point to point system?

What is a Robot and what types of Robots exist?

What is a continuous path system?

What is a Flexible Manufacturing System?

## **Application of Knowledge and Skill**

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SWBAT create a CNC program and run it on a CNC machine.

SWBAT have the opportunity to program 3D Printer and Laser Cutter to make a project.

SWMAT program and run a basic robotic arm.

## **Students will know...**

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Students will know...

What is Cartesian Coordinate system and how it applies to programming.

What is G and M codes and how are they used in programming.

How the computer transfers it information to Computer Numerical Machines.

How does the machine know where to start from.

What is the impact of automation on Human Society.

## **Students will be skilled at...**

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Students will be skilled at...

Computer Numerical Control Programming.

Set up of the CNC Milling machine, 3D Printer and Laser Cutter.

Programming a Robot using teach pendant to do a pick and place routine.

Manufacture a project using the CNC equipment.

What is Quality Control.

## **Academic Vocabulary**

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absolute positioning, automation, Cartesian Coordinate System, computer numerical control, direct numerical control, distributed numerical control, flexible manufacturing system, incremental positioning, just in time manufacturing, numerical control, open loop, closed loop.

## **Learning Goal 1**

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**SWBAT apply the Absolute Coordinate system to CNC programs using G code and M code to create an initial project.**

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| CAEP.9.2.12.C.1          | Review career goals and determine steps necessary for attainment.   |
| CAEP.9.2.12.C.2          | Modify Personalized Student Learning Plans to support declared career goals.  |
| CAEP.9.2.12.C.3          | Identify transferable career skills and design alternate career plans.  |
| CAEP.9.2.12.C.5          | Research career opportunities in the United States and abroad that require knowledge of world languages and diverse cultures.   |
| CAEP.9.2.12.C.6          | Investigate entrepreneurship opportunities as options for career planning and identify the knowledge, skills, abilities, and resources required for owning and managing a business. |
| MANU.9-12.9.4.12.M.(1).2 | Research new manufacturing processes to manage production of new and/or improved products.  |
| MANU.9-12.9.4.12.M.(2).1 | Demonstrate how to communicate with others to ensure production meets business requirements.  |
| MANU.9-12.9.4.12.M.(2).8 | Maintain equipment, tools, and workstations to provide safe work environments and meet company regulations.   |
| MANU.9-12.9.4.12.M.(3).4 | Demonstrate knowledge of the safe use of manufacturing equipment in order to ensure safety during maintenance, installation, and repair work.                                       |
| MANU.9-12.9.4.12.M.1     | Demonstrate language arts knowledge and skills required to pursue the full range of postsecondary education and career opportunities.   |
| MANU.9-12.9.4.12.M.2     | Demonstrate mathematics knowledge and skills required to pursue the full range of postsecondary education and career opportunities.   |
| MANU.9-12.9.4.12.M.3     | Demonstrate science knowledge and skills required to pursue the full range of postsecondary education and career opportunities.   |
| MANU.9-12.9.4.12.M.4     | Select and employ appropriate reading and communication strategies to learn and use technical concepts and vocabulary in practice.  |
| MANU.9-12.9.4.12.M.8     | Use correct grammar, punctuation, and terminology to write and edit documents.  |
| MANU.9-12.9.4.12.M.11    | Apply active listening skills to obtain and clarify information.  |
| MANU.9-12.9.4.12.M.16    | Employ critical thinking and interpersonal skills to resolve.   |

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| MANU.9-12.9.4.12.M.19 | Employ technological tools to expedite workflow.   |
| MANU.9-12.9.4.12.M.20 | Operate electronic mail applications to communicate.   |
| MANU.9-12.9.4.12.M.21 | Operate Internet applications to perform tasks.  |
| MANU.9-12.9.4.12.M.28 | Use computer-based equipment (containing embedded computers or processors) to control devices.   |
| MANU.9-12.9.4.12.M.30 | Describe and use quality control systems and practices to ensure quality products and services.  |
| MANU.9-12.9.4.12.M.34 | Demonstrate knowledge of employee rights and responsibilities and employers' obligations to maintain workplace safety and health.        |
| MANU.9-12.9.4.12.M.48 | Conduct and participate in meetings to accomplish tasks.   |
| MANU.9-12.9.4.12.M.52 | Identify and demonstrate positive work behaviors and personal qualities needed to succeed in the classroom and/or to be employable.      |
| MANU.9-12.9.4.12.M.54 | Demonstrate skills related to seeking and applying for employment in a desired job.  |
| MANU.9-12.9.4.12.M.56 | Demonstrate skills in evaluating and comparing employment opportunities in order to accept employment positions that match career goals. |

## **Target 1**

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SWBAT understand how the Cartesian Coordinate System Works and how the math skill is applied to CNC programming.

## **Target 2**

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SWBAT begin writing CNC programming using computers and CNC Base program using G and M codes and simulation software. They will produce a initial project.

## **Learning Goal 2**

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SWBAT to transfer program to CNC Milling Machine and operate CNC machine safely to produce project.

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| CAEP.9.2.12.C.1          | Review career goals and determine steps necessary for attainment.                                      |
| CAEP.9.2.12.C.2          | Modify Personalized Student Learning Plans to support declared career goals.                           |
| CAEP.9.2.12.C.3          | Identify transferable career skills and design alternate career plans.                                 |
| CAEP.9.2.12.C.4          | Analyze how economic conditions and societal changes influence employment trends and future education. |
| MANU.9-12.9.4.12.M.(1).2 | Research new manufacturing processes to manage production of new and/or improved products.             |

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| MANU.9-12.9.4.12.M.(1).6 | Assess and select a variety of techniques and solutions to ensure safe production of products as well as safe and productive workplaces.           |
| MANU.9-12.9.4.12.M.(2).5 | Summarize and employ safety protocols to maintain a safe and productive production workplace.  |
| MANU.9-12.9.4.12.M.(2).8 | Maintain equipment, tools, and workstations to provide safe work environments and meet company regulations.  |
| MANU.9-12.9.4.12.M.(3).4 | Demonstrate knowledge of the safe use of manufacturing equipment in order to ensure safety during maintenance, installation, and repair work.      |
| MANU.9-12.9.4.12.M.(4).9 | Describe safety inspections and training needed to maintain quality assurance and to provide safe and productive manufacturing workplaces.         |
| MANU.9-12.9.4.12.M.(6).1 | Evaluate procedures used to plan for safety in a new production process in order to ensure health, safety, and environmental well-being.           |
| MANU.9-12.9.4.12.M.(6).7 | Demonstrate the safe use of manufacturing equipment in order to assure health and safety in work environments.                                     |
| MANU.9-12.9.4.12.M.1     | Demonstrate language arts knowledge and skills required to pursue the full range of postsecondary education and career opportunities.              |
| MANU.9-12.9.4.12.M.2     | Demonstrate mathematics knowledge and skills required to pursue the full range of postsecondary education and career opportunities.                |
| MANU.9-12.9.4.12.M.3     | Demonstrate science knowledge and skills required to pursue the full range of postsecondary education and career opportunities.                    |
| MANU.9-12.9.4.12.M.4     | Select and employ appropriate reading and communication strategies to learn and use technical concepts and vocabulary in practice.                 |
| MANU.9-12.9.4.12.M.7     | Evaluate and use information resources to accomplish specific occupational tasks.  |
| MANU.9-12.9.4.12.M.8     | Use correct grammar, punctuation, and terminology to write and edit documents.   |
| MANU.9-12.9.4.12.M.11    | Apply active listening skills to obtain and clarify information.   |
| MANU.9-12.9.4.12.M.18    | Conduct technical research to gather information necessary for decision-making.  |
| MANU.9-12.9.4.12.M.19    | Employ technological tools to expedite workflow.   |
| MANU.9-12.9.4.12.M.21    | Operate Internet applications to perform tasks.  |
| MANU.9-12.9.4.12.M.27    | Employ computer operations applications to manage tasks.   |
| MANU.9-12.9.4.12.M.28    | Use computer-based equipment (containing embedded computers or processors) to control devices.   |
| MANU.9-12.9.4.12.M.33    | Demonstrate knowledge of personal and jobsite safety rules and regulations to maintain safe and healthful working conditions and environments.     |
| MANU.9-12.9.4.12.M.34    | Demonstrate knowledge of employee rights and responsibilities and employers' obligations to maintain workplace safety and health.                  |
| MANU.9-12.9.4.12.M.42    | Demonstrate understanding of how to control workplace hazards in manufacturing business environments in order to maintain safe working conditions. |
| MANU.9-12.9.4.12.M.44    | Employ leadership skills to accomplish goals and objectives.   |
| MANU.9-12.9.4.12.M.52    | Identify and demonstrate positive work behaviors and personal qualities needed to succeed in the classroom and/or to be employable.                |
| MANU.9-12.9.4.12.M.54    | Demonstrate skills related to seeking and applying for employment in a desired job.  |
| MANU.9-12.9.4.12.M.56    | Demonstrate skills in evaluating and comparing employment opportunities in order to accept employment positions that match career goals.           |
| MANU.9-12.9.4.12.M.64    | Employ planning and time management skills and tools to enhance results and complete work tasks.   |

## Target 1

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SWBAT set up CNC Vertical Mill and zero CNC to end of a machinable wax block.

## Target 2

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SWBAT safely run CNC Vertical Mill to produce finished project.

## Learning Goal 3

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SWBAT program an articulated arm robot using a teach pendant to create a pick and place routine. SWBAT program a 3D printer and Laser cutter to produce a project.

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| CAEP.9.2.12.C.1          | Review career goals and determine steps necessary for attainment.  |
| CAEP.9.2.12.C.2          | Modify Personalized Student Learning Plans to support declared career goals.   |
| CAEP.9.2.12.C.3          | Identify transferable career skills and design alternate career plans.   |
| CAEP.9.2.12.C.4          | Analyze how economic conditions and societal changes influence employment trends and future education.                                   |
| MANU.9-12.9.4.12.M.(2).6 | Research the safe use of manufacturing process equipment in order to protect personal well-being in the work environment.                |
| MANU.9-12.9.4.12.M.(3).9 | Identify and diagnose equipment problems in order to effectively repair manufacturing equipment.   |
| MANU.9-12.9.4.12.M.(6).1 | Evaluate procedures used to plan for safety in a new production process in order to ensure health, safety, and environmental well-being. |
| MANU.9-12.9.4.12.M.(6).7 | Demonstrate the safe use of manufacturing equipment in order to assure health and safety in work environments.                           |
| MANU.9-12.9.4.12.M.1     | Demonstrate language arts knowledge and skills required to pursue the full range of postsecondary education and career opportunities.    |
| MANU.9-12.9.4.12.M.2     | Demonstrate mathematics knowledge and skills required to pursue the full range of postsecondary education and career opportunities.      |
| MANU.9-12.9.4.12.M.3     | Demonstrate science knowledge and skills required to pursue the full range of postsecondary education and career opportunities.          |
| MANU.9-12.9.4.12.M.4     | Select and employ appropriate reading and communication strategies to learn and use technical concepts and vocabulary in practice.       |
| MANU.9-12.9.4.12.M.7     | Evaluate and use information resources to accomplish specific occupational tasks.  |
| MANU.9-12.9.4.12.M.19    | Employ technological tools to expedite workflow.   |
| MANU.9-12.9.4.12.M.28    | Use computer-based equipment (containing embedded computers or processors) to control devices.   |
| MANU.9-12.9.4.12.M.30    | Describe and use quality control systems and practices to ensure quality products and services.  |

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| MANU.9-12.9.4.12.M.37 | Explain health, safety, and environmental management systems in organizations and their importance to organizational performance and regulatory compliance. |
| MANU.9-12.9.4.12.M.49 | Employ mentoring skills to assist others.   |
| MANU.9-12.9.4.12.M.52 | Identify and demonstrate positive work behaviors and personal qualities needed to succeed in the classroom and/or to be employable.                         |
| MANU.9-12.9.4.12.M.53 | Develop a Personalized Student Learning Plan to meet career goals and objectives.   |
| MANU.9-12.9.4.12.M.54 | Demonstrate skills related to seeking and applying for employment in a desired job.   |
| MANU.9-12.9.4.12.M.57 | Identify and exhibit traits for retaining employment.   |
| MANU.9-12.9.4.12.M.65 | Describe and employ technical knowledge and skills required for careers in manufacturing in order to perform basic workplace activities.                    |

### **Target 1**

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SWBAT identify parts of the robot arm and what a programmable logic controller does.

### **Target 2**

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SWBAT to program the robotic arm using a teach pendant to run a pick and place routine.

### **Target 3**

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SWBAT program and run a 3D Printer and the laser cutter to make a project.

### **Summative Assessment**

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Students will be able to pass a safety test on shop safety rules for operating CNC equipment and Robot. Students must pass the test to work in the Manufacturing Lab on the machines. SWBAT pass a written test on theory on CNC, Automaton and Robotics.

### **21st Century Life and Careers**

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| CAEP.9.2.12.C.1 | Review career goals and determine steps necessary for attainment.            |
| CAEP.9.2.12.C.2 | Modify Personalized Student Learning Plans to support declared career goals. |
| CAEP.9.2.12.C.3 | Identify transferable career skills and design alternate career plans.       |



|                 |   |
|-----------------|---|
| CAEP.9.2.12.C.4 | Analyze how economic conditions and societal changes influence employment trends and future education.  |
| CAEP.9.2.12.C.5 | Research career opportunities in the United States and abroad that require knowledge of world languages and diverse cultures.   |
| CAEP.9.2.12.C.6 | Investigate entrepreneurship opportunities as options for career planning and identify the knowledge, skills, abilities, and resources required for owning and managing a business. |
| CAEP.9.2.12.C.7 | Examine the professional, legal, and ethical responsibilities for both employers and employees in the global workplace.   |
| CAEP.9.2.12.C.8 | Assess the impact of litigation and court decisions on employment laws and practices.   |

### **Formative Assessment and Performance Opportunities**

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Students will be observed to make sure they are following safety rules by the instructor and other students. Students will be graded on project rubric and craftsmanship. Student will also be graded on assigned assessments for each type of Automation Project required. Ex: Initial Project, Robotics, 3D printer, Laser Cutter.

### **Accommodations/Modifications**

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SWBAT create more than one project in each area if the equipment is available for extra credit.

### **Unit Resources**

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### **Interdisciplinary Connections**

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| MA.K-12.1      | Make sense of problems and persevere in solving them.   |
| LA.RST.11-12.3 | Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. |