Central Westmoreland Career & Technology Center

**Program of Study Scope & Sequence**
**with**
**Certification Outcomes**

# Robotic Engineering Manufacturing
# CIP Code 15.9999

| Task # | Task Description | Level/ Marking Pd | Career Path CIP/Soc<br><br>17-3029 - Engineering Technologists/ Technicians, Other | Certification to test for<br><br>(OSHA 10) |
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| **100 Engineering Safety** | | **Level/** | **Career Path CIP/Soc** | **Certification to test for** |
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| 101 | Implement a safety plan, including first aid procedures. | **`1.1** | | **x** |
| 102 | Operate lab equipment according to safety guidelines. | **1.1-1.4** | | **x** |
| 103 | Use personal protective equipment. | **1.1** | | **x** |
| 104 | Comply with OSHA and EPA regulations for a safe work site. | **1.1** | | **x** |
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| 105 | RESERVED | | | |
| 106 | Maintain safe working practices around tools and equipment. | **1.1** | | **x** |
| 107 | Participate in classroom and laboratory management and clean-up activities. | **1.1** | | **x** |
| 108 | RESERVED | | | |
| 109 | Execute lockout/tag out procedures. | **1.1** | | **x** |
| **200 Knowledge of Engineering** | | | | |
| 201 | Demonstrate knowledge of the history of engineering. | **2.1** | | |
| 202 | Investigate engineering careers, training, and associated opportunities. | **2.1** | | |
| 203 | Participate on an engineering team. | **2.1** | | |
| **300 Ethics in Engineering** | | | | |
| 301 | Identify current professional engineering codes of ethics. | **2.1** | | |
| 302 | Analyze ethical engineering issues. | **2.1** | | |
| 303 | Analyze and explain ethical and technical issues contributing to an engineering disaster. | **2.1** | | |
| **400 Reserved** | | | | |
| 401 | RESERVED | | | |
| 402 | RESERVED | | | |
| 403 | RESERVED | | | |
| 404 | RESERVED | | | |
| 405 | RESERVED | | | |
| **500 Teamwork** | | | | |
| 501 | RESERVED | | | |
| 502 | Apply constructive feedback. | **2.1** | | |

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| 503 | Develop a plan for conflict resolution. | **2.1** | | |
| 504 | Apply active listening techniques. | **2.1** | | |
| 505 | Communicate verbally and in writing. | **2.1** | | |
| 506 | Sell an idea to team members. | **2.1** | | |
| 507 | RESERVED | | | |
| 508 | RESERVED | | | |
| 509 | Perform evaluations, e.g., peer, self, and management. | **2.1** | | |
| **600 Engineering Graphics** | | | | |
| 601 | Use graphics equipment and tools. | **1.2** | | |
| 602 | Read and interpret various types of drawings. | **1.2** | | |
| 603 | Perform metric to U.S. system conversions. | **1.2** | | |
| 604 | Interpret scale on a drawing. | **1.2** | | |
| 605 | Prepare freehand sketches. | **1.2** | | |
| 606 | Apply line conventions. | **1.2** | | |
| 607 | Prepare orthographic projection drawings. | **1.2** | | |
| 608 | Prepare additional views to clarify the design. | **1.2** | | |
| 609 | Apply principles of dimensioning and annotation. | **1.2** | | |
| 610 | Prepare drawings for product assembly, fabrication, or construction. | **1.2** | | |
| 611 | Create schematics. | **1.2** | | |
| 612 | Revise an existing drawing to meet modifications or changes. | **1.2** | | |
| **700 Engineering Problem Solving and Design Processes** | | | | |
| 701 | Apply the steps of an iterative design | **2.2** | | |

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| | process. | | | |
| 702 | Create an engineering solution that meets a given design brief. | **2.2** | | |
| 703 | RESERVED | **2.2** | | |
| 704 | Generate a design improvement to address specific flaws or failures. | **2.2** | | |
| 705 | Create a proposal for an engineering project. | **2.2** | | |
| 706 | Participate in a design review. | **2.2** | | |
| 707 | Prepare a schedule for a design project. | **2.2** | | |
| 708 | Write an engineering problem statement. | **2.2** | | |
| **800 Modeling** | | | | |
| 801 | Identify the three areas of modeling, e.g., physical, conceptual, and mathematical. | **1.2** | | |
| 802 | Create a scale model or working prototype. | **1.2** | | |
| 803 | Evaluate a scale model or a working prototype. | **1.2** | | |
| 804 | RESERVED | | | |
| 805 | RESERVED | | | |
| **900 Manufacturing and Industrial Systems** | | | | |
| 901 | RESERVED | | | |
| 902 | RESERVED | | | |
| 903 | Describe procedures used in manufacturing. | **1.2** | | |
| 904 | RESERVED | | | |
| 905 | Create and apply a flowchart that portrays a manufacturing process. | **2.2** | | |

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| 906 | Create a control system that replicates a factory cell. | **2.3** | | |
| 907 | RESERVED | | | |
| 908 | Evaluate a product and the processes used in its manufacture. | **2.3** | | |
| **1000 Manufacturing Processes** | | | | |
| 1001 | RESERVED | | | |
| 1002 | Determine the relationship of time and cost to manufacturing systems. | **2.1** | | |
| 1003 | Determine if a manufacturing process is primary or secondary. | **2.1** | | |
| 1004 | Evaluate and present a production line activity. | **2.1** | | |
| 1005 | Analyze the product development process. | **2.1** | | |
| 1006 | Plan steps of production for a manufactured product. | **2.1** | | |
| 1007 | List tools needed for a manufactured product. | **2.1** | | |
| 1008 | Make a list of the production processes in manufacturing. | **2.1** | | |
| 1009 | Apply manufacturing systems to develop and produce a product. | **2.1** | | |
| 1010 | RESERVED | | | |
| 1011 | Write a step-by-step procedure for an assembly. | **2.2** | | |
| 1012 | Identify methods and sources for obtaining materials and supplies. | **2.1** | | |
| 1013 | Compile a materials list that includes vendors and costs for all required materials and equipment to build a prototype. | **2.1** | | |

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| **1100 Computer Assisted Manufacturing (CAM)** | | | | |
| 1101 | Prepare a process, identify machines that will be used to carry out the process, and then describe the work that each machine performs. | **2.1** | | |
| 1102 | RESERVED | | | |
| 1103 | Demonstrate how to use computer assisted manufacturing (CAM) software to create a program for a machine part. | **2.1** | | |
| **1200 Power and Energy** | | | | |
| 1201 | Differentiate between power, work, and energy. | **2.1** | | |
| 1202 | Discuss the forms of potential and kinetic energy. | **2.1** | | |
| 1203 | Design a vehicle that stores and releases potential energy for propulsion. | **2.1** | | |
| 1204 | RESERVED | | | |
| 1205 | Calculate the efficiency of energy conversions, e.g., electrical, fluid, mechanical. | **2.1** | | |
| 1206 | RESERVED | | | |
| 1207 | Explain the laws of thermodynamics. | **3.1** | | |
| **1300 Mechanical Advantage and Mechanisms** | | | | |
| 1301 | Identify examples of the six simple machines, their attributes, and components. | **3.1** | | |
| 1302 | Measure forces and distances related to mechanisms. | **3.1** | | |
| 1303 | Calculate mechanical advantage and drive ratios of mechanisms. | **3.1** | | |

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| 1304 | Design, create, and test various drive systems. | **3.1** | | |
| 1305 | Determine efficiency in a mechanical system. | **3.1** | | |
| 1306 | Convert power between units. | **3.1** | | |
| 1307 | Measure torque and use it to calculate power. | **3.1** | | |
| 1308 | RESERVED | | | |
| **1400 Fluid Power Systems** | | | | |
| 1401 | Design, create, and test a fluid power system. | **2.2** | | |
| 1402 | Identify components of a fluid system. | **2.2** | | |
| 1403 | Calculate values in a fluid power system using Pascal's law. | **2.2** | | |
| 1404 | Calculate values in a pneumatic system using the ideal gas laws. | **2.2** | | |
| 1405 | Calculate flow rate, flow velocity, and mechanical advantage in a fluid power system. | **2.2** | | |
| 1406 | RESERVED | | | |
| **1500 Green Energy** | | | | |
| 1501 | Produce mechanical power using alternative energy systems. | **3.2** | | |
| 1502 | Research renewable and non-renewable energy sources. | **3.2** | | |
| 1503 | Investigate energy efficiency and conservation. | **3.2** | | |
| 1504 | Create a model that will utilize a renewable energy concept. | **3.2** | | |
| 1505 | RESERVED | | | |
| 1506 | Prepare a concept of an alternative | **3.2** | | |

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| | energy for transportation. | | | |
| **1600 Machine Controls and Automated Systems** | | | | |
| 1601 | Choose appropriate machine control inputs and outputs based on the need of a technological system. | **3.2** | | |
| 1602 | RESERVED | | | |
| 1603 | Differentiate between the characteristics of digital and analog devices. | **3.2** | | |
| 1604 | Select between open and closed loop systems to solve a technological problem. | **3.2** | | |
| 1605 | Create system control programs using flowchart logic. | **3.2** | | |
| 1606 | RESERVED | | | |
| 1607 | RESERVED | | | |
| 1608 | Identify components needed to integrate computer controls for an automated system. | **3.2** | | |
| 1609 | Plan, design, program, and construct an automated system based on given constraints. | **3.2** | | |
| 1610 | RESERVED | | | |
| 1611 | Interface system output to another automated system. | **3.2** | | |
| 1612 | Create and program a simulated work cell with simulation software. | **3.2** | | |
| 1613 | Program timers, counters, and loops. | **3.2** | | |
| 1614 | Select appropriate motors for an application. | **3.2** | | |
| 1615 | Interface output devices to a computer, | **3.2** | | |

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| | microcontroller, or programmable logic controller. | | | |
| **1700 Properties of Materials** | | | | |
| 1701 | Describe the properties of natural, composite, and synthetic materials. | **2.2** | | |
| 1702 | Investigate methods used to alter materials. | **2.2** | | |
| 1703 | Illustrate causes of failure in materials. | **2.2** | | |
| 1704 | Calculate material properties relating to a stress strain curve. | **2.2** | | |
| 1705 | Create a written report of material test evaluations. | **2.2** | | |
| 1706 | Solve a problem, design a product, or a prototype that requires natural, composites, and/or synthetic materials. | **2.2** | | |
| **1800 Reserved** | | | | |
| 1801 | RESERVED | | | |
| 1802 | RESERVED | | | |
| 1803 | RESERVED | | | |
| 1804 | RESERVED | | | |
| 1805 | RESERVED | | | |
| **1900 Statics and Dynamics** | | | | |
| 1901 | Demonstrate knowledge of the principles of statics and dynamics to calculate the strength of a structure. | **3.1** | | |
| 1902 | Create free body diagrams of objects identifying all forces acting on the object. | **3.1** | | |
| 1903 | Locate the centroid of a rectangle and a triangle using mathematics. | **3.1** | | |

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| 1904 | Calculate the moment of inertia for a rectangular shape. | **2.1** | | |
| 1905 | Differentiate between scalar and vector quantities. | **3.1** | | |
| 1906 | Identify magnitude, direction, and sense of a vector. | **3.1** | | |
| 1907 | Calculate the X and Y components, given a vector. | **3.1** | | |
| 1908 | Calculate moment forces given a specified axis. | **3.1** | | |
| **2000 Kinematics** | | | | |
| 2001 | Calculate distance, displacement, speed, velocity, and acceleration. | **2.1** | | |
| 2002 | Calculate acceleration due to gravity based on data from a free-fall device. | **2.1** | | |
| 2003 | Calculate the X and Y components of a projectile motion. | **2.1** | | |
| 2004 | Determine the needed angle to launch a projectile a specific range given the projectile's initial velocity. | **2.1** | | |
| **2100 Total Quality Control** | | | | |
| 2101 | Explain the eight "M's" as they relate to quality control in the manufacturing industry: machines, methods, materials, manpower, measurement, milieu, management, and maintenance. | **2.2** | | |
| 2102 | Demonstrate knowledge of ISO 9000 quality standards. | **2.2** | | |
| 2103 | Demonstrate the application of the following total quality management techniques: cause and effect diagram, check sheet, control chart, histogram, | **2.2** | | |

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| | Pareto chart, scatter diagram, and flow chart. | | | |
| 2104 | Create a total quality control checklist for a product. | **2.3** | | |
| 2105 | RESERVED | | | |
| 2106 | Identify how to correct and improve a finding from an inspection document. | **2.3** | | |
| 2107 | Develop a report of inspection observations and findings. | **2.3** | | |
| **2200 Precision Measurement for Industry** | | | | |
| 2201 | RESERVED | | | |
| 2202 | Make linear measurements accurately to 1/16". | **1.1** | | |
| 2203 | Use a micrometer to measure accurately to .001". | **1.1** | | |
| 2204 | Use a dial caliper to measure accurately to .001". | **1.1** | | |
| 2205 | Perform angular measurement to the nearest one degree. | **1.1** | | |
| 2206 | Use a height gauge to measure accurately to .001". | **1.1** | | |
| 2207 | Use inside micrometers and telescoping gauges to measure accurately to .001". | **1.2** | | |
| 2208 | Express numbers in scientific notation and engineering notation. | **2.2** | | |
| **2300 Basic Electricity and Electronics** | | | | |
| 2301 | Follow safety rules in the use of electrical lab machines and equipment. | **1.1.** | | |
| 2302 | Define and describe basic terms in electricity and electronics. | **1.1** | | |

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| 2303 | Identify electrical and electronic symbols on a schematic. | **1.1** | | |
| 2304 | Follow a schematic and construct series and parallel electrical and electronic circuits. | **1.1** | | |
| 2305 | Identify resistors by type and value. | **1.1** | | |
| 2306 | Use various types of sensing and control devices. | **1.1** | | |
| 2307 | Use a digital multimeter to measure circuit values of current, resistance, and voltage. | **1.1** | | |
| 2308 | Compute values of current, resistance, and voltage using Ohm's law. | **1.1** | | |
| 2309 | Compare DC and AC waveforms. | **1.1** | | |
| 2310 | Analyze and measure values in AC circuits, including inductance, capacitance, reactance, and LRC circuits. | **1.1** | | |
| 2311 | Calculate voltage, amperage, resistance, and power in all types of circuits. | **1.1** | | |
| 2312 | Troubleshoot all types of circuits. | **1.1** | | |
| 2313 | Identify functions, operation, and characteristics of grounding systems. | **1.2** | | |
| 2314 | RESERVED | | | |
| 2315 | RESERVED | | | |
| 2316 | Identify and install electrical panel boards and switchboards. | **1.2** | | |
| 2317 | Identify, select, and install over-current devices. | **1.2** | | |
| 2318 | RESERVED | | | |

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| 2319 | Explain transformer operation. | **1.2** | | |
| 2320 | Describe and identify types of oscillators. | **1.2** | | |
| 2321 | RESERVED | **1** | | |
| 2322 | Construct an amplifier circuit and verify the characteristics. | **1.2** | | |
| 2323 | Construct a power supply circuit and verify operation. | **1.2** | | |
| 2324 | RESERVED | | | |
| 2325 | RESERVED | | | |
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