Discipline: Engineering Technology / Applied Technology

Date Submitted: October 2015

STATEWIDE CAREER PATHWAYS

ARTICULATION TEMPLATE

Cerritos College Course:
MTT 180 – Robotics for CNC Machines (3 units)
Cerritos College
11110 Alondra Blvd.
Norwalk, CA 90650

Marco Antonio Firebaugh Course:
Computer Integrated Manufacturing (CIM) (Project Lead the Way)
Marco Antonio Firebaugh High School
5246 Martin Luther King Jr Blvd.
Lynwood, CA 90262

General Course Description:
This course introduces the student to the applications of robotics for computer numerically controlled (CNC) machines by the use of activities-based learning, project-based learning, and problem-based learning. The student will learn how to create a part using software and apply computer-generated toolpaths. The student will also learn about setup, operation, and programming of CNC machines. Techniques of integration between several CNC machines in a work cell environment will be emphasized using simulation and robotic applications.

College Prerequisite(s): None	**HS/ROCP Prerequisite(s):** Student has successfully completed "Introduction to Engineering Design", the initial foundation course in the PLTW Engineering pathway. Student has successfully completed "Principles of Engineering" the second foundation course in the PLTW Engineering pathway. Student is expected to be taking a college prep curriculum and be enrolled in Algebra 1, Algebra 2 or Geometry.

Advisories/Recommendations: This course is taught at the 10th, 11th or 12th grade level. Project Lead the Way's Introduction to Engineering Design is a prerequisite and most students are expected to be taking a college prep course sequence throughout high school.

Course Content:
- Computer Integrated Manufacturing Career Awareness
- Social responsibility and ethics
- Safety practices and standards in the manufacturing environment
- Evolution of Programmable Machining
- Just in Time Manufacturing
- Communication, presentation skills and teamwork

- Visualization and sketching techniques
- Computer Modeling
- CIM drawings and standards
- Geometry and coordinate systems
- Rapid Prototyping Systems
- Engineering units, instruments, tools and measurements.
- Properties of materials
- Machinist Handbook
- Programmable Logic Controllers (PLC)
- History of Computer Numerical Control
- CNC Milling and terminology (CNC programming, spindle speed, cutting speed, feed rate, offset, plunge)
- Properties of types of cutting tools
- Feedback Systems
- Incremental encoders
- CAM
- CADp
- Robotics (Degrees of freedom, pitch, roll, and yaw)
- Flow diagrams
- Demonstrate the ability to work as a team member and collaborate in a diverse environment.

Competencies and Skill Requirements (Use additional pages as necessary.) Where appropriate, please incorporate standards being used (e.g. CTE standards).

At the conclusion of this course, the student should be able to:

- Define various careers available and terminology used in Computer Integrated Manufacturing
- Demonstrate the understand of social, economical, environmental and ethical impacts of Computer Integrated Manufacturing
- Demonstrate safety practices and standards in Computer Integrated Manufacturing
- Demonstrate ability to effectively communicate verbally, visually and in written format
- Collaborate in a diverse environment
- Apply visualization and sketching techniques in solving Computer Integrated Manufacturing problems
- Create basic Computer Integrated Manufacturing drawings and programs utilizing industry standards
- When presented with a machining problem be able to use their knowledge of CNC milling to complete a NC program supplying information regarding material, cutting speeds, feed rates, mill plunge rates and G&M code.
- Demonstrate the ability to program a simple robot system to perform a task such as loading and unloading parts onto a conveyor belt. A sensor must be used to detect location of parts.
- Using Fischertechnik or similar components, design, build, and program a freight elevator or equivalent system. Using various analog and digital sensors, the system should be able to respond to a command to go to any floor. The system should incorporate safety features to indicate what floor the elevator is on, or if it is in motion.
- Acquire, analyze interpret data, and prepare formal reports.

Measurement Methods (include any industry certification or licensure):

- Projects
- Written/Oral Technical Presentations
- Portfolio
- Skill Demonstration
- Objective Exam
- Problem-Solving Exam
- Essay Exam
- Class Discussion

- Reports

Textbooks or Other Support Materials (including Software): The entire curriculum is supplied in electronic format by Project Lead the Way along with all required support and evaluation materials.

Textbooks:

- CNC Programming: Principles and Applications (1st Edition)
  Mattson, Mike
  ISBN-13: 978-1418060992
  ISBN-10: 1418060992
- Design Tools for Engineering Teams: An Integrated Approach
  Schertz, Karen and Whitney, Terry
  ISBN-13: 978-0766812277
  ISBN-10: 0766812278
- DeGarmo's Materials and Processes in Manufacturing
  Black, J.T., Kosher, Ronald A
  ISBN-13: 978-0470924679
  ISBN-10: 0470924675
- Project Mangament: A Sytems Approach to Planning, Scheduling, and Controlling by Kerzner, Harold 11th Edition
  Kerzner, Harold
  ASINL B00CAYPGIK

Software/Support Materials:

- CAD modeling software - AutoDesk Inventor
- CAM software for 3D milling – EdgeCAM or Autodesk HSM Pro
- CNC milling machine – e.g. ProLight 1000, Benchmill 6000, or Benchmill 8000
- Shop tools and hand tools
- Manufacturing and robot design system – VEX Robotics Design System
- Programming language – RobotC
- Robot arm hardware – LynxMotion robot arm
- Robot arm programming software – PLTW FlowArm and RoboCell
- Microsoft Office (Word, PowerPoint, Excel or equivalent)

Procedures for Course Articulation:
Cerritos College credit for the articulated course listed above may be received when the following criteria are met:

1. The student has completed the articulated course listed above with a "B" grade or higher in *Computer Integrated Manufacturing.*
2. The student must enroll at Cerritos College within two (2) years from the semester date in which the course was completed.
3. The student will present verification of successful completion of the articulated course by presenting a *Cerritos College Petition for Credit by Examination* to a Cerritos College Engineering Technology Instructor. The *Cerritos College Petition for Credit by Examination* should be completed and signed by the Instructor, Dean, and Admissions & Records.
4. No more than 12 units of credit may be accepted for credit by examination.

This Agreement will be reviewed annually and will remain in effect until cancelled by either party giving 30 days written notice.

High School/ROP District Signatures		Cerritos College Signatures	
Faculty/Department Chair	Date 10-30-15	Instructor/Division Chair	Date 10/26/15
Principal	Date 11-10-15	Dean of Instruction	Date 10/26/15
Superintendent	Date	Vice President	Date 10/27/15