

# **Industrial Mechanical Simulation Class (Robotics) Senior Level Class**

The Industrial Mechanical Simulation Class is a curriculum guide for robotics that was written by Mr. Robin Shoop (Schenley High School, Pittsburgh, Penn.) and is supported by The Board of Public Education Office of Curriculum and Assessment: Pittsburgh Public School System. If you are in more information on this set of educational materials, please contact Mr. Shoop at Schenley High School, 4101 Bigelow Blvd., Pittsburgh, PA 15213-1454

## **CURRICULUM COMMITTEE**

Robin Shoop (Writer, Robotics Teacher, Schenley High School Technology Magnet)

Dr. William Cook (School Support Specialist, ATCD)

Adam Slifko (Engineer, REDZONE Robotics)

Troy Lehman (Engineer, REDZONE Robotics)

Jim Martin (Project Manager, Robotics Institute and Development Consortium, Carnegie Mellon University)

Thanks to the following groups, organizations, and individuals

This robotics curriculum guide would not have been made possible without the help of the following groups and organizations:

NASA – During the 1996-97 school term NASA sponsored a team of students from Schenley High School to compete in a national robotics competition called FIRST and it was during this competition that the idea for a year long robotics curriculum was spawned.

Dave Lavery – the NASA representative that made this possible.

REDZONE Robotics – Todd Simonds, president of REDZONE, asked for volunteers from their engineering staff. Troy Lehman and Adam Slifko volunteered their time at Schenley to help with the competition. Troy and Adam also read the manual and gave feedback, which helped steer the contents and organization of the curriculum guide.

Carnegie Mellon University – CMU graduate students lead the team of student who worked on the FIRST competition. Jack Silberman was the project leader. Matt Deans

captained the electronic and control team. Kimberly Shilcutt was in charge of organization and planning.

Jim Martin, Robotics Institute and Development Consortium – Jim is a project engineer at RIDC and volunteered time to read the Robotics curriculum guide. He gave critical feedback concerning its contents.

Jackie Perhach – Jackie is a facilitator of the High Technology magnet. Without her dedication and continual presence in the magnet students wouldn't have the educational opportunities they enjoy today.

#### Unit 1 Introduction to the Course

- Lesson 1 Introduction to IMS
- Lesson 2 Introduction to technology related career paths
- Lesson 3 General Safety in the Robotics Lab
- Lesson 4 Introduction to Software and Hardware in lab
- Lesson 5 Introduction to the Senior Level Design Problem

#### Unit 2 Robotics and Automation

- Lesson 1 Principals of Robotics
- Lesson 2 Programming a Robot
- Lesson 3 Power Supplies and Electromechanical Systems
- Lesson 4 Fluid Power Systems
- Lesson 5 Sensors
- Lesson 6 End Effectors

#### Unit 3 Machine Operation

- Lesson 1 Layout tools, Calipers and Micrometers
- Lesson 2 Introduction to Machining
- Lesson 3 Properties of materials/Feeds and Speeds
- Lesson 4 The Bench Grinder
- Lesson 5 Drills, Drilling Machines, and Drilling
- Lesson 6 Power Sawing
- Lesson 7 The Engine Lathe
- Lesson 8 Milling Machine

#### Unit 4 Absolute Programming/G-Codes

- Lesson 1 Introduction to History of Numerical Control and CNC
- Lesson 2 Introduction to programming the CNC lathe using absolute coordinate values and G-codes
- Lesson 3 Programming Complex Geometries/Entering programs into the controller

Lesson 4 Safe Operation of the CNC lathe

#### Unit 5 Working Assembly Drawings

Lesson 1 Sketching Technique/Multiview Drawings

Lesson 2 Tolerances

Lesson 3 Review of Section Drawings

Lesson 4 Working Assembly Drawings

#### Unit 6 Incremental Programming/Conversational

Lesson 1 Introduction to Incremental programming on 3 axis machines

Lesson 2 Introduction to advanced features of CNC programming

Lesson 3 Checking the program

Lesson 4 Safe operation of the CNC mill

#### Unit 7 Programming/Electronic Control

Lesson 1 Electromechanical Systems

Lesson 2 Electronic Control using the Interface Box

Lesson 3 Syntax, Loops, Conditional Statements

#### Unit 8 Polar Coordinates

Lesson 4 Introduction to Polar Coordinates

Lesson 5 Trigonometry-Pythagorean Theorem, trig functions

#### Unit 9 Programmable Logic Controllers (PLC)

Lesson 1 Introduction to The Programmable Logic Controller

Lesson 2 Programming PLC using Relay Ladder Logic

Lesson 3 Programmable Logic Controller Lab

#### Unit 10 The Senior Level Design Problem

Lesson 1 Introduction

Lesson 2 Universal Problem Solving Model

Lesson 3 Design Reviews

Lesson 4 Documentation of the Design Process

Lesson 5 Production of the Computer Aided Drawings

Lesson 6 Modeling and Fabrication of Parts