

Drexel University  
Drexel Autonomous Systems Lab  
DASL 141 CNC Manufacturing & CAD/CAM

**Instructor Information**

RJ Gross

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**Prerequisites**

Novice Computer Aided Design (CAD)

- 3D Solid Modeling software
- 2D Drafting Software
- Basic hand tool knowledge

**Textbooks or other required materials**

*Using the Tormach PCNC 1100*

[http://www.tormach.com/document\\_library/PCNC1100-3-II-UM-A2-2b.pdf](http://www.tormach.com/document_library/PCNC1100-3-II-UM-A2-2b.pdf)

Oberg, Erik, & Jones, Franklin D. & Horton, Holbrook L. & Ryffel, Henry H.  
*Machinery's Handbook : a reference book for the mechanical engineer, designer,  
manufacturing engineer, draftsman, toolmaker, and machinist /*  
Industrial Press, New York : 1988

- Laptop Computer or PC that is capable of running a windows based CAD software
- Notebook
- Safety Glasses
- Closed Toe Shoes

**Course Goal**

This course provides an overview of DASL machine tool operations. It will be split into four parts, focusing on manual CNC operations, CAD software, CAM Software, and capstone CNC manufacturing project. Because the CNC mill is both expensive and dangerous to run, the course material includes all of the necessary steps to safely and efficiently produce parts with the DASL CNC.

**Lecture Times**

Bossone 107

Friday – 3:00pm-5:00pm

2 hour class Block

1 hour lecture / 1 hour lab

## Lecture Topics

- Lecture 1: Introduction to Tools and 2D CAD
  - Basic Tools
    - Properties
    - Purpose
    - Practice
  - Tool Holders
    - TTS
    - ER20 Collets
    - Jacobs Taper Standard and Keyless Chucks
  - AutoCAD Introduction
    - Drawing tools/commands
    - Layers / line colors
    - Homework: Tap Block
- Lecture 2: Manual Machine Code and Simulation
  - Code structure
  - G,M, and other codes
  - Debugging G code
  - Feed and Speed
  - Simulation
    - NCPlot (primary)
    - CNC Simulator
  - Tool Measuring
    - Height gauge
    - Tool table
- Lecture 3: Tormach PCNC Introduction
  - Pre-Setup
    - Power
    - Mach3
    - Reference
    - Jog Shuttle
    - Tool Setup
  - Table Setup
    - Vise
    - Indicator
  - Material Zero
    - Edge Finder
    - Roll Gauge
  - Coolant
    - Lock line
    - Level
  - Block Squaring
    - Face
    - Side cut

- Lecture 4: Advanced Machining Techniques
  - Tap Block
    - Week 3 Machine Setup
    - Demo
  - Operations
    - Drill
    - Contour
    - Pocket
    - Slot
    - Facing
  - “Vocabulary”
    - Tool radius & Flutes
    - Counter Bore, Counter Sink
    - Blind Hole Vs. Through Hole
    - Tap properties (taper, plug, bottoming, etc.)
  - Advanced Setups
    - Strap clamps & Step blocks
    - Base Plates & Service Holes
    - 123 Blocks
- Lecture 5: 3D CAD Introduction
  - Autodesk Inventor
    - Part
    - Assembly
    - Drawing
  - AutoCAD Pre-CAM
    - Additional Feature Paths
    - Export
- Lecture 6: CAM Introduction
  - MasterCam X<sup>3</sup>
    - Import
    - Stock Setup
    - Feature Setup
    - Simulation
    - POST/NC Generation
    - Debug
- Lecture 7: Cap Stone Project AutoCAD Stage
  - Robot Chassis
    - Pre-made model
  - 3D Assembly
  - AutoCAD Pre-CAM
    - Instructor Verification
- Lecture 8: Cap Stone Project MasterCAM Stage
  - CAM AutoCAD Pre-CAM
    - Simulation
    - Produce NC Code
    - Instructor Verification

- Lecture 9-10: Open Manufacturing Time
  - Machine
    - Supervised session
    - Proper Machine Setup
    - Use verified MasterCAM NC Code
  - Assembly
    - Based on CAD Assembly
    - Verify with Class Model
  - Course Feedback

### **Final Project Details**

The cap stone project that starts Lecture 7 is designed to allow the student to apply learned CNC Manufacturing knowledge to a simple robotics platform. This project involves manufacturing a pre-designed two wheeled robotic vehicle. This produced platform will be used in conjunction with Bryan Kobe's DASL 132 course on electronics/microcontrollers. The goal is to manufacture a robotic platform that can be integrated with a microcontroller and interact with its environment. It is mandatory that machine operation needs to be supervised by RJ Gross or Robert Ellenberg. The machine time for completion will require out side of lab time, on average 4-5 hours of machine time.

### **Grading Policy**

Every week, homework will be issued at the end of class. This homework will be relevant to topics covered in class. Homework is mandatory but it is not graded, assignments will be submitted at the start of lecture if necessary. Homework will give you the "messing around time" to fully grasp the software and methods presented. The following class a quiz will be issued based upon the homework and previous class material. These will be graded to keep the student accountable for his/her work. The Final project is based on a Pass or Fail policy. Pass: complete manufacturing and assembly of robot in allotted time. Fail: Does not produce final project, no acceptations. Plus you will score poorly in DASL 132, due to not havening a non functional robot for electronics integration.

### **Words of Wisdom**

- Work quickly, but stay accurate (expensive machinery)
- Double check your work (Look at CNC Table for a clue)
- The Big **RED** Button it has a purpose, USE IT
- Be SMART!!!
- Get things done ahead of time
- Help is available so ASK!!
- You want to work on the machine unattended in the future?
  - PRACTICE, PRACTICE, PRACTICE!!!!
  - Gain the trust that you are responsible!
- Don't pull a Keith and Break Three endmills in Two days! (Holds up work for other students...and other reasons)