Places

Machine shop
169 Towne
Places

GM Lab
Towne 193
Prototrak emulators
Places

Towne 205
19 CAD stations
Door code: ####
Lectures from 10:30 am - 12 noon in 309 Towne every Tuesday
People

Peter Szczesniak
Joseph Valdez
Kevin Alcedo
Aedhan Loomis
Mike Choi aka RePeter
Paige Willoughby

*Daleroy Sibanda not shown
Resources

Recommended textbook: Machine Elements in Mechanical Design, 4th ed. by Robert L. Mott

Supplies: Consider purchasing calipers, safety glasses, smock or lab jacket, hand tools

Course wiki: http://medesign.seas.upenn.edu

Homework submissions: Canvas

Contacting the staff: (1) Piazza preferred, or (2) grahamw@seas.upenn.edu
Skills and Topics

- Reading and interpreting technical / engineering drawings
- Safe, responsible, and proficient use of machine shop tools
- Technical understanding of metal cutting techniques
- Common industrial and prototyping manufacturing processes
- Design for manufacturing
Machines

Vertical bandsaw

Manual mill

ProtoTrak mill

Lathe
## Grade Components

<table>
<thead>
<tr>
<th>Component</th>
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<tbody>
<tr>
<td>5 - 6 Safety / skills tests</td>
<td>10</td>
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<tr>
<td>Lecture / HW assignments</td>
<td>25</td>
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<td>Parts submissions</td>
<td>25</td>
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<td>Final assembly (quality, functionality, design)</td>
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<td>Lab Practical</td>
<td>5</td>
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<td>Exam</td>
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Part Submission and Grading

Parts are to be placed in your part box by the beginning of your lab on the part due date.

Parts up to **one week** late will receive a 30% deduction in part grade.

Parts up to **two weeks** late will receive a 60% deduction in part grade.

Revised parts may be submitted up to -2 weeks from the course termination (April 15th) and will inherit deductions associated with the original part submission.

Piazza post to your TA and the instructors to indicate late or resubmitted parts.
Shop Rules

- Only work on machinery for which you have been trained
- Never work alone
- Wear safety glasses at all times while inside the fabrication area
- Wear closed-toe shoes or boots
- Remove jewelry
- Wear no excessively loose clothing that could get caught in machinery
- Tie back long hair
- Do not use your cellphone or headphones while operating machinery
Shop Rules

- Have a clear frame of mind (no intoxication, no excessive sleep deprivation)
- Dispose of any chemical waste in proper containers
- No food or drink are permitted in the shop area
- Ask for help if you are unsure of something
- Keep all work surfaces clean and dry
- Clean, reset, and organize equipment after use
- Report all broken/damaged/worn tools to a member of the lab staff
Shop Rules

- Complete a 5-10 minute shop job (issued at the discretion of the on-duty staff person) before leaving
- Work to ensure the safety of yourself and others
- Any injuries must be reported immediately via an injury incident report
MEAM 201 Engine Examples

Courtesy of Manfred Ritchie
MEAM 201 Engine Examples
MEAM 201 Engine Examples

Courtesy of Foster Collins
MEAM 201 Engine Examples
Fully-defined and Provided* Parts

(P) Air chamber
(08) Heat sink
(P) Displacer
(P) Displacer rod
(07) Displacer bushing tube
(P) Displacer rod fork
(06) Displacer rod fork
(P) Piston tube
(05) Crankshaft bearing tube
(P) Piston
(03) Piston
(02) Piston flange
(01) Mounting block
(04) Web

*P = provided
(09) Bedplate (not shown)
(10) Piston connecting rod
(11) Displacer connecting rod
(12) Return crank
(13) Balance weight
(14) Output shaft and flywheel
(15) Base/stand (not shown)
Engineering Drawings
Title block: conveys notes / details of drawing

- Drawing space -

Drawing border lines
<table>
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<td>THE INFORMATION CONTAINED IN THIS</td>
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<td>DRAWING IS THE SOLE PROPERTY OF</td>
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<td>THE UNIVERSITY OF PENNSYLVANIA.</td>
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**INTERPRET GEOMETRIC TOLERANCING PER:**

**MATERIAL:** AL-6061 T6

**NEXT ASSY:** USED ON FINISH USE/NONE

**APPLICATION:** DO NOT SCALE DRAWING

**TITLE:** Mounting Block

**SIZE:** A 201-01

**REV:** B

**SCALE:** 1:1

**WEIGHT:** SHEET 1 OF 1
Isometric view
Orthographic views

Mounting Block

Size: A
DWG. No.: 201-01
Rev.: B
Scale: 1:1
Weight: 
Sheet 1 of 1
Section view with view arrows.
| UNLESS OTHERWISE SPECIFIED:  
DIMENSIONS ARE IN INCHES,  
TOLERANCES:  
FRACTIONAL±1/64,  
ANGULAR: Mach±1  
TWO PLACE DECIMAL,  
THREE PLACE DECIMAL,  
FOUR PLACE DECIMAL,  
INTERPRET GEOMETRIC TOLERANCING PER:  
MATERIAL:  
AL - 6061 T6  
Q/A:  
COMMENTS:  
BREAK ALL EDGES AND SHARP CORNERS.  
NEXT ASSY USED ON FINISH  
APPLICATION:  
DO NOT SCALE DRAWING  
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Hole centers - provide an alignment point

\[ \phi 1.072^{+000}_{-005} \]

1.250

1.625

3X \( \phi .116 \) \( \downarrow \) THRU
Basic dimensions - associated with GD&T callouts and critical dimensions
Evaluated dimensions (nonconventional)

\( \phi 1.072^{+0.000}_{-0.005} \)

1.250

1.625

0.336

0.672

3x \( \phi 0.116 \) THRU

R.813

0.582
Thread and hole specifications
How Small Is A Thou?

Fingernails grow \(~1\) nm/s

Red blood cells are \(~7\) \(\mu\)m in diameter

Typical machining techniques remove down to 2 thousandths of an inch of material

\(.002" = 125,000\) unit cells of Al = 14 hours of nail growth = 7 diameters of a red blood cell = half the width of a human hair
First Assignments

Before your lab on Thursday / Friday
1) View videos G01 and G02 - introduction to vertical bandsaw safety and operation (~10 min in length)
2) Complete a Canvas-based quiz (Q01)
3) Review the lab safety info located at http://medesign.seas.upenn.edu/index.php/Main/LabInfo

Before lecture next Tuesday
1) A01: Stirling engine brief
2) A02: Stirling engine brainstorming
3) Skim the drawing standards reference linked on the course Wiki (http://mscweb.gsfc.nasa.gov/543web/files/GSFC-X-673-64-1F.pdf)
4) Print out all engineering drawings for all fully defined parts