Real Goals of the Course

• Functions, Design Requirements, Alternatives and Evaluation
• Iterative Solutions; Solutions of problems with too many unknowns
• Familiarity with machine components
Everything that exists is designed somehow…

- Consumer Products
- Manufacturing Systems
- Construction Equipment
- Agricultural Equipment
- Transportation Equipment
- Ships
- Space Systems

Design

- To conceive and plan out in the mind. To devise for a specific function or end. To make a drawing, pattern or sketch of; to draw plans for.
Engineering Design

• Uses engineering techniques to design.

Mechanical Design

• Engineering design dealing with mechanisms etc.

Objective of Mechanical Design

• To produce a useful product that satisfies the needs of a customer and that is safe, efficient, reliable, economical, and practical to manufacture.
Design Process

Determine the criteria for:
1. What the device is supposed to do
2. How it can be done
   DON'T SETTLE ON THE FIRST IDEA!!!
3. Determining if it will work as intended
4. Presenting the solution to others

Communication
Design Considerations

- Safety
- Performance
- Reliability
- Ease of mfg.
- Ease of service
- Ease of operation
- Attractive appearance

- Low initial cost
- Low operating and maintenance cost
- Small size & low weight
- Low noise & vibration

Design Considerations

- Avoid “special” or unique parts – use commercial components when possible
- Optimize design according to requirements
- Limit the number of unique parts
- Meet design codes where applicable
Process

- Develop functions
- Establish Design Requirements
- Alternatives
- Evaluate
Functions

• Tell what the device is supposed to do
• Somewhat general
• Use action phrases:
  – To support…
  – To lift…

Design Requirements

• Detailed & Specific requirements of the project giving quantitative data where possible.
Alternatives

• Brainstorm and come up with as many different design alternatives as is possible.
• Do NOT settle on your first idea.
• Design is an iterative solution to a problem.

Evaluate

• Judge each of the design alternatives against the design considerations and choose the best solution.
• Perform detailed design of the selected alternative
Design Considerations

- Safety
- Performance
- Reliability
- Ease of mfg.
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Communicate the Details

- As the field requested it
- As marketing ordered it
- As engineering designed it
- As the plant manufactured it
- As installed
- What the customer wanted
# Unit Systems

<table>
<thead>
<tr>
<th>System</th>
<th>Unit</th>
<th>Length</th>
<th>Mass</th>
<th>Time</th>
<th>Force and Weight</th>
<th>Gravity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internacional</td>
<td>meter</td>
<td>kilogram</td>
<td>second</td>
<td></td>
<td>Newton</td>
<td>9.81 m/sec²</td>
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<tr>
<td>British Gravitational</td>
<td>foot</td>
<td>slug</td>
<td>second</td>
<td></td>
<td>pound</td>
<td>32.2 ft/sec²</td>
</tr>
</tbody>
</table>

Newton’s Second Law of Motion: \( F = m \times a \)

SI weight = force = mass \times gravity = kg \times m/sec² = Newtons

English mass = force/gravity = pound/(ft/sec²) = pound×sec²/ft