An Introduction to Freshman Engineering

ME 120, 121, 122

Mechanical and Materials Engineering

Portland State University

Broad Objectives (1)

Learn skills for a successful engineering career

- ❖ Structured problem-solving
- ❖ Basic electronics
- ❖ Computer programming
- ❖ Analysis and plotting of data
- ❖ Use of engineering software tools
    - ‣ Excel
    - ‣ MATLAB
    - ‣ Solidworks
- ❖ Fabrication tools and techniques
- ❖ Teamwork
- ❖ Design process

Broad Objectives (2)

Learn attitude for a successful engineering career

- ❖ Rigor
  - ‣ Use correct mathematical techniques
  - ‣ Check your work
  - ‣ Confirm expectations with measurements
- ❖ Teamwork
- ❖ Resilience and self-reliance

Broad Objectives (3)

Become acquainted with engineering practice

- ❖ What kinds of problems do Mechanical Engineers solve?
- ❖ What kinds of tools do Mechanical Engineers use?
- ❖ What is it like to design, build, test, and debug a physical device?
- ❖ How can I use microcontrollers to make "smart" devices?

Teaching Philosophy

Hands-on and Project-based

- ❖ Motivate learning with problems that need to be solved
- ❖ Build confidence through experience with tangible objects
- ❖ Provide a common experience for all students

Fast-paced

- ❖ Practicing engineers have to balance competing demands
- ❖ Learn by doing, even if you can't "do" so well at first
- ❖ Build teamwork skills because teamwork is necessary for success on complicated projects

MME Freshman Engineering Sequence

Course sequence

- ❖ ME 120: Introduction to Engineering
- ❖ ME 121: Introduction to Systems and Controls
- ❖ ME 122: Introduction to Design

Courses build on each other. You can't skip into the middle of the sequence

Equipment requirements

To complete this course sequence you will need to have

- ❖ Sparkfun Inventor's Kit (at the bookstore)
- ❖ A laptop
  - ‣ Run Arduino software
  - ‣ Run Excel
  - ‣ Watch course presentations and project instructions
- ❖ Hand tools
  - ‣ Digital multimeter
  - ‣ Caliper
  - ‣ Screw drivers
  - ‣ Side cutter and needle nose pliers
  - ‣ Utility knife
- ❖ Miscellaneous supplies

ME 120: Introduction to Engineering

Topics

❖ Electrical Circuits

❖ Programming Arduino

❖ Mechanical Fabrication

‣ Measuring parts with a caliper

‣ Specifying part dimensions with 2D CAD drawings

‣ Cutting acrylic parts with a laser cutter

‣ Building 3D solid models of parts and assemblies

‣ Using machine tools and hand tools to fabricate parts

‣ Printing 3D parts with a rapid prototyping machine

‣ Hand assembly of devices

❖ Engineering analysis

‣ Structured problem-solving and documentation

‣ Data analysis and plotting with Excel

ME 120: Introduction to Engineering

Projects

- ❖ Breathing LED
- ❖ Desktop Fan
- ❖ Water pump
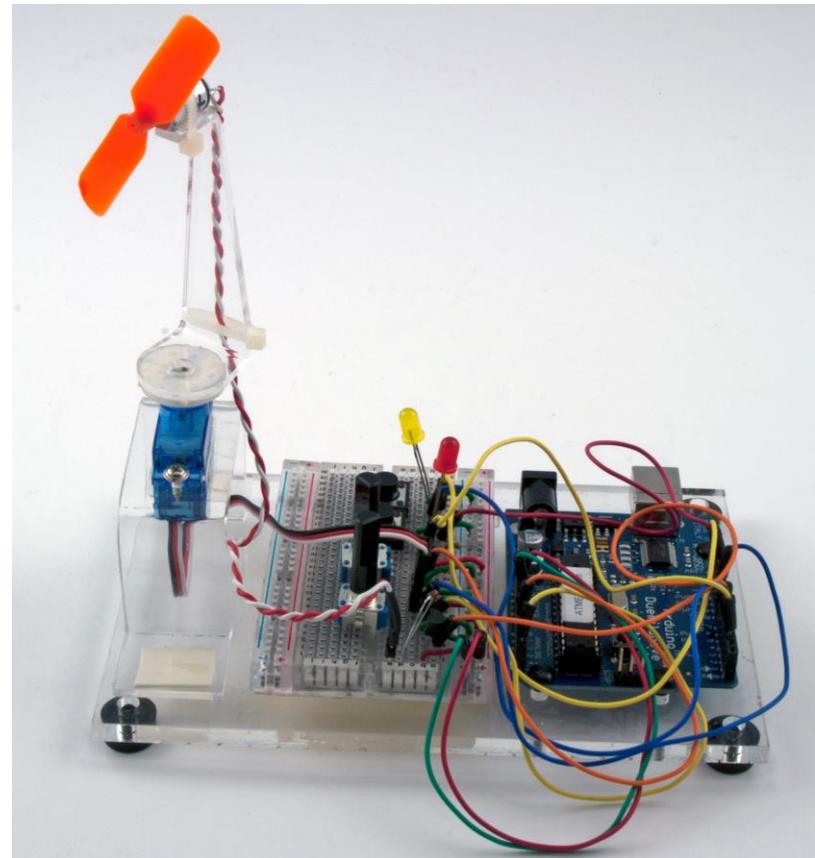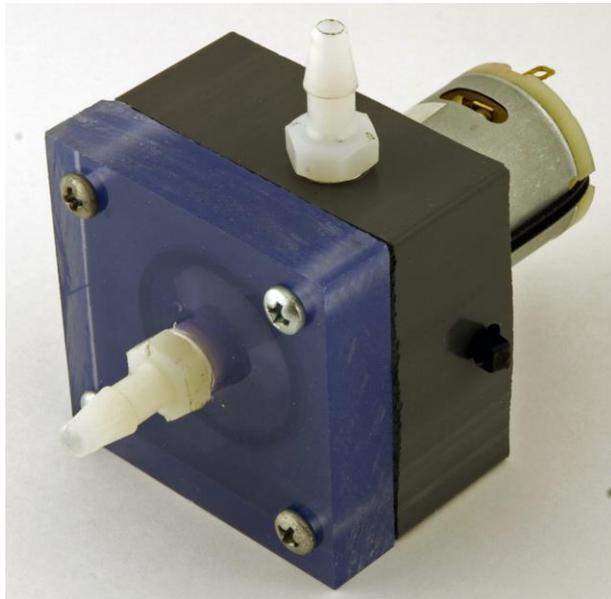
ME 121: Introduction to Systems & Controls

Topics

❖ Electrical Circuits and electromechanical components
  ‣ Transistors, relays & solenoids

❖ Programming Arduino

❖ Feedback control

❖ Data analysis
  ‣ Excel and MATLAB
  ‣ Elementary statistics

❖ Mechanical Fabrication
  ‣ Building 3D solid models of parts and assemblies
  ‣ Using machine tools and hand tools to fabricate parts
  ‣ Hand assembly of devices

❖ Engineering analysis
  ‣ Structured problem-solving and documentation
  ‣ Data analysis and plotting with Excel and MATLAB

ME 121: Introduction to Systems & Controls

Fish Tank Project

- ❖ Build a flow loop using the pump you made in ME 120
- ❖ Build and calibrate a salinity sensor
- ❖ Assemble the wiring harness for an LCD display panel
- ❖ Write an Arduino program to control salinity
- ❖ Create a waterproof temperature probe with a thermistor
- ❖ Create a simple electrical-resistance heater
- ❖ Write an Arduino program to control salinity and temperature
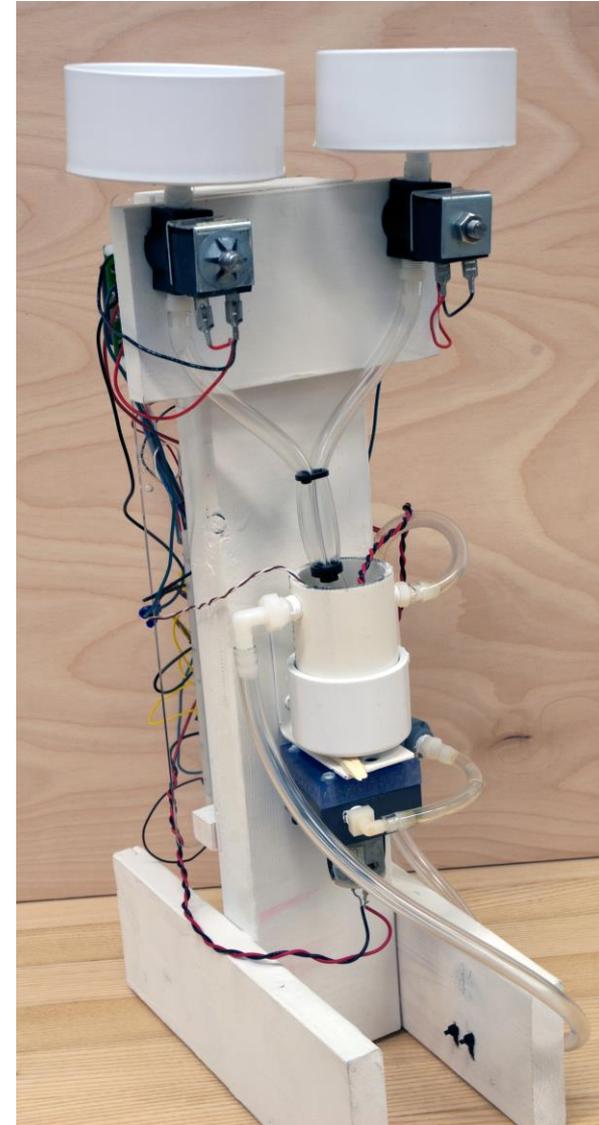
ME 122: Introduction to Design

Topics

- ❖ Analytical models of mechanical components
  - ‣ Statics, dynamics and strength of materials
- ❖ Introduction to engineering economics
- ❖ Design process and methodology
- ❖ Sensors for data gathering and control

ME 122: Introduction to Design

Final Project

- ❖ Identify a problem or opportunity that could be solved or met with a smart mechanical system
- ❖ Build a smart device that responds to its environment