ME 4232:
FLUID POWER CONTROLS LAB

Class #1
Introductions & Fluid Power Fundamentals
Professor: Jim Van de Ven

- Research in Energy Conversion & Storage

MEPS
Mechanical Energy
& Power Systems Laboratory
Introductions

• TAs: Paul Hilsen
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• Active Learning:
  “Tell me and I’ll forget;
  show me and I may remember;
  involve me and I’ll understand.” (Confucius)
Why Use Active Learning?

• Research shows it is effective!


Figure 3. Plot of class average pre-test and post-test FCI scores using a variety of instructional methods [52].
Class Agenda

• Introductions
• Fluid Power Introduction
• Syllabus
• Fluid Power Fundamentals
• Least Squares Fitting
• Summer Opportunities
• Course Goals
Peer Introductions

- Name Cards

2 min
- Meet Neighbor – Groups of 2
  - Name
  - Where they are from
  - Something interesting about them

8 min
- Introduce Neighbor to the Class
Fluid Power Introduction

- Power source (pump)
- Transmission (hoses, pipes carrying fluid)
- Control units (valves)

Bramah press (1795)

40,000 Ton Forging Press

- 1 N weight
- Actuator (cylinder, hydraulic motor)
Fluid Power Applications

- Automotive
- Aerospace
- Construction industry
- Lawn and garden
- Agriculture
- Robotics
  - Rescue
- Biomedical
- Mechanical testing
  - components / materials
  - structure
- Manufacturing
  - steel
  - injection molding
Applications:
Testing Equipment
Fluid Power Introduction

• Video:
  – Fluid Power: A Force for Change
Advantages /
Disadvantages / Challenges

Advantages:
• Power/Force Density
  – Hydraulic vs. Electric
• Precise Control
• Flexibility
• Robust
• Low-cost

Disadvantages:
• Leakage
• Non-linear
• Fire Hazard
• Contamination
• Efficiency

Challenges:
• Compact Energy Storage
• Compact Power Sources
• Efficiency
• Noise / Vibration
• Leakage

Both motors produce 1200 lb-ft torque at 400 RPM.
Local Perspective

• Local fluid power companies
  – Components:
    • Eaton Corporation, Eden Prairie
    • Sauer-Danfoss, Minneapolis
    • Continental Hydraulics, Savage
    • Parker Hannifin, Golden Valley
    • …
  – Systems:
    • MTS Systems, Eden Prairie
    • Toro Company, Bloomington
    • Caterpillar Paving
    • …

Center for Compact and Efficient Fluid Power
@ University of Minnesota
a NSF Funded Engineering Research Center
http://www.ccefp.org/
Syllabus + Course Site

- http://www.me.umn.edu/courses/me4232
- Website will be continually updated
- *the schedule and topics will change without notice
Lab Report Format

• **Introduction:** What you are trying to find out and why
• **Methods:** Explain how the question is answered
• **Results:** Results of the experiment
• **Discussion:** Explain and Interpret your results
Fluid Power Fundamentals
Needle Valve

\[ Q = C_d A_0 \sqrt{\frac{2}{\rho} (P_1 - P_2)} \]
Fluid Power Summer Opportunities

• REU – Research Experience for Undergraduates
  – Fluid Power Research in Academic Lab
    – Georgia Tech, University of Illinois in Urbana-Champaign, University of Minnesota, Milwaukee School of Engineering, North Carolina A&T State University, Purdue University, and Vanderbilt University

• Fluid Power Scholars Program
  – Paid Internship w/ Training Program
    – Caterpillar, John Deere, Sun Hydraulics, CNH and Eaton Corporation
    – http://www.ccefp.org/get-involved/students/fluid-power-scholars-program
Feedback – 2 minute writing

- ½ Sheet of Paper
- No Names

- What are your goals for this course?