Engineering Fundamentals
ENG1100 - Session 14B

Final Exam Review: DP & Ethics
Final Exam Topics

• Design Project
  – Spring Analysis
    • Type of relationship
  – Math Model
    • Length of String
    • Distance Traveled
    • Force Perp to end of MT arm (Ftrap)
    • Force at end of arm extension (Farm)
    • Tension in String
    • Motive Force
    • Net Motive Force
Spring Analysis Graph

- Use symbols to represent actual data points
- Use a line to represent predicted values (linear regression line)
- Use a legend
- Add a proper title and properly labeled axes

![Spring Analysis Graph](image-url)
As a Team

• **Dop** – how do you determine distance between 2 points? **Pythagorean Theorem**

• **Ls** – how do you determine length of one side of a triangle (not right triangle) given the opposite angle \((\theta)\) and two sides \((L_{arm}, Dop)\)? **Law of Cosines**

• **Alpha \((\alpha)\)** – how do you determine the angle of a triangle given 3 sides \((Ls, L_{arm}, Dop)\)? **Law of Cosines**
Rotational Motion & a Mousetrap Vehicle

- **Distance Traveled**: Relate Length of string pulled to distance traveled
Arc length vs Circumference

- **Arc length**: distance along the edge of a circle as related to the angle that distance covers
  
  \[ s = r \times \theta \]
  
  - \( s \) = length of arc
  - \( r \) = radius
  - \( \theta \) = angle in radians (1 revolution = \( 2\pi \) radians)

- **Circumference**:
  
  - distance around a circle
  
  \[ C = 2r\pi \]
  
  - \( C \) = circumference
  - \( r \) = radius
Caution

Spring Angle Measurements

• When you made measurements, you were "opening" spring. \( \theta \)
• For your vehicle design, your spring will be "closing". \( \beta \)

\[
180 - \theta = \beta
\]
As a Team

- Work on Derivation of F_{trap}
- Hint: Think Spring Analysis
Moments & a Mousetrap Vehicle

• Extended Mousetrap Arm

\[ F_{\text{Arm}} = F_{\text{trap}} \times \frac{L_{\text{trap}}}{L_{\text{Arm}}} \]
Tension in the String

- $F_{arm}$ is pulling the string
- What is the tension in the string, $T_s$
Forces

- Forces are vectors
  - Have magnitude and direction
- May break forces into their components
  - $(x$ direction, $y$ direction, $z$ direction)
- Because system is not accelerating, sum of forces in $x$, $y$ and $z$ directions are zero

\[ F = ma \quad a = 0 \quad \Sigma F = 0 \]
As a Team

• What is the tension in the string, $T_s$?
Motive Force

- Using Moments, derive $F_{\text{mot}}$. 

![Diagram showing forces on a wheel](#)
Friction & a Mousetrap Vehicle

- Air Resistance: neglected
- Static Friction: \( F_{fs} = \mu_s F_n \)
- Kinetic Friction of Vehicle: \( F_{fk} = \mu_k F_n \)
\[ F_f = \mu F_n = \text{Force due to Friction} \]

Where:
- \( F_f \) = force due to friction (N)
- \( F_n \) = force perpendicular to friction surface (N)
- \( \mu \) = coefficient of friction
  - Static or Kinetic
Final Exam Topics

• Ethics
  – Morals vs. Ethics
  – 6 Fundamental Canons of NSPE’s Code
  – Steps for analyzing ethical dilemma
  – Simple Tests
  – Be able to use analysis & codes to select best course of action
Ethics

• “consists of general and abstract concepts of right and wrong behavior culled from philosophy, theology, and professional societies” – Holtzapple (p. 527 of Eide)

• “guide to personal conduct of a professional” – Eide (p. 69)

• “set of behavioral standards that all engineers are expected to follow”
My Definition of Ethics

**Morals** are your personal standards for right and wrong.

- Comes from:
  - family/friends
  - religion
  - media
  - school/work

- They are the “little voice in your head”
- **Ethics** guide how a “moral person” will behave
- **Professional ethics** are established to transcend local, cultural or moral beliefs
Why do Engineers need to know about Ethics?

With **Knowledge & Skills**, engineers have the power to do great things. With this power, engineers have a tremendous responsibility to clients, individuals and society. Ethics help guide our decisions to ensure we act responsibly.
Becoming a Professional Engineer (PE)

• Receive an engineering degree from an acceptable institution
• Pass the Fundamentals of Engineering (FE) exam
  – 8 hour exam
  – May take during last semester of school
• Complete four years of engineering practice
• Pass the Principles and Practice exam
  – 8 hour exam
  – Problems in your area of specialty
The Ethical Engineer*

1. Protect the public safety, health, and welfare.
2. Perform duties only in areas of competence.
3. Be truthful and objective.
4. Behave in an honorable and dignified manner.
5. Continue learning to sharpen technical skills.
6. Provide honest hard work to employers or clients.
7. Inform proper authorities of harmful, dangerous, or illegal activities.
8. Be involved with civic and community affairs.
9. Protect the environment.
10. Do not accept bribes/gifts that would interfere with engineering judgment.
11. Protect confidential information of employer or client.
12. Avoid conflicts of interest.

*p.534 Eide/Holtzapple
NSPE Code of Ethics for Engineers

I. Fundamental Canons

• Engineers, in the fulfillment of their professional duties, shall:
  – Hold paramount the safety, health, and welfare of the public.
  – Perform services only in areas of their competence.
  – Issue public statements only in an objective and truthful manner.
  – Act for each employer or client as faithful agents or trustees.
  – Avoid deceptive acts.
  – Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.
Analyzing Ethical Issues

• Identify affected parties/stakeholders.
  – What are their rights and responsibilities?

• Identify ALL possible courses of action.
  – What are the social/political constraints of these actions?
  – What are the possible consequences of these actions?

• Do we need any additional information to make a good decision?

• Evaluate alternatives using basic ethical values.
Evaluating Alternatives

• Use the Code of Ethics from NSPE or other appropriate professional society
• Use basic ethical values, such as:
  – Honesty
  – Fairness
  – Civility
  – Respect
  – Kindness
• **Or, use a simple test...**
Tests for Evaluating Alternatives

- **Harm test:** Do the benefits outweigh the harms, short term and long term?
- **Reversibility test:** Would I think this choice was good if I traded places?
- **Colleague test:** What would professional colleagues say?
- **Legality test:** Would this choice violate a law or a policy of my employer?
- **Publicity test:** How would this choice look on the front page of a newspaper?
- **Common practice test:** What if everyone behaved in this way?
- **Wise relative test:** What would my wise old aunt or uncle do?
Professional Ethics

Liability

Individual Morals and Values

Society, Parents, Religion

U.S. Civil Law

U.S. Patent Law

Foreign Laws

Individual Morals and Values

Society, Parents, Religion

Individual Morals and Values

Society, Parents, Religion
Final Exam: What to study

- Previous Exams – stop by my office to study
  - Extra Office Hours
    - Sunday 4/29
      - 2pm-4pm Dillman 202
    - Monday 4/30
      - 10am-2pm Dillman 112C
      - 2pm-5pm Dillman 104A

- Notes: your own and/or from ENG1100 webpage
- Homework assignments