PHY 115
Professionalism in Science

Introduction to Engineering
Three Main Questions

1) What is engineering?
2) What do engineers do?
3) Why choose to study engineering?

The difference between scientists and engineers.

Scientists seek to explain physical phenomena through investigation of matter and energy.
Engineers use mathematics and science as tools to develop and produce products and processes for the betterment of society.

What is engineering?

The practical application of mathematics and science to create, design, test, improve, and develop knowledge, research, money, business, economics, and technology.

(Schiavone, 2002)

Engineering is a process that applies mathematics and physical science to the design and manufacture of a product or service for the benefit of society. This process is illustrated in the following diagram.

(Schiavone, 2002)
THE ENGINEERING PROCESS

IDEA $\rightarrow$ PRODUCT OR SERVICE $\rightarrow$ SOCIETY

Mathematics and Physical Science

Communication

What do engineers do?

Five traditional areas + two emerging areas

1) Mechanical engineering
2) Electrical engineering
3) Civil engineering
4) Chemical engineering
5) Industrial engineering
6) Materials engineering
7) Computer engineering

Other fields in engineering

8) Biomedical engineering
9) Environmental engineering
10) Aerospace engineering
11) Nuclear engineering
12) Mining & petroleum engineering
13) Agricultural and biosystems engineering
14) Manufacturing engineering
15) Ocean engineering/naval architecture
16) Architectural engineering
**Mechanical Engineering**

Mechanical engineering is concerned with the analysis, design, and development of structures, machines, devices, and mechanical systems. Mechanical engineers work in areas involved in:

- The design and development of machinery.
- The analysis of mechanical systems including the study of vibrations on structures.
- The design and development of manufacturing systems, as well as energy conversion systems.
- The design of heating, ventilation, and air-conditioning systems.

Mechanical engineering is very broad and can be classified into several areas.

- Solid mechanics
- Fluid mechanics
- Thermodynamics
- Mechanical design
Electrical Engineering

Electrical engineering covers all things electrical, with emphasis on electrical devices, electrical systems, and electrical energy.

Five major specialties of electrical engineering are:

1) Electric power engineering
2) Communications
3) Control systems engineering
4) Digital systems engineering
5) Electronics
Civil Engineering

Civil engineering involves planning, designing, constructing, operating, and maintaining of structures and facilities.

Seven specialties of civil engineering:

1) Construction engineering
2) Environmental engineering
3) Geotechnical engineering
4) Structural engineering
5) Surveying
6) Transportation engineering
7) Water resources engineering
Chemical Engineering

Chemical engineers are responsible for translating small-scale successes in the conception and development of new products in laboratories, into large-scale commercial realities for the benefit of society.

Six specialties of chemical engineering are:
1) Polymer engineering
2) Biotechnology
3) Process control engineering
4) Environmental engineering
5) Engineering management
6) Oil and natural gas
Industrial Engineering

Efficiency, industrial engineers are concerned with efficiency in the design, organization, implementation, and operation of the basic factors of production (materials, equipment, people, information, and energy).

Seven specialties of industrial engineering are:

1) Manufacturing
2) Work design
3) Ergonomics
4) Management decision making
5) Quality control
6) Facility design
7) Engineering management
Materials Engineering

Materials engineering has evolved into a separate area due to the rapid development and production of advanced materials (polymers, ceramic composites, and electronic materials). Engineers are involved in the production, processing, application, and design of these advanced materials.

Computer Engineering

Computer engineering has splintered away from electrical engineering. Computer engineers apply knowledge from both electrical engineering and computer science to design and implement systems in which the software and hardware are intimately integrated. The integration is critical to the success of the design.
The job of “being an engineer” can be classified in several ways:

- Analytical engineer
- Experimental engineer
- Design engineer
- Research engineer
- Test engineer
- Consulting engineer
- Engineering management
- Engineering professor
Why study engineering?

- Engineering is interesting and enjoyable.
- Engineering is personally and intellectually rewarding.
- Engineering is continually challenging.
- Engineering offers a wide variety of career options.
- Engineering offers financial security.
- Engineering is a “real-world playground” for mathematics and science.
- Engineering is very respectable and prestigious.
- Engineering allows for creativity.
- Engineering helps society.
Assignment 1

Engineering Success

1. What is engineering? Write down your definition of engineering and what you think the subject is about. Give some examples to justify your conclusions.

2. Write a 500-word description on the engineering or science discipline of your choice. Your choice should correspond with your career goal. Include the most important features of the discipline.

3. What kind of engineer do you hope to become — for example, an analytical engineer, an experimentalist, a professor, a test engineer, ...? Why?

4. Consider the following four courses/sequences:
   - Chemistry
   - Applied Statics and Dynamics
   - Calculus
   - Physics

   (a) Look in the WSC catalog for their descriptions.
   (b) List the formal prerequisites for each course.
   (c) Write down what you think are the most important prerequisite skills you learned in the formal prerequisites from above. If you have yet to take one of the formal prerequisites, ask a professor to help identify the necessary skills.

5. Complete the attached information form.
Name ________________________________________________________________
SS# ______________________________ email: ________________________________
Address ______________________________________________________________
City ___________________________ State _______________ Zip ________________

What is your current level of mathematics? _________________________________

Describe your science background. _________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________

Major:

☐ Chemical Engineering
☐ Civil Engineering
☐ Computer Engineering
☐ Electrical Engineering
☐ Industrial Engineering
☐ Mechanical Engineering
☐ Other ______________________________

Engineering school you wish to transfer to:

☐ South Dakota School of Mines and Technology
☐ South Dakota State University
☐ Iowa State University
☐ University of Nebraska
☐ Other ______________________________