PHY 115
Professionalism in Science

Engineering Ethics
What is Engineering Ethics?

Ethics is the study of the characteristics of morals.

Engineering ethics refers to the rules and standards governing the conduct of engineers in their role as a professional.

Is engineering a profession?

The attributes of a profession are:

- The work requires sophisticated skills, use of judgment, and discretion. The work is not routine and cannot be mechanized.
- Membership in the profession requires extensive “formal” education.
- The public allows for the existence of special societies or organizations that are controlled by members. These societies and organizations have some authority to set standards for admission into the profession, to set standards for conduct, and to enforce these standards.
- Significant public good results from the practice of the profession.

(Martin and Schinzinger, 1989)

Judgment as referred to in the definition above, means the making of significant decisions based on education and training.

Discretion may mean keeping confidentiality when comes to working with clients. It can also mean that the engineer is held in high regard, that he/she can make his/her own decisions (“use your own discretion”).
Importance of Studying Ethics

The main need for studying engineering ethics is to sensitize one to the important issues that he/she may eventually confront.

Origins of Ethics

Western ethical thoughts have been developed over the years in the Judeo-Christian tradition. Non-Western cultures have also developed similar ethics. Thus, it is not necessarily a societal or religious phenomenon.

Ethics is also strongly related to law. One must follow international, federal, state, and local laws.

Rules and regulations may also exist for professional societies and organizations. These societies and organizations may also have “Codes of Ethics and Conduct”.

National Society of Professional Engineers (NPSE)

Objections to Society Codes

Relatively few practicing engineers belong to professional societies. Members of societies are not aware of their codes of conduct. Members aware of the codes seldom consult them. Engineering codes may have internal conflicts. Codes may be coercive; they force members to comply with a “big stick” rather than with a “carrot” (Fleddermann, 1999, p 22).
Resolving Internal Conflict

An example of internal conflict in codes of ethics is where an employer orders an engineer to implement an unsafe design (Ford Pinto). The NSPE Codes of Conduct state in clause 1.4, that an engineer has a duty to his/her employer. But, they also state in clause 1.1 as well as the preamble, that public safety is also important.

Most codes have a hierarchy in their clauses and standards. In the NSPE codes, public safety is paramount, thus superceding duty to an employer.

Safety and Risk

Safety and risk tend to play center stage in many cases involving ethics. One cannot discuss safety without including risk. An engineer must decide how much risk is appropriate? How safe is safe enough?

Risk involves the possibility of suffering injury or harm. Safety can mean the absence of danger or risk.

Safety in terms of a safe design must meet four criteria.

1) A design must comply with applicable laws.
2) A design must meet the standard of “acceptable engineering practice”.
3) Alternative designs, that are potentially safer, must be explored.
4) Engineers must attempt to foresee all potential misuses of a product and design to handle them.
Safety should be embedded into the engineering design process. A six-step process to engineering design is:

1) Define the problem. This step includes determining the needs and requirements and often involves determining the constraints.
2) Generate several solutions. Multiple alternative designs are created.
3) Analyze each solution to determine the pros and cons of each. This step involves determining the consequences of each design solution and determining whether it solves the problem.
4) Test the solutions.
5) Select the best solution.
6) Implement the chosen solution.

(Wilcox, 1990)
Accidents and Safety

Three categories of accidents:

1) Procedural
2) Engineered
3) Systematic

Procedural accidents are most common and are the result of someone making a bad choice or failing to follow the appropriate procedure (for example: “pilot” error).

Engineered accidents are caused by flaws in the design. Failures in the choice of material, devices not operating properly, devices or parts not operating well under all circumstances.

Systematic accidents are difficult to describe and difficult to control. They occur as a result of complex technologies and the complex organizations necessary to operate the technologies.
Assignment 2

Engineering Ethics

Based on the NSPE Code of Ethics, answer the following true or false. Also, cite the clause in the codes that support your answer. Note: This ethics test is intended solely to test individual knowledge of the specific language contained in the NSPE Code of Ethics and is not intended to measure individual knowledge of engineering ethics or the ethics of individual engineers or engineering students.

1) Engineers in the fulfillment of their professional duties must carefully consider the safety, health and welfare of the public.

Clause: Art. 2.2.3.1

2) Engineers may perform services outside of their areas of competence as long as they inform their employer or client of this fact.

Clause: Art. 2.2.1.2

3) Engineers may issue subjective and partial statements if such statements are in writing and consistent with the best interests of their employer, client or the public.

Clause: Art. 2.2.1.1

4) Engineers shall act for each employer or client as faithful agents or trustees.

Clause: Art. 2.2.3.2

5) Engineers shall not be required to engage truthful acts when required to protect the public health, safety and welfare.

Clause: Art. 2.2.3.3

6) Engineers may not be required to follow the provisions of state or federal law when such actions could endanger or compromise their employer or their client's interests.

Clause: Art. 2.2.3.4

7) If engineers' judgment is overruled under circumstances that endanger life or property, they shall notify their employer or client and such other authority as may be appropriate.

Clause: Art. 2.2.3.5

8) Engineers may review but shall not approve those engineering documents that are in conformity with applicable standards.

Clause: Art. 2.2.3.6
9) Engineers shall not reveal facts, data or information without the prior consent of the client or employer except as authorized or required by law or this Code.

10) Engineers shall not permit the use of their name or associate in business ventures with any person or firm that they believe is engaged in fraudulent or dishonest enterprise, unless such enterprise or activity is deemed consistent with applicable state or federal law.

11) Engineers having knowledge of any alleged violation of this Code, following a period of thirty days during which the violation is not corrected, shall report thereon to appropriate professional bodies and, when relevant, also to public authorities, and cooperate with the proper authorities in furnishing such information or assistance as may be required.

12) Engineers shall undertake assignments only when qualified by education or experience in the specific technical fields involved.

13) Engineers shall not affix their signatures to plans or documents dealing with subject matter in which they lack competence, but may affix their signatures to plans or documents not prepared under their direction and control where the engineer has a good faith belief that such plans or documents were competently prepared by another designated party.

14) Engineers may accept assignments and assume responsibility for coordination of an entire project and shall sign and seal the engineering documents for the entire project, including each technical segment of the plans and documents.

15) Engineers shall strive to be objective and truthful in professional reports, statements or testimony, with primary consideration for the best interests of the engineer's client or employer. The engineer's reports shall include all relevant and pertinent information in such reports, statements or testimony, which shall bear the date on which the engineer was retained by the client to prepare the reports.

16) Engineers may express publicly technical opinions that are founded upon knowledge of the facts and competence in the subject matter.
17) Engineers shall issue no statements, criticisms, or arguments on technical matters that are inspired or paid for by interested parties, unless they have prefaced their comments by explicitly identifying the interested parties on whose behalf they are speaking, and by revealing the existence of any interest the engineers may have in the matters.

18) Engineers may not participate in any matter involving a conflict of interest if it could influence or appear to influence their judgment or the quality of their services.

19) Engineers shall not accept compensation, financial or otherwise, from more than one party for services on the same project, or for services pertaining to the same project, unless the circumstances are fully disclosed and agreed to by all interested parties.

20) Engineers shall not solicit but may accept financial or other valuable consideration, directly or indirectly, from outside agents in connection with the work for which they are responsible, if such compensation is fully disclosed.

21) Engineers in public service as members, advisors or employees of a governmental or quasi-governmental body or department may participate in decisions with respect to services solicited or provided by them or their organizations in private or public engineering practice as long as such decisions do not involve technical engineering matters for which they do not possess professional competence.

22) Engineers shall not solicit or accept a contract from a governmental body on which a principal or officer of their organization serves as a member.

23) Engineers shall not intentionally falsify their qualifications or actively permit written misrepresentation of their or their associate's qualifications. Engineers may accept credit for previous work performed where the work was performed during the period the engineer was employed by the previous employer. Brochures or other presentations incident to the solicitation of employment shall specifically indicate the work performed and the dates the engineer was employed by the firm.
24) Engineers shall not offer, give, solicit, or receive, either directly or indirectly, any contribution to influence the award of a contract by a public authority, or which may be reasonably construed by the public as having the effect or intent of influencing the award of a contract unless such contribution is made in accordance with applicable federal or state election campaign finance laws and regulations.

25) Engineers shall acknowledge their errors after consulting with their employer or client.

Peruse the Columbia Accident Report. Based on what you know about Safety, Risk, and Accidents, answer the following.

26) Is there any evidence of a procedural accident? Explain.

27) Describe the engineered accident, if there is one.

28) Describe the systematic accident that occurred.

29) The astronauts of the Columbia mission were aware of the dangerous nature of a space shuttle flight, so they can be thought of as having given informed consent to participating in a dangerous enterprise. What role should informed consent play in this case? Do you think that the astronauts had enough information to give informed consent to land the shuttle (or even to launch the shuttle)? Explain.

30) Engineering codes of ethics require engineers to protect the safety and health of the public in the course of their duties. Do the astronauts count as “public” in this context?