Ethics in Engineering

ECE 400
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Slide content based on Dr. Green’s previous ECE 400 lectures.
Introduction

- General Definition of Ethics
  - The study of the characteristics of morals
  - The study of the moral choices made by each person in his/her relationships with other people
Engineering Ethics

- The rules and standards which govern the conduct of engineers in their role as professionals
- Engineering ethics are similar to general ethics, but apply to the specific issues which affect engineering professionals
- Because of its importance to all engineers, ABET (Accreditation Board for Engineering and Technology) now mandates that ethics be included in the engineering curriculum
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<th>Ethics</th>
<th>Morals</th>
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<td>Truthfulness</td>
<td>Caring for others</td>
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<td>Character</td>
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<td>A higher power</td>
<td>Up-bringing</td>
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<td>Integrity</td>
<td>Being honest with yourself</td>
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Ethical Issues Faced by Engineers

- Public Safety
- Bribery and Fraud
- Environmental Protection
- Fairness
- Honesty in Research and Testing
- Conflicts of Interest
Why Study Engineering Ethics?

- Increased awareness of importance due to publicity surrounding high profile engineering failures.
- Engineering decisions can impact public health, safety, business practices and politics.
- Engineers should be aware of moral implications as they make decisions in the workplace.
Why Study Engineering Ethics?

- Study of ethics helps engineers develop a **moral autonomy**:
  - Ability to think critically and independently about moral issues
  - Ability to apply this moral thinking to situations that arise in the course of professional engineering practice

- Ethical problems in engineering are often complex and involve conflicting ethical principles. Engineers must be able to intelligently resolve these conflicts and reach a defensible decision
Personal versus Business/Professional Ethics

- **Personal Ethics:** Deals with how we treat others in our day-to-day lives

- **Business/Professional Ethics:**
  - Involves choices regarding relationships between organizations and other organizations, government, and groups of individuals
  - The complexity of these relationships often pose dilemmas not encountered in personal ethics
Ethics versus the Law

- Both engineering and business are governed by laws.
- Legal acts are not necessarily ethical.
- Acts which are ethical are not necessarily legal.
Nature of Ethical Problems

- Ethical problems are often open-ended – there is often no unique correct solution
- There will typically be a range of possible solutions to an ethical problem
- Deriving a good solution requires analytical skills that draw from a large body of knowledge
Differences Between Engineering and other Professions

- Most engineers work for large corporations and are **not self-employed**
- Engineers are neither as **well compensated** for their work nor as **highly regarded** as physicians or lawyers
- Engineering societies are **not as powerful** as those established for physicians (AMA) or lawyers (ABA)
The formal training period is less extensive for engineers than for other professionals.

Many individuals employed as engineers have not been licensed. Physicians and lawyers must be licensed by the state before they may practice their profession.
Engineering Codes of Ethics

- Express the rights, duties and obligations of members of the profession
- Do not express new ethical principles, but coherently restate existing standards of responsible engineering practice
- Create an environment within the profession where ethical behavior is the norm
- Not legally binding – an engineer cannot be arrested for violating an ethical code, but may be expelled from or censured by the engineering society
Objections to Existing Engineering Codes of Ethics

- Relatively few engineers are members of engineering societies. Nonmembers don’t necessarily follow the ethical codes.
- Many engineers either don’t know that the codes exist, or have not read them.
- The engineering codes often have internal conflicts, but do not provide means for their resolution.
- The codes can seem coercive at times.
Professionalism and Codes of Ethics

- Engineering Codes of Ethics have evolved over time
  - Originally concerned with:
    - Issues pertaining to the conduct of business
    - Employee/employer relations
  - Now: emphasize commitments to safety, public health, and environmental protection
Which Ethical Codes Apply?

- Depending on your discipline and organizational affiliations, you may be bound by more than one ethical code:
  - Disciple related (ASME, IEEE, etc)
  - National Society of Professional Engineers (NSPE)
  - Employee codes (corporation, university, etc)
  - Union codes

- Familiarity with the codes that apply to you, as well as a basic knowledge of ethical theory, can help to resolve conflicts among the different codes, and can help an engineer to make coherent ethical choices.
Understanding Ethical Problems

Four Common Ethical Theories

- Utilitarianism
- Duty Ethics
- Rights Ethics
- Virtue Ethics
Utilitarianism

- Attempts to achieve a balance between good and bad consequences of an action
- Tries to maximize the well-being of society and emphasizes what will provide the most benefits to the largest group of people
- Fundamental to many types of engineering analysis, including risk-benefit analysis and cost-benefit analysis
- Drawbacks:
  - Sometimes what is best for the community as a whole is bad for individuals
  - Impossible to know in advance which decision will lead to the most good
Duty Ethics

- Contends that certain acts should be performed because they are inherently ethical (e.g. honesty, fairness)

- This theory concludes that individuals who recognize their ethical duties will choose ethically correct moral actions

- Drawback – this method does not always lead to a solution which maximizes the public good
Rights Ethics

- Everyone has inherent moral rights
- Any act that violates an individual’s moral rights is ethically unacceptable
- Drawbacks:
  - How do we prioritize the rights of different individuals?
  - Rights ethics often promote the rights of individuals at the expense of large groups/society
Virtue Ethics

- Focuses on the type of person we should strive to be
- Actions which reflect good character traits are inherently right
- Actions which reflect bad character traits are inherently wrong
- Virtue ethics are tied more to individual behavior than to an organization
Issues Pertaining to Ethical Problem Solving

- **Factual Issues**
  - What the “facts” really are is often a point of contention - are the facts truly known?

- **Conceptual Issues**
  - Pertain to the meaning of actions
    - Is a gift intended to influence a decision?
    - Should certain information be regarded as proprietary?

- **Moral Issues**
  - Once factual and conceptual issues have been resolved, the moral issue in dispute often becomes apparent
Conflicts and their Resolution

- **Conflicts** are situations which present a choice between two or more moral values, each of which has its own merits.

- Three possible solution scenarios:
  - Choose the *ethical value which is stronger* (health and safety of public versus duty toward employer).
  - Find a *creative middle ground* usually involving a compromise agreed upon by all parties.
  - When all else fails, make the *best choice possible* based on available information.
Gifts and Bribes

- When does a gift become a bribe?
  - **Bribery**: Something offered or given to someone in a position of trust in order to induce him/her to act dishonestly.

- Where is the line which separates appropriate and inappropriate gifts?
  - Look for answers in written company policy and ethical codes.
Which of the following situations are acceptable?

- Accepting a gift from a sales representative:
  - Five dollar coffee mug
  - $350 crystal bowl engraved with company logo
  - Same bowl without engraving

- Attending a lunch meeting with a sales representative:
  - Each of you pays for your own meal:
    - At a fast food restaurant
    - At an expensive bistro
  - Sales representative pays for your meal:
    - At a fast food restaurant
    - At an expensive bistro
Risk, Safety, and Accidents

The most important duty of an engineer is to protect the safety and well-being of the public.

Definitions

- **Safety** – Freedom from damage, injury, or risk
- **Risk** – The possibility of suffering harm or loss. Similar to danger

The definitions of safety and risk are linked

- We engage in **risky behavior** when we do something that is **unsafe**
- Something is **unsafe** if it involves substantial **risk**
“Safety” and “free of risk”: Subjective

- Voluntary versus involuntary risk
- Short-term versus long-term consequences
- Expected probability
- Reversible effects
- Delayed versus immediate effects
Four criteria to help ensure that engineers produce safe designs

- Comply with applicable laws
- Meet the standard of accepted engineering practice
- Explore potentially safer alternative designs
- Attempt to foresee potential misuses of the product by the consumer, and design to minimize the risks associated with such misuse
Designing for Safety

- Define the problem, including the needs, requirements and constraints
- Generate several different solutions to the problem
- Analyze each solution to determine the pros and cons of each
- Test the solution
- Select the best solution
- Implement the chosen solution
Risk-Benefit Analysis

- Risks and benefits of a project are assigned dollar amounts.
- Most favorable ratio between risks and benefits is sought.
- This is often a difficult task:
  - Difficult to assign appropriate dollar amounts.
  - Technique can be misused (dishonest and subject assignment of costs).
Procedural Accidents

- Most common
- Often caused by bad choice, or failure to follow regulations or established procedures
- Can be reduced through increased training, more supervision, new laws or regulations, or closer scrutiny by regulators
Engineered Accidents

- Caused by flaws in the design of a product or system
- Engineering failures
- Engineered accidents
Systemic Accidents

- Harder to understand and control
- Characteristic of complex technologies and systems
- A series of minor mistakes or insignificant factors, can, if they occur under certain conditions, have catastrophic consequences
- Can be reduced by paying scrupulous attention to detail
Confidentiality and Proprietary Information

- Engineers are required to keep confidential certain information belonging to their employer or client.
- Such information, if released, might allow other companies or organizations to gain an unfair competitive advantage.
- Borderline area: how long does confidentiality extend once an employee moves to a new company?
Conflicts of Interest

- **Actual** Conflict of Interest
- **Potential** Conflict of Interest
- **Appearance** of Conflict of Interest

- Avoid conflicts of interest by consulting company policies and seeking second opinions
Ethics and Computers

- Computers make it easier to perpetrate crimes such as theft from an employer or financial institution.
- Privacy is more difficult to maintain because of the number of personal records stored on and transferred among computers.
- Computer hacking
- Computer viruses
Professional Rights

- Right to privacy
- Right to participate in activities of one’s own choosing outside of work
- Right to reasonably object to company’s policies without fear of retribution
- Right to due process
- Rights accorded to engineering professionals include the right of professional conscience: engineers may choose not to participate in activities which he/she considers to be unethical
Whistleblowing

Definition: The act by an employee which informs the public or higher management of unethical or illegal behavior by an employer or supervisor.

Types of whistleblowing:
- Internal
- External
- Anonymous
Whistleblowing

- When should whistle blowing be attempted?
  - Need
  - Proximity
  - Capability
  - Last resort
Whistleblowing

- When is an engineer morally obligated to blow the whistle?
  - You *may* blow the whistle if all of the previous conditions have been met
  - You *must* blow the whistle when you feel that there is great imminent danger of harm if the activity continues unchecked and if all of the previous conditions have been met
Ethics in Research and Experimentation

- Avoid preconceived notions about what the results of the research will be.
- Be open to changing the hypothesis when such action is indicated by the experimental evidence.
- Ensure that an objective frame of mind is maintained throughout the research process.
- Conclusions should be confirmed by as many colleagues as possible, and should not be prematurely announced to the public.
- The ultimate goal of research is not publicity and fame, but rather the discovery of new knowledge.
Reporting of research results

- An accurate assessment and interpretation of the experimental data must be given.
- “Massaging” data to improve results is not acceptable.
- *Proper* credit should be given to all who contributed to a particular project.
Summary

- Ethical Issues
- Personal versus Professional Ethics
- Engineering Ethical Concerns
- Ethical Theory
- Risk, Safety and Accidents
- Conflicts of Interest
- Ethics in Research
Contemporary Issues

- 9/11
- Mars exploration
- Alternative energy and the consequences
- Stadium implosion
- Failed bridge implosion
- Security issues
- Biomedical applications
- Class examples
Schedule

- April 14 – full attendance, please!
  - Paperwork, report order draw, discuss IRIS presentations, more contemporary issues
- April 26 and 28 – Final presentation, demo (TBD), rough draft online
- April 27 – IRIS meeting and demo
- Monday, May 3 – Final report online by noon
Thank you

- Questions?
- Comments?
- Snide remarks?