

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

# Introducing Engineering Ethics



## LECTURE # 01

# Morality

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- Morality is the set of standards every rational person wants everyone to follow.
  - Speaking truth.
  - Helping a friend.
  - Saving environment.
  - Being honest
  - Etc.

# What is Ethics?

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- Ethics is a set of morally permissible standards of a group that each member of a group wants every other member to follow.
- Being consistent with particular standards.

# Defining Engineering Ethics

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- Study of policies, decisions and the values that are morally desirable in engineering practice and research.

# Case Study 1

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*“Alice and Josh are two software engineering majors and are also very good friends. Josh is senior and Alice has already graduated and working as a software engineer at Alpha Software. Josh tells Alice that his account on university’s network is disabled and he needs to complete a paper for English class. He asks Alice to use Alice’s account at Alpha Software rather than a university account. Because Alice considers Josh a close friend, she provides him with her password. Josh log onto Alice account and completes his paper for English. He did not look at the content of any of Alice’s files, nor did he delete or modify anything. He simply wrote his paper and logs off the system.”*

# Types of Morality

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- Common Morality
- Personal Morality
- Professional Ethics

# Common Morality

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- Set of moral beliefs shared by almost everyone.
  - Do not lie.
  - Do not kill.
  - Do not steal.
  - Etc.



# Personal Morality

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- Also called **Personal Ethics**.
- Set of moral beliefs that a person holds.

# Professional Ethics

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- Set of standards adopted by the professionals insofar as they view themselves acting as professionals.
  1. Professional ethics is stated in a formal code focusing on the issues that are important in that profession.
  2. While being in professional relationship, professional ethics is supposed to take precedence over personal morality.
  3. Professional ethics differs from the personal morality in its degree of restriction of personal conduct.

# Role Morality

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- Moral obligations based on special roles and relationships.
  - Special obligations of parents to their children.
  - Obligations of political leaders to promote the well-being of citizens.
- Professional ethics is an example of Role Morality.

# Preventive Ethics – The Negative Face of Engg. Ethics

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- Oriented towards the prevention of professional malpractice and harm to public.
- Rules stated in the form of prohibition.
- Preventive Code of Ethics:  
*“Engineers shall not reveal facts, data, or information without the permission of the client or employer except as authorized by law or this Code.”*

# Aspirational Ethics – The Positive Face of Engg. Ethics

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- Oriented towards the obligation on professionals to use their knowledge and expertise to promote public good.
  - Develop new medical devices to save life.
  - Create automobiles that consume less fuel and are less polluting.
  - Airbags.

# THEMES OF ENGINEERING ETHICS

1. Engineering projects are social experiments.
2. Moral values are embedded in engineering.
3. Personal Commitment and meaning matters in engineering ethics.
4. Promoting responsible conduct is more important than punishing wrong-doing.
5. Myriad moral reasons generate ethical dilemmas.
6. Engineering ethics should explore both micro and macro issues.
7. Cautious optimism about technology.

# 1.Engineering as Social Experimentation

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- Explosion of *Columbia* space shuttle in 2003 killing 7 astronauts just after 82 seconds of its launch.
- Working hypothesis emerged: Piece of insulating foam from the external fuel tank stuck the left wing 82 seconds after launch.
- Several previous accidents were caused by the same reason.



# Ethical Issues needed to be considered

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- Why previous occurrences of accidents were not properly scrutinized?
- Why were additional hazards not considered?
- Had safety culture at NASA need not to be improved after *Challenger* disaster?
- Why was the accident that occurred in *Columbia's* last trip was not simulated to find out and prevent the appropriate causes?
- Why was the necessary time and money not given to the project?
- Why were the services of knowledgeable engineers not availed?
- Why were the procedures for ensuring safety not devised?

# What should be the Responsible Ethical behavior?

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- Engineers should:
  1. Accept and share the responsibility for their work.
  2. Exercise due care.
  3. Imaginatively foresee the hazards.
  4. Continuously monitor their projects when possible.
  5. Inform others of dangers.

## 2. Moral Values are Embedded in Engineering

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- Assignment given to the students at Harvey Mudd College:

*“Design a chicken coop that would increase chicken and egg production, using materials that were readily available and maintainable by local workers. The end users were the women of a weaving cooperative who wanted to increase the protein in their children’s diet in ways that are consistent with their traditional diet, while not appreciably distracting from their weaving.”*

# What should be the Responsible Ethical Behavior?

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- Even the small projects like this require ethical considerations from the following viewpoints:

- (1) Cage building
- (2) Human
- (3) Chicken
- (4) Environmental

# Cage Building

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- Identify the plausible building materials.
- Decide between cages or one open area.
- Design structures for strength and endurance.

# Human

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- Should be safely accessed by the villagers including ample head and shoulder room at entrances.
- Safe floor for bare feet.

# Chicken

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- Humane conditions for the chicken.
- Adequate space and ventilation for chicken.
- Comfort during climate changes.
- Convenient delivery of food and water.
- Protection from local predators.

# Environmental

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- Proper cleaning procedures need to be followed to prevent environmental damage.



### 3. Personal Commitment and Meaning

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- Designing of artificial lung.
- Desire for meaningful work, concern to make living, care for other human beings, need to maintain self-respect, recognition and appreciation the engineer's efforts brings excellence in engineering.
- Personal commitments should be integrated with shared responsibility in engineering.

## 4. Promoting Responsible Conduct and Preventing Wrong-Doing

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- Prevent wrong-doing in the first place.
- Implement procedures to deter fraud, theft, bribery, incompetence and other forms of immorality.
- Reasonable laws and government regulations should be devised setting penalties for careless conduct.
- Strengthen the connection between ethics and excellence in engineering, individuals and corporations.

## 5. Myriad Moral Reasons Generate Ethical Dilemmas

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- Ethical dilemmas are the situations in which moral reasons come into conflict.
- One cannot easily decide among the alternatives keeping in view the moral values.
- Indicate the presence of moral complexity.
- Moral problems can be solved by:
  - The good judgment.
  - Convincing power.

## Case Study 2

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*“A chemical engineer working in the environmental division of a computer manufacturing firm learns that her company might be discharging unlawful amounts of lead and arsenic into city sewer. The city processes the sludge into a fertilizer used by local farmers. To ensure safety, it imposes restrictive laws on the discharge of lead and arsenic. Preliminary investigations convince the engineer that the company should implement stronger pollution controls, but her manager insists the cost of doing so is prohibitive and technically the company is in compliance with the law.”*

# Ethical Dilemmas

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- The engineer is responsible for doing what promotes the success of her company.
- But she also has the responsibility to the local community that might be harmed by the effluent.
- She has the responsibilities to her family.
- Rights to pursue her career.

*What should she do?*

## 6. Explore Micro and Macro Issues

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- Both micro and macro issues need to be addressed by engineering ethics as both are interconnected.
- **Micro issues** concern the decisions made by the individuals and companies.
- **Macro issues** concern global issues such as:
  - Directions in technological development.
  - Laws that should or should not be passed.
  - Collective responsibilities of groups such as engineering professional societies.

## Case Study 3

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*“Ford Explorer is a Sport Utility Vehicle (SUV) and Bridgestone/Firestone provided tires for the Explorer. During the late 1990’s, reports began to multiply about the tread on Explorer tires separating from the rest of the tire, leading to blowouts and rollovers. By 2002, estimates were that 300 people had died and another thousand were injured and more recent estimates put the number much higher since then. Ford and Bridgestone blamed each other for the problem, leading to the breakup of century-old business partnership.”*

# Micro Issues

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- On account of Bridgestone:
  - Used flawed tire design.
  - Poor quality control.
- On account of Ford:
  - Chose tires with poor safety margin.
  - Relied on drivers to maintain proper inflation.



# Macro Issues

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- SUVs are the most harmful vehicles on the road.
- Cause instability because of their height that leads to rollovers.
- Far greater kill rate of other drivers during accidents.
- Reduce vision of drivers in shorter cars behind them.
- Blind other drivers' vision because of high-set lights.
- Excessively polluting.
- 1000 extra deaths are caused each year in SUVs rollover.
- 1000 extra people killed in car hits by SUVs than otherwise would be.
- Respiratory problems are caused by extra pollution caused by SUVs.

## 7. Cautious Optimism about the Technology

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- ***Pessimists*** view advanced technology as ominous and out of control:
  - (1) Pollution.
  - (2) Mass death on high-ways and high-tech wars.
  - (3) Fear of chemical weapons.
  - (4) Lingering threat of nuclear war.

# Optimistic View about Technology

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- Focuses on how technology improved our lives:
  - (1) Electrification
  - (2) Automobiles
  - (3) Airplanes
  - (4) Radio and Television
  - (5) Internet
  - (6) Air-conditioning and refrigeration
  - (7) Health technologies
  - (8) Household appliances
  - (9) Laser etc.

# Cautious Optimism

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- Being cautiously optimistic is fair enough.
- Optimism focuses on advance technological benefits that should really be appreciated.
- Being cautious requires that appreciation should be accompanied by sober realism about dangers.

# The End