

Engineering Ethics is the study of decisions, policies, and values that are morally desirable in engineering research and practice. The primary objective of this field is to analyze the ethical principles that engineers must follow in their engineering projects. Engineers have significant influence over technological development, public safety, and environmental sustainability. Therefore, ethical practices are essential in making decisions that have noticeable impacts on the society and the environment. In this detailed tutorial, we have explained the core topics in engineering ethics, which are important for engineering students and practicing engineers. It can help engineers to understand the principles, responsibilities, and challenges that they face in their real-world engineering practices.

What is Ethics and Its Types?

Ethics is nothing but a subdomain of philosophy that deals with investigation of the moral principles governing/controlling the behavior of a person. It is sometimes also known as Moral Philosophy. Therefore, we can state that ethics is one that evaluates human actions and their values.

Ethics systematizes, defends, and evaluates the right and wrong behavior of a person.

The study of ethics is often categorized into the following three main branches –

- **Meta Ethics** – This branch deals with understanding the nature of ethics and moral reasoning. It explains the origin and meaning of ethical concepts.
- **Normative Ethics** – This branch of ethics map out principles that teach us how we should live and act in an ethical manner.
- **Applied Ethics** – This branch of ethics provides principles and tools to analyze and resolve issues concerned with morality of specific actions, practices, and real-world problems. Examples of applied ethics include engineering ethics, business ethics, biomedical ethics, etc.

What is Engineering Ethics?

The system of moral principles that applies to the engineering practices and researches is termed as engineering ethics. This field analyzes and sets the responsibilities and moral duties by engineers to profession, society, clients, and environment.

Engineering ethics is not limited to comply with regulations only, but it is an obligation to public advantage, environmental sustainability, and morality in professional actions. Therefore, it is always advisable to engineers that they must adhere to principles of engineering ethics to make informed decisions, positively impact the society, and avoid destructive consequences of ethics.

Problem Solving in Engineering Ethics

Most times engineers find themselves in a conflicting position. Let us understand this with an example. Consider an electrical engineer working on a project of high-voltage power line installation to supply electricity in remote areas. This project is dedicated to enhance the lives of several thousand people by providing reliable electric supply and hence improved education, healthcare, and economic support.

However, when the project reaches the implementation stage, the engineer can face several ethical problems. For example, people living in the nearby areas of planned route for the power line could have health issues due to electromagnetic radiation generated by the power line, or they may meet accidents like electric faults or line collapse in bad weather and get injured. Electrical accidents sometimes cause loss of life as well.

In this kind of situations, the engineer has a challenge to either go with the same design and route which fulfil the timeline and budget of the project but have severe risks to community or he makes changes in the design or routes of the power line that may increase the project cost and time required. In such situations, engineering ethics helps the engineer to make informed decisions and take best actions.

The engineer can follow these steps to solve the problem ethically –

Step 1 – First of all, identify the ethical problems in the project and collect all relevant facts.

Step 2 – Analyze the pros and cons in the project and pick the best set of actions.

Step 3 – Analyze the balance of safety and practicality, and make implementation decisions.

Step 4 – Once the actions decided, the engineer should explain them to the community and starts the project implementation.

Importance of Engineering Ethics

Engineering ethics is very important, as it provides an effective set of duties and responsibilities for engineers to make informed decisions. Engineering ethics provides a way to ensure public safety, environmental security, and morality in engineering activities and the profession.

Here is a list of some of the key points that highlight why engineering ethics is important –

- Engineering ethics helps engineers to uphold the public safety and welfare as their first priority.
- Engineering ethics provides a guidance for making moral decisions that benefit society.
- Engineering ethics helps in maintaining society's trust in engineers that they will develop safe, effective, and sustainable technological solutions.
- Engineering ethics also plays a vital role in identifying hazards in engineering activities and reducing them.
- Engineering ethics also encourages engineers to develop designs that have minimal impacts on the environment and promote sustainable development.
- Engineering ethics develops a culture of integrity and responsibility within the engineering profession and it motivates engineers to maintain high standards, respect, and transparency in their work.

Why Do Engineers Need to Learn the Principles of Ethics?

Engineers play a critical role in the society, and their work affects the public safety, environment, technological aspects, and economics. Therefore, it is needed that engineers must follow principles of ethics in their profession because of the following reasons –

- Maintain public safety and welfare
- Make decisions responsibly
- Protect the environment and promote sustainable development
- Maintain integrity in the profession and build public trust
- Maintain accountability and professionalism
- Resolve challenges that arise with technological development
- Helps in personal and professional development, etc.

Advantages and Disadvantages of Engineering Ethics

The following table highlights some of the key pros and cons of the engineering ethics –

Engineering Ethics - Advantages	Engineering Ethics - Disadvantages
It helps ensuring safety, health, and welfare of public.	Sometimes, the principles of engineering ethics are not found suitable to apply in specific situations.
It encourages engineering practices that minimize the environmental impacts.	Engineering ethics becomes a cause of pressure on engineers when there is a tension between ethical standards and business goals.
It builds public trust on engineers and their services.	In an unethical corporate environment, engineering ethics becomes challenging for engineers and it may cause job loss to them.

It helps engineers to avoid legal issues, conflicts of interest, negligence, and frauds.	Traditional engineering ethics is limited in modern situations.	
It creates a culture of fairness, respect, and equality in the profession.	Engineering ethics is difficult to keep up-to-date with rapid technological advancement.	

Variety of Moral Issues in Engineering Ethics

There are a variety of moral issues which arise from a number of situations that engineers face in their profession. These moral issues are often categorized into the following two main types –

Macro-Ethical Issues

In engineering ethics, those **moral issues that affect the entire society at a large-scale** are termed as **macro-ethical issues**. These issues are mainly related to responsibility of the engineering profession to the society.

Common examples of macro-ethical issues include environmental impacts, human health issues, social justice, negative impacts of technology on social values, etc.

Micro-Ethical Issues

These are moral issues that **engineers face everyday in their profession**. Hence, micro-ethical issues are related to **engineers personal integrity, ethical responsibilities** to employers, colleagues, and clients.

Examples of micro-ethical issues include misbehave with workers, misuse of others intellectual property, unfair relationships with clients, issues associated with health and safety of public and workers, etc.

Applications of Engineering Ethics

The primary application of engineering ethics is to develop honesty and integrity in engineers behavior to follow in their profession.

Listed below is a set of examples highlighting the applications of engineering ethics, from academics to profession –

- Engineering ethics is studied as a subject in academics to develop honesty and responsibility in students, which is very important for their future careers..
- Engineering ethics teaches engineering professionals to balance between personal and professional ethics.

- Engineering ethics is used to identify and respond to ethical dilemmas in the profession..
- Engineering ethics teaches engineers to respect others intellectual property..
- Engineering ethics also helps companies to understand their obligations toward society and community.