Professional Ethics in Engineering

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Professional Ethics in Engineering

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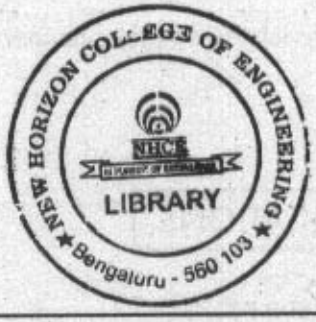

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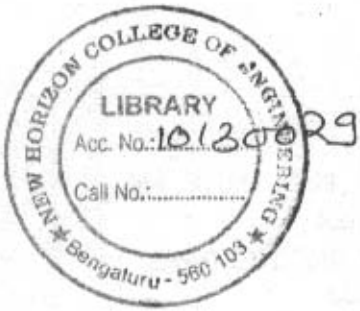
First Edition : Jan 2015
Revised Edition : Jan 2016



Price : **Rs.180/-**

CHARULATHA PUBLICATIONS
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ACKNOWLEDGEMENT

We express our deep sense of gratitude to our **Dr. Mohan Manghnani**, Chairman of New Horizon Educational Institutions and **Dr. Manjunatha**, Principal of New Horizon College of Engineering, Bangalore for their constant-continuous encouragement, valuable criticisms and pleasant relationship during the course of writing this book. The support they have given in matters, both academic and otherwise is greatly acknowledged.

We would like to express our gratitude to many people who saw us through this book; to all those who provided support, talked things over, read, wrote, offered comments, allowed us to quote their remarks and assisted in the editing, proof reading and design.

We would like to thank the editorial team of for helping us in the process of review the manuscript, selection and editing. We also would like to thank **Mr. M. R. Bharathi** for enabling us to publish this book.

Our respectful thanks are extended to our parents. Above all we want to thank our family, who supported and encouraged us in spite of all the time it took us away from them. It was a long and difficult journey for them. We thank them for their patience, moral support and cooperation.

We wish to thank all the faculty members of New Horizon College of Engineering for their motivation, encouragement and support rendered during the course of writing this book.

This book is a dedication to my father

Who always supported me in my professional life.

P. BABUCHANDRAN

PREFACE

I am very much pleased to bring this book "Professional Ethics In Engineering", for Engineering and Technology studies. This book is based on Anna University syllabus. This book has been written in simple language, so that students can easily observe the concepts, with numerous real time examples for better understandability. Another feature of this book is, it contains ten Anna University Question papers solved and available in the Appendix 2, of this book.

This book is written with the main objective to train the students with the Moral principles, and Ethical Standards, and to understand the basic human values, to behave with utmost responsibility, to the society, as well as in their profession.

This book deals with the characters that an engineer should have, in their profession such as responsibility, autonomy, authority, accountability, etc., Some of the global issues discussed in this book are, Discrimination, Engineers in weapons development, International Rights for Engineers. There are nine case studies discusses in Appendix 1, helps to review the past technological failures, and learn lessons from the previous disasters, so that, they can be avoided in future Technology development.

I hope, this book will be useful to learn the professional codes and students can have their ethical behavior developed.

Syllabus

GE6075 - PROFESSIONAL ETHICS IN ENGINEERING

UNIT I HUMAN VALUES

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS

Senses of „Engineering Ethics" – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination

UNIT V GLOBAL ISSUES

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility

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UNIT - 4 SAFETY RESPONSIBILITIES AND RIGHTS

UNIT - 5 GLOBAL ISSUES

1
UNIT

HUMAN VALUES

1.1. INTRODUCTION

Human values are the virtues that guide us to take into account the human element when one interacts with other human beings. They are the many positive dispositions that create bonds of humanity between people and thus have value for all of us as human beings.

Human values are the principles, standards, convictions and beliefs that people adopt as their guidelines in daily activities. Principal human values are the foundation on which professional ethics are built. They are a set of consistent measures and behaviours that individuals choose to practice in the pursuit of doing what is right or what is expected of them by society. Most laws and legislation are shaped by human values.

1.2. MORALS, VALUES AND ETHICS

1.2.1. Morals

Moral is concerned with the principles of right and wrong behaviour. It represents the act of holding or manifesting high principles for proper conduct. Moral can be considered as a lesson that can be derived from a story or experience.

Moral values are relative values that protect life and are respectful of the dual life value of self and others. The great moral values, such as truth, freedom, charity, etc., have one thing in common. When they are functioning correctly, they are life protecting or life enhancing for all.

Morality is the quality of being moral: that which renders an action right or wrong; also it is the practice of moral duties apart from religion. Simply Morals refer to an individual's own principles regarding right and wrong.

Morals can also be referred as Descriptive Ethics. It is a study of human behaviour as a consequence of beliefs about what is right or wrong, or good or bad, insofar as that behaviour is useful or effective. In a sense, morals are the study of what is thought to be right and what is generally done by a group, society, or a culture.

In general, morals correspond to what actually is done in a society.

1. Morals are best studied as psychology, sociology, or anthropology. Different societies have different moral codes.
2. Morals are a descriptive science; it seeks to establish "what is true" in a society or group.
3. Often morals are considered to be the shared ideals of a group, irrespective of whether they are practiced.
4. In the sense of descriptive ethics or morals, different persons, groups, and societies have different moral standards. This observation is seen as true by all sides.

1.2.2. Values

Values can be defined as principles or standards of behaviour; one's judgement of what is important in life. Value is the regard that something is held to deserve; the importance, worth, or usefulness of something.

What are Values?

According to the dictionary, values are "things that have an intrinsic worth in usefulness or importance to the possessor," or "principles, standards, or qualities considered worthwhile or desirable."

However, it is important to note that, although we may tend to think of a value as something good. We can understand the nature of a value by asking the questions "How is it good?" or "Good to whom?" The "good" can sometimes be just a matter of opinion or taste, or driven by culture, religion, habit, circumstance, or environment, etc.

Again, almost all values are relative. The exception, of course, is the value of life. Life is a universal, objective value. Life is also a dual value i.e., we value our own life and the lives of others also.

1.2.3. Ethics

Ethics refer to the moral principles that govern a person's behaviour or the conducting of an activity. It is the branch of knowledge that deals with moral principles. It also refers to rules provided by an external source, e.g., codes of conduct in workplaces or principles in religions.

What is Ethics?

A person who knows the difference between right and wrong and chooses right is moral. A person whose morality is reflected in his willingness to do the right thing, even if it is hard or dangerous is ethical.

Ethics are moral values in action. Being ethical id an imperative because morality protects life and is respectful of others. It is a lifestyle that is consistent with human equality and the inalienable right to life.

1.2.3.1. TYPES OF ETHICS

a) Descriptive ethics / morals

b) Normative ethics / prescriptive ethics

c) Metaethics / analytical ethics

a) Descriptive Ethics or Morals: A study of human behaviour as a consequence of beliefs about what is right or wrong, or good or bad, insofar as that behaviour is useful or effective.

b) Normative Ethics or Prescriptive Ethics: The study of moral problems which seeks to discover how one ought to act, not how one does in fact act or how one thinks one should act.

More specifically, (normative) ethics is the discipline concerned with judgments of setting up norms for the following queries.

a. When an act is right or wrong. e.g., is it wrong to litter on campus

b. What kinds of things are good or desirable.

c. When a person deserves blame, reward, or neither.

c) Metaethics or Analytical Ethics: The discipline concerned with elucidating the meaning of ethical terms or the discipline concerned with the comparison of ethical theories. If one can develop a set of principles for distinguishing between good and bad conduct, we must be able to understand what "good" means.

MORALS, VALUES & ETHICS

Morals describes the goodness or badness or right or wrong of actions

Values describe individual or personal standards of what is valuable or important.

Ethics describes a generally accepted set of moral principles

1.3. INTEGRITY

Integrity is the quality of being honest and having strong moral principles; moral uprightness. It is generally a personal choice to uphold oneself to consistently moral and ethical standards.

In ethics, integrity is regarded by many people as the honesty and truthfulness or accuracy of one's actions.

When we discuss on behaviour and morality, an individual is said to possess the virtue of integrity if the individual's actions are based upon an internally consistent framework of principles. These principles should uniformly adhere to sound logical axioms or postulates.

One can describe a person as having ethical integrity to the extent that the individual's actions, beliefs, methods, measures and principles all derive from a single core group of values.

An individual must therefore be flexible and willing to adjust these values in order to maintain consistency when these values are challenged; such as when an expected test result fails to be congruent with all observed outcomes. Because such flexibility is a form of accountability, it is regarded as a moral responsibility as well as a virtue.

1.3.1. What The Word 'Integrity' Means?

In general, integrity is a concept that can be used in relation to anything that can be damaged. The Latin 'integritas' from which the English word 'integrity' derives generally denotes 'the undiminished or unimpaired condition of a thing'.

A thing that has integrity is as good as it can be and cannot be improved. Since, per definition, the worse is to be avoided and the better to be preferred, the state of full integrity is a state that ought to be preserved whenever possible, that is, when there is no good reason for not preserving it. In other words, if all other things are equal, integrity is preferable to non-integrity. Thus any action that leads to a loss of integrity is in need of justification.

1.3.2. Various Types Of Integrity

Every object in this world has some means of integrity which is to be maintained and not to be spoiled. The following are some forms of integrity which is also to be followed to lead an ethical life, since ethics and integrity are closely bonded together.

1. Personal Integrity
2. Professional Integrity
3. Business Integrity
4. Academic Integrity
5. Research Integrity

1) Personal Integrity

In everyday life, the term integrity is most commonly used in the sense of personal integrity. Persons are said to have integrity or not, or to have more or less integrity. A person possessing integrity cannot be bribed, is honest, truthful, i.e., says what she believes and acts in accordance with what she says. A person possessing integrity is trustworthy; he / she do not fall apart in a real self and an apparent self. When we say that someone has integrity, we usually mean it as a compliment.

2) Professional Integrity

Integrity is essential for maintaining engineering practice excellence and for keeping the public's trust. Integrity characterizes both individuals and the institutions in which they work.

The concept of integrity cannot, however, be reduced to a simple definition. When used as a virtue term, 'integrity' refers to a quality of a person's character. Integrity literally means moral 'wholeness,' a single sense of self across a wide range of circumstances.

3) Business Integrity

Business integrity is the reliability with which the business undertakes its transactions with the various parties with which it interacts. It is the soundness and honesty with which it conducts its business transactions and the relationship that it promotes with all parties with which it interacts.

The values of honesty and integrity are the foundation of an organization's reputation. So, in addition to the personal integrity that each employee brings to work at the company, they need to demonstrate organizational integrity – ensuring that all of their combined efforts align with organizational values and commitments. Integrity and ethical behavior are guiding forces behind our personal and professional conduct.

4) Academic Integrity

Honesty as an engineer begins with honesty in studying to become an engineer. Studies of colleges and universities reveal alarming statistics about academic integrity. Integrity in research is about promoting excellence (high quality) in pursuing truth, and this positive emphasis on excellence should be kept paramount in thinking about honesty in research.

5) Research Integrity

Research should be guided by what Richard Feynman calls a kind of utter honesty, a kind of leaning over backwards.

For example, if you're doing an experiment, you should report everything that you think might make it invalid, not only what you think is right about it: other causes that could possibly explain your results; and things you thought of that you've eliminated by some other experiment, and how they worked to make sure the other fellow can tell they have been eliminated.

1.4. WORK ETHIC

Work ethic is a value based on hard work and diligence. It is also a belief in the moral benefit of work and its ability to enhance character.

1.4.1. Understanding Work Ethics

The term Work Ethic is very difficult to explain in just a couple of sentences. However, in simple words, work ethics are standard measures that control all functioning in a professional environment. This means, as an employee you are expected to be honest, sincere and diligent about the work you are assigned. The practices you opt for (to finish the work) should be 'clean', acceptable and should abide by concerned laws.

On smaller grounds, you should be understanding, just and true towards other colleagues. As an employee, you should be perceived as hardworking, reliable, honest, diligent and worthy of the monetary compensation you receive.

1.4.2. Five Characteristics of a Good Work Ethic

In organizations there may be two kinds of employee, some individuals try to get by doing

as little work as possible; others possess a dedication that leads them to give it their all every day. People who possess a strong work ethic embody certain principles that guide their work behaviour, leading them to produce high-quality work consistently.

The following five characters ensure the possession of work ethic in an employee;

a) Reliability

b) Dedication

c) Productivity

d) Co-operation

e) Character

a) Reliability

Reliability goes hand in hand with a good work ethic. If individuals with a good work ethic say they are going to attend a work function or arrive at a certain time, they do, as they value punctuality.

Individuals with a strong work ethic often want to appear dependable, showing their employers that they are workers to whom they can turn. Because of this, they put effort into portraying and proving this dependability by being reliable and performing consistently.

b) Dedication

Employees with a good work ethic are dedicated to their jobs and will do anything they can to ensure that they perform well. Often this dedication leads them to change jobs less frequently, as they become committed to the positions in which they work.

They also often put in extra hours beyond what is expected, and truly dedicate themselves to their positions.

c) Productivity

Since they work at a consistently fast pace, individuals with a good work ethic are often highly productive.

They commonly get large amounts of work done more quickly than others who lack their work ethic, as they don't quit until they've completed the tasks with which they were presented.

This high level of productivity shows the fact that these individuals want to appear to be strong workers. The more productive they are, the more beneficial to the company they appear to those managing them.

d) Cooperation

Cooperative work can be highly beneficial in the business environment, something that individuals with a strong work ethic know well. Because they recognize the usefulness of cooperative practices such as teamwork they often put an extensive amount of effort into working well with others.

These individuals commonly respect their bosses enough to work with any individuals with whom they are paired in a productive and polite manner, even if they do not enjoy working with the individuals in question.

e) Character

Individuals with a good work ethic often also possess generally strong character. This means they are self-disciplined, pushing themselves to complete work tasks instead of requiring others to intervene.

They are also often very honest and trustworthy.

To demonstrate their strong character, these workers embody these positive traits daily, likely distinguishing themselves from the rest.

1.4.3. Factors that Demonstrate a Strong Work Ethic

A work ethic is a set of moral principles an employee uses in his job. Certain factors come together to create a strong work ethic. To experience and maintain a good as well as strong work ethics in an organization, the following five mandatory factors are to be considered. These are the factors which influence an employee's sincerity, and dedication in the work assigned to him, also strengthens his career and adds in his responsibilities.

A strong work ethic can improve your career - A strong work ethic is vital to a company achieving its goals. Every employee, from the CEO to entry-level workers, must have a good work ethic to keep the company functioning at its peak.

Integrity - stretches to all aspects of an employee's job. An employee with integrity fosters trusting relationships with clients, co-workers and supervisors. Co-workers value the employee's ability to give honest feedback. Clients trust the employee's advice. Supervisors rely on the employee's high moral standards, trusting him not to steal from the company or create problems.

Sense of Responsibility - A strong sense of responsibility affects how an employee works and the amount of work she does. When the employee feels personally responsible for her job performance, she shows up on time, puts in her best effort and completes projects to the best of her ability.

Emphasis on Quality - Some employees do only the bare minimum, just enough to keep their job intact. Employees with a strong work ethic care about the quality of their work. They do their best to produce great work, not merely churn out what is needed. The employee's commitment to quality improves the company's overall quality.

Discipline - It takes a certain level of commitment to finish your tasks every day. An employee with good discipline stays focused on his goals and is determined to complete his assignments. These employees show a high level of dedication to the company, always ensuring they do their part.

Sense of Teamwork - Most employees have to work together to meet a company's objectives. An employee with a high sense of teamwork helps a team meet its goals and deliver quality work. These employees respect their peers and help where they can, making collaborations go smoother.

1.4.4. How to Increase Employee Work Ethic

A work ethic is typically something ingrained within a person. There are, simply put, lazy people who are impossible to motivate. However, other factors, both economical and psychological, can affect an employee's work ethic. Most people can be encouraged to greater performance, once the right motivating factors are found. This can be a process of trial and error because each individual may have different motivators. However, there are some basic guidelines you can follow to increase employee work ethic.

Step 1: Expect your managers to set a good example.

Make sure they are serving as role models for the rest of your employees.

Step 2: Create a public recognition system.

Rewarding an employee's good work ethics can be a great motivator for other employees who may not be as productive.

Employee of the month competitions and special rewards for those who do their job well may encourage those with a poor work ethic to try harder. Human beings thrive on recognition and feeling appreciated, and these are very powerful motivating factors.

Step 3: Set clear goals and milestones.

In some cases, employees may feel overwhelmed with a project if they are not entirely sure how to complete it or if it looks insurmountable.

Break apart projects into tasks that have clear goals. Set milestones with clear target dates so employees know exactly what you expect of them and how long they have to complete the task.

Step 4: Monitor potential troublemakers.

Almost every office has at least one person who is there for the pay check and not much else. These people can cause dissension among the ranks and bring down not only the morale of the rest of the staff, but also the productivity levels for the company.

Weed through new applicants to make sure they will have job dedication. Monitor current troublemakers, set strict guidelines they must follow or encourage them to seek employment elsewhere.

Step 5: Create a monetary award system.

Some employees will be motivated only by the promise of receiving a bonus or a raise if they complete certain tasks and improve their performance. While not all companies may have the resources to give large monetary awards to their employees, even simple gift card challenges and free products can encourage lackadaisical employees.

1.4.5. Negative Work Ethic

Definition

Negative work ethics may be the behaviour of a single individual or something more systematic; regardless of the specifics, identifying the signs is the first step toward correcting it.

Companies like to promote positive work ethics because it needs results in happier and more productive employees. Just as it is important to understand a positive work ethic, however, it is equally important to recognize the signs of a negative work ethic.

1.4.6. Negative Influences of Bad Work Ethics

Lack of Productivity

The most obvious sign of a negative work ethic is a lack of productivity. Lack of productivity costs the company time and money: essentially paying the employee for doing nothing.

Attendance

A positive work ethic means showing up on time every time, and using sick days for their designated purpose rather than a vacation by proxy. A negative work ethic, on the other hand, looks to get the most out of the system.

A good worker, for instance, may arrive late every once in a while, but also stays late to make up the time. A bad worker will assume that showing up late is normal, and do so beyond the range of what the company considers acceptable.

Politics

Every company experiences a certain amount of office politics, as different departments compete for different resources and personal peccadilloes enter into otherwise professional relationships.

Someone with a negative work ethic, however, may let office politics consume him: stoking the fires of discontent around a perceived rival and worried more about his comparative standing than the well-being of the company as a whole. Such employees might even instigate political crises, forcing senior management to spend time and resources calming everyone down rather than getting along with the business at hand.

Esprit de Corps

A good company seeks to foster camaraderie and loyalty among their workers: making them feels like family members as much as employees toiling for a salary. Someone with a negative work ethic, however, fails to engage in office esprit de corps. It may be a repeated refusal to participate in company activities such as picnics or mixers.

1.4.7. How to Deal with Bad Work Ethics in Coworkers

One employee's bad work ethic can hamper productivity throughout the workplace. A work ethic is a set of values people have about the benefits and importance of working hard and being productive. Values are subjective, so a co-worker doesn't necessarily have a bad work ethic if his opinions about working aren't in line with yours.

However, you should address a fellow employee's work ethic if he's making it difficult for you to complete your job duties. Address the problem with the employee directly first, but sometimes you have to involve a manager.

Step 1

- Avoid the temptation to wait for a co-worker to figure out that his bad work ethic is affecting you.
- Speak to the co-worker in private, and explain the problem by giving specific examples of how his failure to complete work hampered your ability to get your job done.
- Explain the problem with a teamwork perspective, pointing out how he and others have an important role to fulfil in the workplace.

Step 2

- Find out if your co-worker understands how to complete his assigned tasks when you discuss work-ethic problems with him.
- Employees sometimes get duties from managers that they don't have the skills to fulfil, so they avoid those duties.
- Recommend that a co-worker ask a manager for guidance or training on how to complete tasks he doesn't understand. Help him yourself if you can, but don't do his job for him.

Step 3

- Bear in mind that a co-worker might not be getting his job done because he has personal problems that are distracting him.
- Don't feel compelled to take on a co-worker's problems, but you can show understanding by giving him some slack on the job while he sorts out his troubles.
- In such cases, ask him to consider whether taking time off from work would be beneficial in tackling his problems.

Step 4

- Tell your manager about the problems a co-worker's bad work ethic is causing if your other efforts to help him fail.
- Don't make the issue personal when you tell your manager about the matter.
- Present your manager with business-related reasons the co-worker's poor work habits are affecting the workplace.
- Consider things such as whether the co-worker's behaviour is creating a backlog of work for you and others.

1.5. SERVICE LEARNING

Service-learning is a method of teaching, learning and reflecting, frequently youth service, throughout the community. As a teaching method, it falls under the philosophy of experiential education. More specifically, it integrates meaningful community service with instruction and reflection to enrich the learning experience, teach civic responsibility, encourage lifelong civic engagement, and strengthen communities for the common good.

Definition

It is defined as "a method under which students or participants learn and develop through active participation in thoughtfully organized service that is conducted in and meets the needs of a community; is coordinated with an elementary school, secondary school, institution of higher education, or community service program, and with the community; and helps foster civic responsibility; and that is integrated into and enhances the academic curriculum of the students, or the educational components of the community service program in which the participants are enrolled; and provides structured time for the students or participants to reflect on the service experience."

Service-learning is a teaching strategy that offers students opportunities to learn both in the classroom and in the wider world. This pedagogical tool provides students with chances to directly interact with local agencies and effect change in the community. Alternatively, the National Youth Leadership Council defines service learning as "a philosophy, pedagogy, and model for community development that is used as an instructional strategy to meet learning goals and/or content standards."

1.5.1. Key Components

Service-learning combines experiential learning and community service opportunities. It can be distinguished in the following ways:

- ***Curricular connections***- Integrating learning into a service project is a key to successful service-learning. Academic ties should be clear and build upon existing disciplinary skills.
- ***Student voice*** - Beyond being actively engaged in the project itself, students have the opportunity to select, design, implement, and evaluate their service activity, encouraging relevancy and sustained interest. In community settings, this is alternatively called youth voice.
- ***Students discussion*** - Students discuss their learning experience during in-class discussions.
- ***Reflection*** - Structured opportunities are created to think, talk, and write about the service experience. The balance of reflection and action allows a student to be constantly aware of the impact of their work.
- ***Community partnerships*** - Partnerships with community agencies are used to identify genuine needs, provide mentorship, and contribute assets towards completing a project. In a successful partnership, both sides will give to and benefit from the project. In order for this partnership to be successful, clear guides must be implemented as to how often a student engages in service to a particular community agency.
- ***Authentic community needs*** – Local community members or service recipients are involved in determining the significance and depth of the service activities involved.
- ***Assessment*** – Well-structured assessment instruments with constructive feedback through reflection provide valuable information regarding the positive 'reciprocal learning' and serving outcomes for sustainability and replication.

In 2008, the National Youth Leadership Council released the K–12 Service-Learning Standards for Quality Practice that used research in the field to determine eight standards of quality service-learning practice.

The standards are:

- Meaningful Service
- Link to Curriculum
- Reflection
- Diversity
- Investigation
- Partnerships
- Progress Monitoring
- Project Design
- Action
- Demonstration
- Recognition

Further, to distinguish high quality from low quality service learning experiences, Youth Service California has published the "Seven Elements of High Quality Service Learning" that include:

- Integrated Learning
- High Quality Service
- Collaboration
- Student Voice
- Civic Responsibility
- Reflection
- Evaluation

1.5.2. Types of Service Learning

The following are the four various types of service learning methods followed;

1. ***Direct Service-Learning:*** Person-to-person, face-to-face projects in which service impacts individuals who receive direct help from students (tutoring, work with elderly, oral histories, peer mediation, etc.).
2. ***Indirect Service-Learning:*** Projects with benefits to a community as opposed to specific individuals (i.e., environmental, construction, restoration, town histories, food and clothing drives).

3. ***Advocacy Service-Learning:*** Working, acting, speaking, writing, teaching, presenting, informing, etc., on projects that encourage action or create awareness on issues of public interest (i.e., promoting reading, safety, care for the environment, local history, violence and drug prevention, disaster preparedness).

4. ***Research Service-Learning:*** Surveys, studies, evaluations, experiments, data gathering, interviewing, etc., to find, compile, and report information on topics in the public interest (i.e., energy audits of homes or public buildings, water testing, flora and fauna studies, surveys).

1.5.3. Comprehensive Action Plan for Service Learning (Capsl)

- CAPSL Identifies four constituencies on which a program for service learning needs to focus its principle activities: institution, faculty, students, and community.
- CAPSL also identifies a sequence of activities (Planning; awareness; prototype; resources; expansion; recognition; monitoring; evaluation; research; institutionalization) to be pursed for each of the four constituencies(institution, faculty ,students, and community).
- CAPSL provide a heuristic for guiding the development of a service learning program in higher education.

Advantages of CAPSL : It is general enough that the execution of each cell can be tailored to local conditions.

Disadvantages of CAPSL: It is not possible to detail how each step can be successfully accomplished to take the sequence of activities from the whole CAPSL model and apply it to any cell in the matrix.

1.5.4. Service Learning in Language Education

Service learning can be used in all standard disciplines and recently has been explored for use in improving language instruction. A recent study found that integrating environmental issues with foreign language study provides significant opportunities for students to increase their language proficiency, develop their understanding of concepts related to the environment, and become more involved in a global community through a virtual service learning project. Similar work has found that students can contribute to sustainable development while improving their language skills.

1.5.5. Effect on Engineering Education

Many engineering educators see service-learning as the solution to several prevalent problems in engineering education today. In the past, engineering curriculum has fluctuated between emphasizing engineering science to focusing more on practical aspects of engineering.

Today, many engineering educators are concerned their students do not receive enough practical knowledge of engineering and its context.

Some speculate that adding context to engineering help to motivate engineering students' studies and thus improve retention and diversity in engineering schools.

Others feel that the teaching styles do not match the learning styles of engineering students.

Many engineering faculty members believe the educational solution lies in taking a more constructivist approach, where students construct knowledge and connections between nodes of knowledge as opposed to passively absorbing knowledge.

Educators see service-learning as a way to both implement a constructivism in engineering education as well as match the teaching styles to the learning styles of typical engineering students.

As a result, many engineering schools have begun to integrate service-learning into their curricula and there is now a journal dedicated to service learning in engineering.

1.6. CIVIC VIRTUE

Definition

Civic virtue is morality or a standard of righteous behaviour in relationship to a citizen's involvement in society. An individual may exhibit civic virtue by voting, volunteering, organizing a book group, or attending a PTA meeting.

Civic virtue is the cultivation of habits of personal living that are claimed to be important for the success of the community. Civic virtue is also the dedication of citizens to the common welfare of their community even at the cost of their individual interests.

The term civility refers to behaviour between persons and groups that conforms to a social mode (that is, in accordance with the civil society), as itself being a foundational principle of society and law.

1.6.1. Importance of Civic Virtue

Civic virtue helps people understand their ties to the community and their responsibilities within it.

Civic virtue both expresses and builds trust and cooperation in the citizenry, and it is these qualities-"social capital"-that make everything else go well.

1.7. RESPECT FOR OTHERS

"The true measure of a man is how he treats you when others are not looking."

Showing other people respect is a critical part of maintaining important personal relationships. Learning to respect people's efforts, abilities, opinions, and quirks will help keep you happy and successful in your interpersonal life. Respecting yourself can help you move forward with the confidence to make a habit of respect and share it with the people around you.

Respect for other individuals can be shown in many forms, but the following four ways

may teach you how to respect others opinions, also the need of self-respect in the society, in an organization, wherever people being together while working, living, and when they meet publicly.

1. Showing gratitude
2. Respecting other's opinions
3. Respecting your enemies
4. Respecting yourself.

1. Showing gratitude

Thank people for their assistance and their support on a regular basis. It's important to remember all the people who've helped you on your journey. Show respect by saying thanks. Remember to thank your parents, siblings, co-workers, classmates, friends, teachers, neighbours.

a) Remember to speak politely to everyone.

Compliment the achievements of others. When others are successful, draw attention to it and celebrate their ability and their achievement. Learn to recognize when other people put forth extra effort and achieve something and praise them for it with sincerity.

b) Be sincere.

Always be sincere in your every work, whether it is in your work place or home. Sincere work definitely gets its reward one day. Sincerity is the first step among the steps to success in life.

c) Respect the abilities of others.

Try to recognize when someone is capable of doing something on his or her own and mind your own business to show that person the respect he or she deserves.

2. Respecting other's opinions

a) Be a good listener.

Practice active listening to show people that you have respect for their opinions and ideas. Watch and be quiet when someone else is talking and spend time thinking actively about what they're saying.

b) Ask lots of questions.

To show respect for other peoples' opinions, question them. Ask open-ended, leading questions that show you're fully engaged with their ideas and that you're listening closely.

c) Learn about the perspectives of others.

Learning to empathize with other people who have very different experiences and perspectives than your own will help you learn to show respect. Be proud of your own opinions and perspectives, but don't assume everyone feels the same way and avoid putting them in an awkward position.

d) Respectfully disagree.

When you have to dissent, do it calmly and by treating your conversation with tact. Respect the perspective of the other person. Don't insult their opinion or ideas, even if you disagree with them.

3. Respecting your enemies

a) Don't judge people before you get to know them.

Give people the benefit of the doubt, even people of whom you might have a bad first impression.

b) Decide to like people.

It's too easy to come up with reasons to dislike someone, to disrespect someone, or to dismiss them. Decide to like them, and it'll be much easier to show respect.

c) Worry about your own backyard.

Don't get mixed up in other peoples' business and create unnecessary enemies.

4. Respecting yourself.

a) Take care of yourself.

To show respect for yourself, try and give yourself the same consideration that you give everyone else.

b) Avoid self-destructive behaviours.

Drinking to excess on a regular basis or habitually self-deprecating yourself will tear you down in mind and body. Try to work actively to build yourself up and surround yourself with encouraging, enlightening, helpful people.

c) Stay healthy.

Make regular visits to the doctor to make sure you're healthy and fit. Exercise regularly and eat well. Start developing easy routines, even walking a few miles a day or doing some light stretches to get in touch with your body and maintain it. Cut out junk foods and eat a variety of nourishing foods.

d) Be ambitious.

Develop plans for yourself and specific steps for carrying them out. Plot an upward trajectory for yourself to keep yourself moving forward in life and staying satisfied. Show respect for yourself by being the best version of yourself you can be.

1.8. LIVING PEACEFULLY

Think peace before power. Gandhi said that power based on love is a thousand times more effective and permanent than the power gained through threat of punishment.

In our daily lives, we often rush through tasks, trying to get them done, trying to finish as much as we can each day.

Living in peace is about living harmoniously with yourself, others, and all sentient beings around you. Living in peace is both an outward and an inward process. Outwardly, living in peace is a way of life in which we respect and love each other in spite of our cultural, religious, and political differences. Inwardly, we all need to search our hearts and minds and understand the fear that causes the impulse to violence, for in continuing to ignore the rage within, the storm outside will never subside.

1.8.1. Ten Ways to Stop Stressing & Start Living Peacefully

Instead of replaying the same old worries day after day, why don't we look at how to stop worrying and start living peacefully?

1. Take time for silence: Through silence, we can become acquainted with worrying thoughts and through mindfulness and meditation we can change these thoughts.
2. Get rid of stuff: Minimalism is a way to put a stop to the gluttony of the world around us. By adopting a minimalist lifestyle you can throw out what you don't need in order to focus on what you do need.
3. Give yourself a safe space: Whether your safe space is a room designed for yoga or meditation or simply your bedroom or office, the point is it should be relaxing, a place where you can close the doors to the outside stressors and just breathe.
4. Create a budget: Even though it may seem like you'll never have enough money, you need to stop stressing about it. One way to stop worrying about money is to gain some control over it. Create a budget and follow it.
5. Organize your time and self: Make effective use of your time; learn how to say no, set a realistic schedule and forget about the expectations others project onto you.
6. Stop being influenced by media: The media can make us feel like we are not thin, rich, or successful enough. It also instils fear of war, disease and even coffee. The media can be a fear-based breeding ground for worry.
7. Be rational: Ask yourself, "Are my worries realistic?"
8. Exercise: It releases endorphins, which make the brain feel good. Exercise also reduces the body's stress hormones.
9. Express gratitude: Stop worrying about things that may or may not happen and start being thankful for the things you have right now. Developing an attitude of gratitude can transform our states of mind. Spend a few minutes each day, listing things for which you are thankful.
10. Trust yourself: Do you worry about whether you're on the right path? Get quiet so that you can hear the small voice deep inside of you. Your inner GPS won't steer you wrong. Simply tune into your inner compass; it's guiding you in the right direction.

Remember these things:

a) Worrying accomplishes nothing.

b) Worrying is bad for you.

c) Worrying is the opposite of trust and peace.

d) Worrying puts your attention in the wrong direction.

When worry does grab a hold of you, these fun tips can help stop it;

- Listen to music
- Go to a party
- Read a book
- Have a movie night with your friends
- Go camping
- Have a family outing
- Spend a day at the beach
- Take a relaxing cleansing breath

1.9. CARING

Caring can be defined as an act of feeling and exhibiting concern and empathy for others, i.e., feeling or showing care and compassion.

The Self-realization ethics, however, gives greater prominence to self-interest and to personal commitments that individuals develop in pursuing self-fulfilment. In a community-oriented version, the self to be realized is understood in terms of caring relationships and communities. Engineers have capacities for genuinely caring about the public safety, health, and welfare. Engineers are strongly motivated by self-interest, but they are also capable of responding to moral reasons in their own right, as well as additional motives concerned with the particular nature of their work.

The following are some basic assumptions underlying the caring process:

1. Caring can only be effectively demonstrated and practised interpersonally.
2. Caring consists of basic processes between people which result in some sense of satisfaction often associated with human needs.
3. Effective caring results in individual health promotion, growth of a family as well as society.

1.10. SHARING

Sharing is the joint use of a resource or space. In its narrow sense, it refers to joint or alternating use of inherently finite goods, such as a common pasture or a shared residence. It is also the process of dividing and distributing.

Apart from obvious instances, which we can observe in human activity, we can also find many examples of this happening in nature. When an organism takes in nutrition or oxygen for instance, its internal organs are designed to divide and distribute the energy taken in, to supply parts of its body that need it. For e.g., flowers divide and distribute their seeds.

In a broader sense, it can also include free granting of use rights to goods that can be treated as non-rival goods, such as information.

Still more briefly, "sharing" can actually mean giving something as an outright gift: for example, to "share" one's food really means to give some of it as a gift.

Sharing is a basic component of human interaction, and is responsible for strengthening social ties and ensuring a person's well-being. Share is meant to be a part or portion belonging to, distributed to, contributed by, or owed by a person or group. It is an equitable portion.

Sharing can be considered as one of the following criteria;

a) To allow someone to use or enjoy something that one possesses.

b) To use or enjoy something jointly or in turns.

c) To talk about personal experiences or feelings with others.

d) To be concerned or partake equally or jointly, as in a business venture.

e) One of the equal parts into which the capital stock of a company is divided.

1.11. HONESTY

Honesty - refers to a facet of moral character and denotes positive, virtuous attributes such as integrity, truthfulness, and straightforwardness along with the absence of lying, cheating, or theft.

Additionally an honest person will inform others of opportunities for growth and self-actualization. Secrets allowing people to be harmed, self-deception - not being aware of one's own environment, and remaining silent when duty calls forth an opinion become silences which hurt others in the long-run. Honesty means being open about one's life.

Honesty could be defined as truthfulness in speech and action. While this sounds simple, it's surprisingly difficult to practice. Being truthful implies the presence of an active conscience and a working knowledge of ethics at the minimum. In everyday life, being truthful means listening to, and obeying, the voice of our conscience.

1.11.1 Importance of Honesty

Honesty is defined as the quality or fact of being honest; uprightness and fairness. This term is so important in everyday life because it as the simple basis of how we carry out routine activities.

Everybody in the world interacts with one another and when honesty is neglected problems tend to arise. Essentially honesty is the major factor that supports every known source of information. For example without honesty how would someone actually know the simple truth?

Each time new information is obtained or we just carry out an ordinary conversation we assume that honest words are coming out of the other person as mouth and when lies are told controversy sparks like a match.

The fact that honesty provides accurate information is so influential to every aspect of life. Sometimes people reiterate false information simply by mistake, but there are others that purposely condone false information for the fact of pure entertainment or because they feel it as necessary.

Honesty reflects good character because when people know that someone is honest they feel that they can overall trust that person. It as always comforting and reassuring when you can count on that person no matter the circumstances.

1.11.2. Honesty in Engineering

As an engineer you are likely to be working for the benefit of a number of different groups of people, and in many cases you will have a duty to keep these people informed of relevant facts. The public trusts professionals to provide information that is as complete and accurate as possible.

However, it is not always obvious what information you will need to disclose, and to whom, particularly when you have conflicting obligations to different groups. You may need to make a judgment about what you are required to do in order to satisfy the principle of professional honesty.

Honesty is particularly important for engineers when:

- Bidding for projects;
- Disclosing conflicts of interest;
- Deciding whether to draw attention to unethical behavior;
- Answering requests for information under the Freedom of Information Act;
- Disclosing sensitive personal issues;
- Talking about your qualifications, experience, positions of responsibility, etc.

Honesty is not simply a matter of not lying: you may at times need to disclose information which has not been requested directly, and which in some cases people may not want to hear.

These two interactive case-studies look at honesty and bribery in the context of procurement and bids for engineering projects.

1.11.3. Role of Honesty in Business

Business runs on trust. Capital trust in running the business. The key to success is honesty, with capitalize honesty, people will believe in us. Besides honesty we must also work in a professional manner, thus requiring anyone who we feel satisfied with what we are doing. Honesty should always be nurtured and in the case.

- Maintain honesty is hard for us to do bad things we're going to be a bad image. This can be fatal in business that we run. Securities in dishonest is caused from loss of trust elements of our environment, better living environments and business environments.

- Many people have success with, a business tycoon's right hand began his career with maintaining the trust of the boss himself. Some of the many that have foundered amid his career, because a single mistake he did, which was also compounded by the loss of belief error.
- Value trust and honesty is a treasure to be preserved. For example in the recruitment of employees, companies must look for employees who are honest and trustworthy and have the dedication and loyalty of their work.
- Believe not only to believe on attitudes or our behaviour, but also the value of an honesty of what is spoken of and spoken the truth on all forms of deeds. If all elements are already there we hope people will always believe in yourself.
- In the development of self, in opening a small business we may often encounter shortcomings in the capital. With a capital of trust which is always possible to looking for people ready to help. With reason, our confidence will be easy to find better opportunities.
- Previous research has documented that attribution information contained in causal accounts for success induces impressions of arrogance and modesty. The research further examined the role of accounts as well as level of success when perceivers know the real reason for success.
- Two studies of university students revealed that honesty strongly decreases arrogance and increases modesty in the case of effort accounts, and not in situations of communicated ability.
- In addition, honesty was determined not only by the truth value of an account but also by the extent to which the account induced impressions of arrogance and modesty. The present findings provide further understanding of the link between attribution information and social judgments.

1.11.4 Dishonesty

Dishonesty is a word which, in common usage, may be defined as the act or to act without honesty. It is used to describe a lack of probity, cheating, lying or being deliberately deceptive or a lack in integrity, knavishness, perfidiosity, corruption or treacherousness. It is used about charlatanism and quacks.

Dishonesty is the fundamental component of a majority of offences relating to the acquisition, conversion and disposal of property (tangible or intangible) defined in the criminal law such as fraud.

Dishonesty in law is more complex and has been subject to a number of incomplete and unsatisfactory definitions. This is because such are the variety of circumstances in which dishonesty may occur that creating an over-arching definition is virtually impossible.

For many years, there were two views in English law. The first contention was that the definitions of dishonesty (such as those within the Theft Act 1968) described a course of action, whereas the second contention was that the definition described a state of mind.

A clear test within the criminal law emerged from R v Ghosh (1982) 75 CR App. R. 154. The Court of Appeal held that dishonesty is an element of mensrea, clearly referring to a state of mind, and that overall, the test that must be applied is hybrid, but with a subjective bias which "looks into the mind" of the person concerned and establishes what he was thinking.

The test is two-stage:

- "Were the person's actions honest according to the standards of reasonable and honest people?" If a jury decides that they were, then the defendant's claim to be honest will be credible. But, if the court decides that the actions were dishonest, the further question is:
- "Did the person concerned believe that what he did was dishonest at the time?"

The decision of whether a particular action or set of actions is dishonest remains separate from the issue of moral justification. For example, when Robin Hood robbed the Sheriff of Nottingham he knew that he was, in effect, stealing from the Crown, was acting dishonestly and would have been properly convicted of robbery. His argument would have been that he was morally justified in acting in this way but in modern legal terms this could only have been brought to the court by way of mitigation of sentencing and would not have affected the inference of dishonesty.

Where dishonesty is an issue in civil cases, the trend in English Law is for only the actions to be tested objectively and not to apply any test as to the subjective state of mind of the actor.

1.11.5 Top 10 Reasons for Employees Get Fired

1. Dishonesty, evasion, or lack of integrity on the job.
2. Lying on a resume.
3. Refusing to follow directions and orders.
4. Talking too much and conducting personal business at work.
5. Inconsistency - unreliable work and behaviors.
6. Inabilities to get along with other people/reducing group productivity.
7. Inability to actually do assigned job tasks.
8. Performing tasks slowly, with numerous errors.
9. High absenteeism rate.
10. Drug and/or alcohol abuse.

- So every employee should behave in a honest way to their employers, to their family, to the society, and to themselves.
- They have to follow the proper ethical codes of conduct, formulated by various engineering societies and forums.

1.12 COURAGE

In general courage is the ability to face danger, difficulty, uncertainty, or pain without being overcome by fear.

When you see something happening in the workplace that just doesn't seem right do you have the courage to stand-up and do something? What are you afraid of? Retribution, disapproval, your image, damaged relationships, or simply the unknown?

Moral Courage is about setting aside your fear and taking action for the good of yourself or someone else. Standing up for your ethical principles takes courage. Courage comes in confronting those feelings inside and taking action.

For instance a fire-fighter courageously runs into a burning building because he or she is protecting life and property. Part of his courage comes from his duty to his job and community but the rest comes from a courageous instinct that kicks in.

Although most ethical dilemmas at work aren't a matter of life and death, the principle of standing up to protect someone's rights as well as basic principles of honesty, moral virtue, and ethical behaviour is a noble cause.

Ethics without the component of courage to stand-up for it keeps it in the realm of heady philosophy and out reality. Principles of decency, integrity and what is good and right are not to be treaded upon lightly.

Ethics is more than just following a set of rules; it is a part of our deeply-held belief system that makes-up the core of our character. Ethics is worth stepping out in courage and making personal sacrifices.

Two forms of courage

- Physical courage
- Moral courage

Physical courage is when a person braves the potential for physical peril to engage in a right action.

Moral courage, choosing to do the right thing when faced with an ethical challenge or dilemma, takes character strength.

1.13 VALUING TIME

Time is gold is a well-known proverb, even tons and tons of gold cannot be used to buy a missed fraction of second. Every individual has the same amount of time but the way they spent time varies from one to other. Some people have better time management and capable of doing their works in a proper schedule, some others do not follow a schedule and doesn't know the value of time they are wasting.

Wasting of time is also ethically wrong; everybody should know the value of time. One should practice to do right things in the right time; otherwise there is no use of doing it. People who follow ethical behaviour in personal as well as professional life definitely know the value of time and utilize it in a wise manner.

Time is the only thing which cannot be borrowed from others and lend to anybody. Each individual should know the way of effective usage of time, only by knowing its original value.

It is rightly said "Time and Tide wait for none". An individual should understand the value of time for him to succeed in all aspects of life. People who waste time are the ones who fail to create an identity of their own.

1.13.1. What is Time Management?

- Time Management refers to managing time effectively so that the right time is allocated to the right activity.
- Effective time management allows individuals to assign specific time slots to activities as per their importance.
- Time Management refers to making the best use of time as time is always limited.

Ask yourself which activity is more important and how much time should be allocated to the same? Know which work should be done earlier and which can be done a little later. Time Management plays a very important role not only in organizations but also in our personal lives. Time Management includes the following activities;

i. Effective Planning of a task
ii. Setting goals and objectives
iii. Setting deadlines to finish your works
iv. Delegation of responsibilities
v. Prioritizing activities as per their importance
vi. Spending the right time on the right activity

1.14 CO-OPERATION

Co-operation is the process of groups of people working or acting together for their common/mutual benefit, as opposed to working in competition for self-benefit.

The term 'Co-operation' is derived from the two Latin words 'Co' meaning together and 'Operari' meaning to work. Literally, Co-operation means 'joint work' or 'working' together' for a common goal'.

1.14.1. Types of Co-Operation

There are differences of opinion among the sociologists regarding the types of co-operation. There are two basic types of co-operation. They are as follows;

1. Direct co-operation.
2. Indirect co-operation.

1. Direct Co-operation:

Direct co-operation implies direct relationship among the individuals. In this type of co-operation, people do like things together. In other words, when people directly co-operate with each other for the achievement of a common goal it is called direct co-operation. Playing together, working together, worshiping together, ploughing the field together, traveling together and so on are some of the examples of direct co-operation.

2. Indirect Co-operation:

Indirect co-operation is just, the opposite of direct co-operation. In indirect co-operation people do different tasks towards a similar end. In other words, in this type of co-operation people work individually for the attainment of a common goal and this is based on the principle of division of labour and specialization of functions.

For example, in a college the principal, lecturers, office assistants, accountant, typist, librarian and dispatcher perform different functions but they make co-operative effort towards a common goal.

A.W. Green has divided co-operation into three types such as

1. Primary, Co-operation.
2. Secondary Co-operation.
3. Tertiary Co-operation.

1. Primary Co-operation:

Primary co-operation is generally found in the primary group, children's play group and so on. Primary co-operation is that type of co-operation in which there is no selfish interest. Every member works for the betterment of all. Thus primary relation leads to primary co-operation,

2. Secondary Co-operation:

Secondary co-operation is that type of co-operation in which an individual co-operates with others for the achievement of some selfish interests. Secondary co-operation is the characteristic of modern industrial society, which is mostly found in secondary groups such as social, economic, religious and political group where work is based on division of labour and specialization of functions. Secondary co-operation does not provide equal benefit to all the members. Each may work in co-operation with others for his own status, power and prestige.

3. Tertiary Co-operation:

In tertiary co-operation, different groups make mutual adjustment with each other under certain compelling circumstances. Tertiary co-operation is purely voluntary in nature. People or groups co-operate with each other according to their sweet will. The attitudes of the co-operating parties or groups in the field of tertiary co-operation are very opportunistic and selfish. For instance, when two political parties of different ideologies are co-operative together to defeat their rival party in an election, it is known as tertiary co-operation.

4. Role of Co-operation

Co-operation is so important in human life that it is difficult for man to survive without it. Co-operation is the foundation on which our social life is built up. Without active co-operation of fellow beings, a man cannot lead a happy and comfortable life. In a family without active co-operation of wife, a man cannot lead a happy conjugal life; Man cannot fulfil his basic needs like food, clothing and shelter without co-operation. Progress in science, technology, art, literature depends upon co-operation. Co-operation brings all round development of individual as well as of society. Without this, the very existence of human society is impossible.

1.14.2. Social Co-Operation

Cooperation is an associative and basic process of social life. Society cannot exist without this. It is the very basis of social existence. It is one of the continuous social processes. Merrill and Hdredge says, 'Co-operation is a form of social interaction wherein two or more persons work together to gain a common end.'

According to Fairchild "Co-operation is the process by which the individuals or groups combine their effort, in a more or less organized way for the attainment of common 'objective'. From the above definitions, two characteristics of co-operation become clear. They are as follows;

1. Organised effort.
2. Common end

1.14.3. Organizational Co-Operation

Organization are working together to accomplish goals. By networking, coordinating, cooperating, and collaborating, organizations working together can accomplish goals they couldn't reach working in isolation.

Groups of people can work together to accomplish amazing tasks. They can figure out ways to garner the necessary skills, funds, and time to solve community problems and improve human services. What you need are people who are well-organized, cooperative, and determined.

When organizations cooperate, they not only share information and make adjustments in their services - they share resources to help each other do a better job. In a cooperative relationship, organizations may share staff, volunteers, expertise, space, funds, and other resources. For example, if the school and the community counselling centre share physical space for evening services in order to better meet the needs of neighbourhood youth, they are in a cooperative relationship. Another example would be if community organizations in a town shared staff time to put out a yearly calendar of major events for the whole community.

Cooperating requires more trust and a greater investment in time than either networking or coordination. In order to enter into a cooperative relationship, organizations also have to let go of some turf issues. Organizations have to be willing to share the ownership and the responsibility, to risk some hassles, and to reap the rewards of their efforts together.

1.15 COMMITMENT

In general commitment can be referred to the state or quality of being dedicated to a cause, activity, etc. A promise is also a form of commitment by someone to do or not do something.

An ethical commitment is like a duty, or a moral obligation. You are bound to the morals you go by. A commitment to legal ethics involves a commitment to the introduction of Codes of Ethics or Standards of Professional Practice.

An example is the standards reflected in the International Bar Association General Principles of Ethics. However not all jurisdictions have Professional Codes and not all of those that do give sufficient attention to their enforcement. In any case, the lawyer who acts in accordance with a professional code of ethics may still be engaging in unethical practice.

1.15.1. Organizational Commitment and Professional Commitment

1.15.1.1 Organizational Commitment

Organizational commitment is made up of more factors, such as faith and acceptance of the organization's set of values and objectives, the employee's wish to strive for the organization and a strong will to keep working within it. Organizational commitment predicts work variables such as turnover, organizational citizenship behaviour, and job performance. Some of the factors such as role stress, empowerment, job insecurity and employability, and distribution of leadership have been shown to be connected to a worker's sense of organizational commitment.

Organizational commitment can be contrasted with other work-related attitudes, such as job satisfaction, defined as an employee's feelings about their job, and organizational identification, defined as the degree to which an employee experiences a 'sense of oneness' with their organization.

1.15.1.2 Professional Commitment

The concept of professional commitment signifies an attitude reflecting the strength of the bound between an employee and an organization. Teaching is a profession which needs utmost commitment since a teacher not only teaches a student the subjects also he/she train them to behave morally, and mould them into a perfect individual in a society. The quality of teaching depends a great deal on the level of teachers' involvement in relation to the profession exerted, to the organization one is part of and the professional satisfaction that one feels.

The shapes of professional commitment and, accordingly, of organizational commitment represent behavioural predictors of work achievements, absenteeism, fluctuation, but also of the professional satisfaction.

1.15.2. THREE-COMPONENT MODEL OF ORGANIZATIONAL COMMITMENT

In 1990, based on observations on several types of organizations, Meyer and Allen develop "The model of the three components of organizational commitment".

1. Affective Commitment
2. Continuity Commitment
3. Normative commitment

Affective Commitment (AC) has been considered to be the type of commitment based on the individual's identification with and involvement in the organization. It is an emotional commitment, where people that are in a great deal affectively connected to an organization stay within it because they want to.

Continuity Commitment (CC) is based upon the material and psychological costs involved by one's leaving the organization, people with such kind of commitment remaining within it because they are compelled to do so. This denomination has been attributed by Meyer and Allen that have started from the "side-bet" theory, created in 1960 by Becker. Side-bets represent investments in values of any kind, made both by the employees and the organization, that are not connected through work, but serve to ensuring certain continuity within the organization.

The benefits offered by the organization usually refer to health insurance or certain systems of promotion or retirement, which benefits reduce the attractiveness of other employment opportunities. Actually, Becker referred to this type of commitment as "the individual's tendency to commit to a consistent line of activity". We may notice the commitment becomes more and more accountable, reflecting a cumulus of interests of the employees, accepted and fulfilled by the organization, that "bind" the individual to the organization, leading therefore to a sort of exchange or informal contract.

Normative Commitment (NC) is based upon an ideology or a sense of obligation towards the organization, on the individual's moral belief that it is right and moral to continue within the organisation.

People having a high normative commitment keep staying within an organization, because they think they should. This feeling of obligation is the result of internalising the norms exerted on the individual before of following his admission into the organisation, thorough a process of familial or cultural socialization and, accordingly, organizational socialization.

The studies carried on assess that the organizational commitment may be determined by two categories of factors:

1. ***Individual ones:*** where we may include variables of inclinations like professional values, type of personality, and demographic variables such as age, gender, educational level, marital status.
2. ***Organizational factors:*** structure of the job, type of organization, professional experience etc.

1.16 EMPATHY

The ability to co-experience and relate to the thoughts, emotions, or experience of another without them being communicated directly by the individual is referred to as empathy. Empathy can best be described as feeling with the person

To an extent you are placing yourself in that person's place, have a good sense of what they feel, and understand their feelings to a degree. The idea of empathy implies a much more active process.

Since empathy involves understanding the emotional states of other people, the way it is characterized is derivative of the way emotions themselves are characterized. If, for example, emotions are taken to be centrally characterized by bodily feelings, then grasping the bodily feelings of another will be central to empathy. On the other hand, if emotions are more centrally characterized by a combination of beliefs and desires, then grasping these beliefs and desires will be more essential to empathy. The ability to imagine oneself as another person is a sophisticated imaginative process. However, the basic capacity to recognize emotions is probably innate and may be achieved unconsciously. Yet it can be trained and achieved with various degrees of intensity or accuracy.

Empathy is distinct from sympathy, pity, and emotional contagion.

- Sympathy or empathic concern is the feeling of compassion or concern for another, the wish to see them better off or happier.
- Pity is feeling that another is in trouble and in need of help as they cannot fix their problems themselves, often described as "feeling sorry" for someone.
- Emotional contagion is when a person (especially an infant or a member of a mob) imitatively "catches" the emotions that others are showing without necessarily recognizing this is happening.

1.16.1. Types of Empathy

Empathy can be divided into two major components: Affective and cognitive empathy

- ***Affective empathy, also called emotional empathy:*** the capacity to respond with an appropriate emotion to another's mental states. Our ability to empathize emotionally is supposed to be based on emotional contagion, being affected by another's emotional or arousal state.
- ***Cognitive empathy:*** the capacity to understand another's perspective or mental state. The terms cognitive empathy and theory of mind are often used synonymously, but due to a lack of studies comparing theory of mind with types of empathy, it is unclear whether these are equivalent.

  Although science has not yet agreed upon a precise definition of these constructs, there is consensus about this distinction.

  Affective empathy can be subdivided into the following scales:

- ***Empathic concern:*** sympathy and compassion for others in response to their suffering.
- ***Personal distress:*** self-centred feelings of discomfort and anxiety in response to another's suffering. There is no consensus regarding whether personal distress is a basic form of empathy or instead does not constitute empathy.

Cognitive empathy can be subdivided into the following scales:

- ***Perspective taking:*** the tendency to spontaneously adopt others' psychological perspectives.
- ***Fantasy:*** the tendency to identify with fictional characters.

1.17. SELF-CONFIDENCE

Self-Confidence or having belief in yourself has been directly connected to an individual's social network, the activities they participate in, and what they hear about themselves from others. Positive factors of self-confidence have been linked to factors such as psychological health, mattering to others, and both body image and physical health. On the contrary, low confidence level in adolescents has been shown to be an important predictor of unhealthy behaviours and psychological problems such as suicidal ideation later in life.

Self-confidence can vary and be observed in a variety of dimensions. An individual's self-confidence can vary in different environments, such as at home or in school / workplace.

During adolescence, confidence level of students is affected by age, race, ethnicity, puberty, health, body height, body weight, body image, involvement in physical activities, gender presentation, and gender identity. Components of one's social and academic life affect their self-confidence.

1.17.1. Steps to Build your Self-Confidence

To develop confidence by self you have to keep in mind the following steps

Step 1: Changing your perspective

- Identify your talents
- Take pride in your good qualities
- Recognize your insecurities and discuss it with your friends
- Bounce back from your mistakes
- Adapt a more positive mind-set
- Stop comparing yourself to others

Step 2: Taking action

- Accept compliments gracefully
- Help others
- Stick to your principles
- Get rid of as many sources of negativity as you can
- Make eye contact when you talk to people
- Put care into your appearance

Step 3: Continuing to build your confidence

- Avoid perfectionism since it paralyses you and keep you away from attaining your goals

- Always be thankful for what you have
- Address your own addressable flaws
- Spend time with people who make you feel good.
- Live in the present moment - Yoga and meditation can help you live in the present moment and to get more in touch with your mind and body.

1.18. CHARACTER

Character can be referred to the mental and moral qualities distinctive to an individual. Character is the combination of mental characteristics and behaviour that distinguishes a person or group. Also it is the combination of traits and qualities distinguishing the individual nature of a person or thing. Simply character refers to the distinguishing / unique nature of something.

Character deals with how people think and behave related to issues such as right and wrong, justice and equity, and other areas of human conduct.

Moral character or character is an evaluation of a particular individual's stable moral qualities. The concept of character can imply a variety of attributes including the existence or lack of virtues such as empathy, courage, fortitude, honesty, and loyalty, or of good behaviours or habits.

Moral character primarily refers to the assemblage of qualities that distinguish one individual from another — although on a cultural level, the set of moral behaviours to which a social group adheres can be said to unite and define it culturally as distinct from others. Psychologist Lawrence Pervin defines moral character as "a disposition to express behaviour in consistent patterns of functions across a range of situations".

1.18.1. Character and Ethics

Character is the combination of personal qualities that make each person unique. Teachers, parents, and community members help children build positive character qualities. For example, the six pillars of character are trustworthiness, respect, responsibility, fairness, caring, and citizenship.

Ethics is the study of human actions. It deals with issues such as defining "right and wrong" as well as the grey area in between. Ethics seeks answers to questions like what is "good behaviour" and what should be valued?

Schools often have character education programs that focus on the qualities of character that are honoured by most cultures and traditions. Character education is the development of knowledge, skills, and abilities that encourage children and young adults to make informed and responsible choices.

Ethics are a philosophical reflection of moral beliefs and practices. The Greek and Roman philosophers were particularly interested in discussions related to ethics. Religions and faiths each have their own ethical systems to guide their people. Ethical decision making involves the process of making informed decisions when faced with difficult dilemmas with many alternative solutions.

1.18.2. Characteristics of Ethical People in the Workplace

Of the many characteristics that businesses look for in candidates, ethics is one of the most important. Human resources officials commonly seek individuals who possess highly defined ethics, as a strong ethical base improves the likelihood that the worker is a productive and upright employee. Many of the characteristics associated with an ethical individual are desirable ones that businesses hope to have in their workforce.

Honesty

Ethical workers value honesty and are honest at all costs. This means that they remain honest even when being honest isn't the easiest road to take.

For example, if an ethical employee makes a mistake, he does not lie about the situation in an attempt to make himself seem less culpable. Having an employee who is overtly honest allows management to trust the employee more implicitly and rely upon him.

Responsibility

Workers who are ethical take responsibility seriously and do all that they can to complete the tasks with which they are charged.

Reliability

When ethical team members say they are going to do something, they follow through. They are reliable at all times and can be trusted to complete projects of great importance.

Goal-Oriented

Ethical individuals are often goal-focused and able to dedicate themselves fully to their job tasks. These individuals often recognize the importance of working to better them and improve the overall success of their company; they are willing to work toward reaching potentially challenging goals.

Job-Focused

Ethical employees remain focused on their jobs at all times, not allowing themselves to become distracted, as doing so pulls them away from the duties of their occupations. These individuals are never found working on a task that is not related to the job in question; as they recognize that their on-the-job time is to be spent only doing job-related tasks.

1.19. SPIRITUALITY

Spirituality is a process of personal transformation, either in accordance with traditional religious ideals, or, increasingly, oriented on subjective experience and psychological growth independently of any specific religious context.

In a more general sense, it may refer to almost any kind of meaningful activity or blissful experience. It still denotes a process of transformation, but in a context separate from organized religious institutions, termed "spiritual but not religious".

1.19.1. What is Spirituality?

Spirituality has many definitions, but at its core spirituality helps to give our lives context. It's not necessarily connected to a specific belief system or even religious worship. Instead, it

arises from your connection with yourself and with others, the development of your personal value system, and your search for meaning in life.

For many, spirituality takes the form of religious observance, prayer, meditation or a belief in a higher power. For others, it can be found in nature, music, art or a secular community. Spirituality is different for everyone.

1.19.2. The Meaning of Spirituality

One of the great gifts of spiritual knowledge is that it realigns your sense of self to something you may not have even ever imagined was within you. Spirituality says that even if you think you're limited and small, it simply isn't so. You're greater and more powerful than you have ever imagined. A great and divine light exists inside of you. This same light is also in everyone you know and in everyone you will ever know in the future. You may think you're limited to just your physical body and state of affairs — including your gender, race, family, job, and status in life — but spirituality comes in and says "there is more than this."

Notice that spirit sounds similar to words like inspire and expire. These are two of the main themes of the spiritual journey:

Inspiring Spirituality: Allowing you to be filled with inspiration, this also translates into love, joy, wisdom, peacefulness, and service.

Expiring Spirituality: Remembering that an inevitable expiration waits to take you away from the very circumstances you may think are so very important right now.

1.19.3. Spirituality differs from Religion

Although religion and spirituality are sometimes used interchangeably, they really indicate two different aspects of the human experience. You might say that spirituality is the mystical face of religion.

Spirituality is the wellspring of divinity that pulsates, dances, and flows as the source and essence of every soul. Spirituality relates more to your personal search, to finding greater meaning and purpose in your existence. Some elements of spirituality include the following:

- Looking beyond outer appearances to the deeper significance and soul of everything
- Love and respect for God
- Love and respect for yourself
- Love and respect for everybody

Religion is most often used to describe an organized group or culture that has generally been sparked by the fire of a spiritual or divine soul. Religions usually act with a mission and intention of presenting specific teachings and doctrines while nurturing and propagating a particular way of life.

Spirituality is:

- Beyond all religions yet containing all religions
- Beyond all science yet containing all science
- Beyond all philosophy yet containing all philosophy

1.19.4. Spirituality and Stress Relief

Some stress relief tools are very tangible: exercising more, eating healthy foods and talking with friends. A less tangible but no less useful way to find stress relief is through spirituality.

How can spirituality help with stress relief?

Spirituality has many benefits for stress relief and overall mental health.

Feel a sense of purpose. Cultivating your spirituality may help uncover what's most meaningful in your life. By clarifying what's most important, you can focus less on the unimportant things and eliminate stress.

Connect to the world. The more you feel you have a purpose in the world, the less solitary you feel even when you're alone. This can lead to a valuable inner peace during difficult times.

Release control. When you feel part of a greater whole, you realize that you aren't responsible for everything that happens in life. You can share the burden of tough times as well as the joys of life's blessings with those around you.

Lead a healthier life. People who consider themselves spiritual appear to be better able to cope with stress and heal from illness or addiction faster.

1.19.5. Discovering your Spirituality

Uncovering your spirituality may take some self-discovery. Here are some questions to ask yourself to discover what experiences and values define you:

- What are your important relationships?
- What do you value most in your life?
- What people give you a sense of community?
- What inspires you and gives you hope?
- What brings you joy?
- What are your proudest achievements?

The answers to such questions help you identify the most important people and experiences in your life. With this information, you can focus your search for spirituality on the relationships and activities in life that have helped define you as a person and those that continue to inspire your personal growth.

1.20 INTRODUCTION TO YOGA AND MEDITATION FOR PROFESSIONAL EXCELLENCE

Yoga and meditation when practiced together strengthen the mind body connection, improving overall fitness and well-being. Many styles of yoga combine meditation with the physical routines, which use controlled breathing throughout the yoga poses. You can meditate without practicing yoga by simply relaxing, clearing your mind and concentrating on controlled breathing. Both yoga and meditation, when used consistently, have proven health benefits.

1.20.1. Benefits of Practicing Yoga

Increased Flexibility

Yoga poses focus on stretching and lengthening the muscles. Increased flexibility will help you with daily movements such lifting and bending, while improving sports performance. Many athletes incorporate yoga into their workout schedules to improve or maintain flexibility.

Emotional Boost

Both yoga and meditation improve mental focus and provide a general feeling of well-being. Many yoga disciplines are based around an upbeat theme. A 2012 control study published in "Alternative Therapies in Health and Medicine" found yoga participants happy, peaceful and upbeat in contrast to the control group who had a decrease in general well-being. Meditation provides an emotional boost through deep relaxation, and it can be done anywhere. You can give yourself an emotional boost by taking a 10-minute meditation break right at your desk. Just simply shut your eyes, focus on relaxing your muscles and practice deep breathing.

Better Diet

Studies suggest that practicing yoga improves fitness and body awareness, leading to better eating habits. This in turn leads to increased self-esteem and the desire to take care of your body. Practicing meditation or yoga is a behaviour modification technique that can help you improve your overall fitness.

Improved Health

Adding yoga or meditation to your life will improve the quality and possibly the quantity of your life. Improved health means you can participate in more physical activities and just feel better in the things you do daily.

1.20.2. What is Meditation?

Meditation is a practice that has been associated with almost all religions and civilizations across the word. Since it is so closely associated with religion, many people take meditation to be the same thing as praying.

1.20.3. Benefits of Meditation

Meditation has two important benefits:

a) Meditation prevents stress from getting into the system

b) Meditation releases accumulated stress that is in the system

Both of these happen simultaneously, leaving one refreshed and joyful.

1.20.3.1. Physical Benefits of Meditation

With meditation, the physiology undergoes a change and every cell in the body is filled with more prana (energy). This result in joy, peace, enthusiasm as the level of prana in the

body increases.

A physical level, meditation does the following things:

- Lowers high blood pressure
- Lowers the levels of blood lactate, reducing anxiety attacks
- Decreases any tension-related pain, such as, tension headaches, ulcers, insomnia, muscle and joint problems
- Increases serotonin production that improves mood and behaviour
- Improves the immune system
- Increases the energy level, as you gain an inner source of energy

1.20.3.2. Mental Benefits of Meditation

Meditation brings the brainwave pattern into an Alpha state that promotes healing. The mind becomes fresh, delicate and beautiful. With regular practice of meditation:

- Anxiety decreases
- Emotional stability improves
- Creativity increases
- Happiness increases
- Intuition develops
- Gain clarity and peace of mind
- Problems become smaller
- Meditation sharpens the mind by gaining focus and expands through relaxation
- A sharp mind without expansion causes tension, anger and frustration
- An expanded consciousness without sharpness can lead to lack of action/progress
- The balance of a sharp mind and an expanded consciousness brings perfection
- Meditation makes you aware - that your inner attitude determines your happiness.

1.20.3.3. Other Benefits of Meditation

- ***Emotional steadiness and harmony:*** it cleanses and nourishes you from within and calms you, whenever you feel overwhelmed, unstable, or emotionally shut down.
- ***Meditation brings harmony in creation:*** when you meditate, you are in the space of vastness, calmness and joy and this is what you emit into the environment, bringing harmony to the Creation/planet.
- ***Consciousness evolves:*** with the assimilation of meditation into daily life, your consciousness evolves and in time, is able to experience the higher and refined states of consciousness. When your consciousness evolves and expands, the disturbances in your life become negligible. Anger and disappointments become fleeting emotions that occur momentarily and then vanish. You start living in 'the moment' and let go of 'the past'.

- ***Personal Transformation:*** meditation can bring about a true personal transformation. As you learn more about yourself, you'll naturally want to discover more about the mystery of life, this universe, etc. Then the questions that arise in the mind are - What is the meaning of Life? What is its purpose? What is this world, what is love, what is knowledge...? Once these questions arise, know that you are very fortunate. These questions need to be understood; you cannot find the answers in books. As you live through answering them you'll witness that life transformation to a richer level.

1.20.4. How to get the Benefits?

To experience the benefits of meditation, regular practice is necessary. It takes only a few minutes every day. Once imbibed into the daily routine, meditation becomes the best part of your day!

Meditation is like a seed. When you cultivate a seed with love, the more it blossoms. Similarly, the sapling of consciousness is within you. It needs to be nurtured with simple meditation techniques.

1.21. STRESS MANAGEMENT

Reducing your stress level, eating healthier and getting more exercise can only lead to better health. Modern life is full of stressful situations, fatigue from long hours and little sleep, allergies, anxiety disorders and a long list of stress-related diseases.

Regular yoga practice helps to reduce stress responses in your body, according to a study in the 2010 issue of "Psychosomatic Medicine." Reducing the inflammatory response to stressors on your body will help reduce your chance of stress-related conditions such as high blood pressure and cardiovascular disease. Meditation is also an effective stress reducer that is used to help reduce anxiety, panic disorders and agoraphobia, an anxiety disorder.

1.21.1 De-Stress with Meditation

Do you wish to be stress-free and worry-free? You can enjoy all these benefits and much more, with meditation. Meditation offers innumerable benefits for your body, mind and spirit. The rest you gain in meditation is deeper than the deepest sleep. The deeper your rest, the more dynamic your activity is.

- You start living in 'the moment' and let go of 'the past'.
- Taking the path less travelled by exploring your spirituality can lead to a clearer life purpose, better personal relationships and enhanced stress management skills.

TWO MARKS QUESTIONS & ANSWERS

1. What are human values?

Human values are the principles, standards, convictions and beliefs that people adopt as their guidelines in daily activities. Principal human values are the foundation on which professional ethics are built.

2. Define Moral.

Moral is concerned with the principles of right and wrong behaviour. It represents the act of holding or manifesting high principles for proper conduct. Moral can be considered as a lesson that can be derived from a story or experience.

3. What are values?

Values can be defined as principles or standards of behaviour; one's judgement of what is important in life. Value is the regard that something is held to deserve; the importance, worth, or usefulness of something.

Values are "things that have an intrinsic worth in usefulness or importance to the possessor," or "principles, standards, or qualities considered worthwhile or desirable."

4. Define Ethics.

Ethics refer to the moral principles that govern a person's behaviour or the conducting of an activity. It is the branch of knowledge that deals with moral principles. It also refers to rules provided by an external source.

5. Mention the various types of Ethics.

a) Descriptive ethics / morals
b) Normative ethics / prescriptive ethics
c) Metaethics / analytical ethics

6. What is Descriptive ethics?

Descriptive ethics is a study of human behaviour as a consequence of beliefs about what is right or wrong, or good or bad, insofar as that behaviour is useful or effective.

7. What is Normative Ethics?

Normative or perspective ethics is the study of moral problems which seeks to discover how one ought to act, not how one does in fact act or how one thinks one should act.

8. Define Meta Ethics.

Meta ethics is the discipline concerned with elucidating the meaning of ethical terms or the discipline concerned with the comparison of ethical theories.

9. Define Integrity.

Integrity is the quality of being honest and having strong moral principles; moral uprightness. It is generally a personal choice to uphold oneself to consistently moral and ethical standards. In ethics, integrity is regarded by many people as the honesty and truthfulness or accuracy of one's actions.

10. List the types of integrity.

1. Personal Integrity
2. Professional Integrity
3. Business Integrity
4. Academic Integrity
5. Research Integrity

11. Define Work Ethic.

Work ethic is a value based on hard work and diligence. It is also a belief in the moral benefit of work and its ability to enhance character. Work ethics are standard measures that control all functioning in a professional environment.

12. How can you ensure an employee is possessing work ethic?

The following five characters ensure the possession of work ethic in an employee;

a) Reliability
b) Dedication
c) Productivity
d) Co-operation
e) Character

13. What is Negative/ Bad work ethic?

Negative work ethics may be the behaviour of a single individual or something more systematic; regardless of the specifics, identifying the signs is the first step toward correcting it.

14. Define Service Learning.

Service-learning is a method of teaching, learning and reflecting, frequently youth service, throughout the community. As a teaching method, it falls under the philosophy of experiential education.

Service-learning is a teaching strategy that offers students opportunities to learn both in the classroom and in the wider world. This pedagogical tool provides students with chances to directly interact with local agencies and effect change in the community.

15. What are the various service learning methods followed?

The following are the four various types of service learning methods followed;

1. Direct Service-Learning
2. Indirect Service-Learning
3. Advocacy Service-Learning
4. Research Service-Learning

16. Define Civic Virtue.

Civic virtue is morality or a standard of righteous behaviour in relationship to a citizen's involvement in society.

Civic virtue is the cultivation of habits of personal living that are claimed to be important for the success of the community.

Civic virtue is also the dedication of citizens to the common welfare of their community even at the cost of their individual interests.

17. How can you show your respect for others?

Respect for other individuals can be shown in many forms, but the following four ways are simple and effective;

1. Showing gratitude
2. Respecting other's opinions
3. Respecting your enemies
4. Respecting yourself.

18. Define the term 'Caring'.

Caring can be defined as an act of feeling and exhibiting concern and empathy for others, i.e., feeling or showing care and compassion.

19. Define the term 'Sharing'

Sharing is the joint use of a resource or space. In its narrow sense, it refers to joint or alternating use of inherently finite goods, such as a common pasture or a shared residence. It is also the process of dividing and distributing.

20. What is meant by Honesty?

Honesty refers to a facet of moral character and denotes positive, virtuous attributes such as integrity, truthfulness, and straightforwardness along with the absence of lying, cheating, or theft.

21. Define Dishonesty.

Dishonesty may be defined as the act or to act without honesty. It is used to describe a lack of probity, cheating, lying or being deliberately deceptive or a lack in integrity, knavishness, perfidiosity, corruption or treacherousness. It is used about charlatanism and quacks.

22. Define Courage.

In general courage is the ability to face danger, difficulty, uncertainty, or pain without being overcome by fear.

Moral courage is about setting aside your fear and taking action for the good of yourself or someone else. Standing up for your ethical principles takes courage. Courage comes in confronting those feelings inside and taking action.

23. Define the two forms of courage.

Two forms of courage

- Physical courage
- Moral courage

Physical courage is when a person braves the potential for physical peril to engage in a right action.

Moral courage, choosing to do the right thing when faced with an ethical challenge or dilemma, takes character strength.

24. What is meant by Time Management?

Time Management refers to managing time effectively so that the right time is allocated to the right activity. Time Management also refers to making the best use of time as time is always limited.

25. Define Co-operation.

Co-operation is the process of groups of people working or acting together for their common/mutual benefit, as opposed to working in competition for self-benefit.

26. What are the types of Co-operation exists and define them?

There are two basic types of co-operation. They are as follows;

1. Direct co-operation.
2. Indirect co-operation.

1. Direct Co-operation:

Direct co-operation implies direct relationship among the individuals. In this type of co-operation, people do like things together.

2. Indirect Co-operation:

Indirect co-operation is just, the opposite of direct co-operation. In indirect co-operation people do different tasks towards a similar end.

27. What are the types of co-operation according to A.W. Green?

A.W. Green has divided co-operation into three types such as

1. Primary, Co-operation.
2. Secondary Co-operation.
3. Tertiary Co-operation.

28. What is social co-operation?

"Co-operation is the process by which the individuals or groups combine their effort, in a more or less organized way for the attainment of common 'objective'. Co-operation is a form of social interaction wherein two or more persons work together to gain a common end.

29. Define commitment.

In general commitment can be referred to the state or quality of being dedicated to a cause, activity, etc. A promise is also a form of commitment by someone to do or not do something.

An ethical commitment is like a duty, or a moral obligation. You are bound to the morals you go by. A commitment to legal ethics involves a commitment to the introduction of Codes of Ethics or Standards of Professional Practice.

30. Define Organizational commitment.

Organizational commitment is made up of more factors, such as faith and acceptance of the organization's set of values and objectives, the employee's wish to strive for the organization and a strong will to keep working within it.

31. What is Professional commitment?

The concept of professional commitment signifies an attitude reflecting the strength of the bound between an employee and an organization.

32. What are the types of commitment?

"The model of the three components of organizational commitment" defines the following three types of commitment;

1. Affective Commitment
2. Continuity Commitment
3. Normative Commitment

33. Define Empathy.

Empathy is the ability to co-experience and relate to the thoughts, emotions, or experience of another without them being communicated directly by the individual is referred to as empathy. Empathy can best be described as feeling with the person

34. What are the two major components of empathy?

Empathy can be divided into two major components: Affective and cognitive empathy

- Affective empathy, also called emotional empathy: the capacity to respond with an appropriate emotion to another's mental states.
- Cognitive empathy: the capacity to understand another's perspective or mental state.

35. Define Character.

Moral character or character is an evaluation of a particular individual's stable moral qualities. The concept of character can imply a variety of attributes including the existence or lack of virtues such as empathy, courage, fortitude, honesty, and loyalty, or of good behaviours or habits.

36. What is Spirituality?

Spirituality is a process of personal transformation, either in accordance with traditional religious ideals, or, increasingly, oriented on subjective experience and psychological growth independently of any specific religious context.

37. What is meditation?

Meditation is a practice that has been associated with almost all religions and civilizations across the word. Since it is so closely associated with religion, many people take meditation to be the same thing as praying.

38. Mention some benefits of practicing Yoga.

1. Increased Flexibility
2. Emotional Boost
3. Better Diet
4. Improved Health

39. What are the benefits of meditation?

Meditation has two important benefits:

a) Meditation prevents stress from getting into the system

b) Meditation releases accumulated stress that is in the system

39. What are the physical benefits of meditation?

A physical level, meditation does the following things:

- Lowers high blood pressure
- Lowers the levels of blood lactate, reducing anxiety attacks
- Decreases any tension-related pain, such as, tension headaches, ulcers, insomnia, muscle and joint problems
- Increases serotonin production that improves mood and behaviour
- Improves the immune system
- Increases the energy level, as you gain an inner source of energy

40. Give some of the mental benefits of meditation?

- Anxiety decreases
- Emotional stability improves
- Creativity increases
- Happiness increases
- Meditation sharpens the mind by gaining focus and expands through relaxation
- Meditation makes you aware - that your inner attitude determines your happiness.

41. Describe some ways for stress management.

Yoga and Meditation are two best and effective ways for stress management.

Regular yoga practice helps to reduce stress responses in your body, according to a study in the 2010.

Meditation is also an effective stress reducer that is used to help reduce anxiety, panic disorders and agoraphobia, an anxiety disorder.

2 UNIT

ENGINEERING ETHICS

2.0 INTRODUCTION

Engineering Ethics is the activity and discipline aimed at

(a) understanding the moral values that ought to guide engineering profession or practice,

(b) resolving moral issues in engineering, and

(c) justifying the moral judgments in engineering.

It deals with set of moral problems and issues connected with engineering. Engineering ethics is defined by the codes and standards of conduct endorsed by engineering(professional) societies with respect to the particular set of beliefs, attitudes and habits displayed by the individual or group.

Another important goal of engineering ethics is the discovery of the set of justified moral principles of obligation, rights and ideals that ought to be endorsed by the engineers and apply them to concrete situations.

Engineering is the largest profession and the decisions and actions of engineers affect all of us in almost all areas of our lives, namely public safety, health, and welfare.

2.0.1 Scope

The scope of engineering ethics is as follows:

a) Ethics of the workplace which involves the co-workers and employees in an organization.

b) Ethics related to the product or work which involves the transportation, warehousing, and use, besides the safety of the end product and the environment outside the factory.

2.0.2 Approach

There are conventionally two approaches in the study of ethics:

1. Micro-ethics → which deals with decisions and problems of individuals, professionals, and companies.
2. Macro-ethics → which deals with the societal problems on a regional/national level.

For example: Global issues, collective responsibilities of groups such as professional societies and consumer groups.

2.1 SENSE OF ENGINEERING ETHICS

There are two different senses (meanings) of engineering ethics, namely the Normative and the Descriptive senses.

The normative sense includes the following:

1. Knowing moral values, finding accurate solutions to moral problems and justifying moral judgments in engineering practices,
2. Study of decisions, policies, and values that are morally desirable in the engineering practice and research, and
3. Using codes of ethics and standards and applying them in their transactions by engineers.

The descriptive sense - refers to what specific individual or group of engineers believe and act, without justifying their beliefs or actions.

2.2 VARIETY OF MORAL ISSUES

The reasons for people including the employer and employees, behaving unethically may be classified into three categories:

1. Resource Crunch:

Due to pressure, through time limits, availability of money or budgetary constraints, and technology decay or obsolescence.

Pressure from the government to complete the project in time (e.g., before the elections), reduction in the budget because of sudden war or natural calamity (e.g., Tsunami) and obsolescence due technology innovation by the competitor lead to manipulation and unsafe and unethical execution of projects.

Involving individuals in the development of goals and values and developing policies that allow for individual diversity, dissent, and input to decision-making will prevent unethical results.

2. Opportunity:

(a) Double standards or behavior of the employers towards the employees and the public.

(b) Management projecting their own interests more than that of their employees. Some organizations over-emphasize short-term gains and results at the expense of themselves and others,

(c) Emphasis on results and gains at the expense of the employees, and

(d) Management by objectives, without focus on empowerment and improvement of the infrastructure.

3. Attitude:

Poor attitude of the employees set in due to

(a) Low morale of the employees because of dissatisfaction and downsizing,

(b) Absence of grievance redressal mechanism,

(c) Lack of promotion or career development policies or denied promotions,

(d) Lack of transparency,

(e) Absence of recognition and reward system, and

(f) Poor working environments.

Giving ethics training for all, recognizing ethical conduct in work place, including ethics in performance appraisal, and encouraging open discussion on ethical issues, are some of the directions to promote positive attitudes among the employees

To get firm and positive effect, ethical standards must be set and adopted by the senior management, with input from all personnel.

2.3 TYPES OF INQUIRIES

The three types of inquiries, in solving ethical problems are:

- Normative inquiry,
- Conceptual inquiry, and
- Factual or descriptive inquiry.

1. Normative Inquiry:

It seeks to identify and justify the morally-desirable norms or standards that should guide individuals and groups. It also has the theoretical goal of justifying particular moral judgments.

Normative questions are about what ought to be and what is good, based on moral values.

For example:

1. How far does the obligation of engineers to protect public safety extend in any given situation?
2. When, if ever, should engineers be expected to blow whistle on dangerous practices of their employers?

3. Whose values ought to be primary in making judgment about acceptable risks in design for a public transport system or a nuclear plant? Is it of management, senior engineers, government, voters or all of them?
4. When and why is the government justified in interfering with the organizations?
5. What are the reasons on which the engineers show their obligations to their employees or clients or the public?

2. Conceptual Inquiry:

It is directed to clarify the meaning of concepts or ideas or principles that are expressed by words or by questions and statements.

For example:

(a) What is meant by safety?

(b) How is it related to risk?

(c) What is a bribe?

(d) What is a profession?

When moral concepts are discussed, normative and conceptual issues are closely interconnected.

3. Factual or Descriptive Inquiry:

It is aimed to obtain facts needed for understanding and resolving value issues. Researchers conduct factual inquiries using mathematical or statistical techniques.

The inquiry provide important information on business realities, engineering practice, and the effectiveness of professional societies in fostering moral conduct, the procedures used in risk assessment, and psychological profiles of engineers.

The facts provide not only the reasons for moral problems but also enable us to develop alterative ways of resolving moral problems.

For example:

(a) How were the benefits assessed?

(b) What are procedures followed in risk assessment?

(c) What are short-term and long-term effects of drinking water being polluted? And

(d) Who conducted the tests on materials?

2.4 MORAL DILEMMA

2.4.1 Definition:

Dilemmas are situations in which moral reasons come into conflict, or in which the application of moral values are problems, and one is not clear of the immediate choice or solution of the problems.

Moral reasons could be rights, duties, goods or obligations. These situations do not mean that things had gone wrong, but they only indicate the presence of moral complexity. This makes the decision making complex.

For example:

A person promised to meet a friend and dine, but he has to help his uncle who is involved in an accident — one has to fix the priority. There are some difficulties in arriving at the solution to the problems, in dilemma. The three complex situations leading to moral dilemmas are:

1. The problem of vagueness

One is unable to distinguish between good and bad (right or wrong) principle. Good means an action that is obligatory.

For example, code of ethics specifies that one should obey the laws and follow standards. Refuse bribe or accept the gift, and maintain confidentiality

2. The problem of conflicting reasons

One is unable to choose between two good moral solutions. One has to fix priority, through knowledge or value system.

3. The problem of disagreement

There may be two or more solutions and none of them mandatory. These solutions may be better or worse in some respects but not in all aspects.

One has to interpret, apply different morally reasons, and analyze and rank the decisions. Select the best suitable, under the existing and the most probable conditions.

2.4.2 Steps to Solve Dilemma

The logical steps in confronting moral dilemma are:

1. Identification of the moral factors and reasons. The clarity to identify the relevant moral values from among duties, rights, goods and obligations is obtained (conceptual inquiry).

   The most useful resource in identifying dilemmas in engineering is the professional codes of ethics, as interpreted by the professional experience. Another resource is talking with colleagues who can focus or narrow down the choice of values.

2. Collection of all information, data, and facts (factual inquiry) relevant to the situation.

3. Rank the moral options i.e., priority in application through value system, and also as obligatory, all right, acceptable, not acceptable, damaging, and most damaging etc. For example, in fulfilling responsibility, the codes give prime importance to public safety and protection of the environment, as compared to the individuals or the employers (conceptual inquiry).
4. Generate alternate courses of action to resolve the dilemma. Write down the main options and sub-options as a matrix or decision tree to ensure that all options are included.
5. Discuss with colleagues and obtain their perspectives, priorities, and suggestions on various alternatives.
6. Decide upon a final course of action, based on priority fixed or assumed. If there is no ideal solution, we arrive at a partially satisfactory or 'satisfying' solution.

2.5 MORAL AUTONOMY

Moral autonomy is defined as, decisions and actions exercised on the basis of moral concern for other people and recognition of good moral reasons. Alternatively, moral autonomy means 'self determinant or independent'.

The autonomous people hold moral beliefs and attitudes based on their critical reflection rather than on passive adoption of the conventions of the society or profession. Moral autonomy may also be defined as a skill and habit of thinking rationally about the ethical issues, on the basis of moral concern.

Viewing engineering as social experimentation will promote autonomous participation and retain one's professional identity. Periodical performance appraisals, tight-time schedules and fear of foreign competition threatens this autonomy.

It appears that the blue-collar workers with the support of the union can adopt better autonomy than the employed professionals. Only recently the legal support has been obtained by the professional societies in exhibiting moral autonomy by professionals in this country as well as in the West.

The engineering skills related to moral autonomy are listed as follows:

1. Proficiency in recognizing moral problems in engineering and ability to distinguish as well as relate them to problems in law, economics, and religion,
2. Skill in comprehending clarifying and critically assessing arguments on different aspects of moral issues.
3. Ability to form consistent and comprehensive view points based on facts,
4. Awareness of alternate responses to the issues and creative solutions for practical difficulties,
5. Sensitivity to genuine difficulties and subtleties, including willingness to undergo and tolerate some uncertainty while making decisions,

6. Using rational dialogue in resolving moral conflicts and developing tolerance of different perspectives among morally reasonable people, and
7. Maintaining moral integrity

- **Autonomy** which is the independence in making decisions and actions, is different from authority.
- **Authority** provides freedom for action, specified within limits, depending on the situation.
- **Moral autonomy** and **respect for authority** can coexist. They are not against each other.
- If the authority of the engineer and the moral autonomy of the operator are in conflict, a consensus is obtained by the two, upon discussion and mutual understanding their limits.

2.6 MORAL DEVELOPMENT (THEORIES)

1. Kohlberg Theory:

Moral development in human being occurs overage and experience. Kohlberg suggested there are three levels of moral development, namely:

- Pre-conventional,
- Conventional, and
- Post-conventional,

Based on the type of reasoning and motivation of the individuals in response to moral questions.

In the pre-conventional level, right conduct for an individual is regarded as whatever directly benefits oneself.

At this level, individuals are motivated by obedience or the desire to avoid punish mentor to satisfy their own needs or by the influence by power on them. All young children exhibit this tendency.

At the conventional level, people respect the law and authority. Rules and norms of one's family or group or society is accepted, as the standard of morality.

Individuals in this level want to please or satisfy, and get approval by others and to meet the expectations of the society, rather than their self interest (e.g., good boy, good girl). Loyalty is regarded as most important. Many adults do not go beyond this level.

At the post-conventional level, people are called autonomous. They think originally and want to live by universally good principles and welfare of others. They have no self-interest.

They live by principled conscience. They follow the golden rule, 'Do unto others as you would have them do unto you'. They maintain moral integrity, self-respect and respect for others.

Kohlberg believed that individuals could only progress through these stages, one stage at a time. He believed that most of the moral development occurs through social interactions.

2. Gilligan's Theory

- Carol Gilligan found that Kohlberg's theory had a strong male bias.
- According to Gilligan's studies, men had a tendency to solve problems by applying abstract moral principles.
- Men were found to resolve moral dilemma by choosing the most important moral rule, overriding other rules.
- In contrast, women gave importance to preserve personal relationships with all the people involved.
- The context oriented emphasis on maintaining personal relationships was called the ethics of care, in contrast with the ethics of rules and rights adopted by men.
- Gilligan revised the three levels of moral development of Kohlberg, as stages of growth towards ethics of caring.

The pre-conventional level, which is same as that of Kohlberg's first one, right conduct, is viewed in a selfish manner solely as what is good for oneself.

The second level called conventional level , the importance is on not hurting others, and willing to sacrifice one's own interest and help others. This is the characteristic feature of women.

At the post-conventional level, a reasoned balance is found between caring about others and pursuing the self-interest. The balance one's own need and the needs of others, is aimed while maintaining relationship based on mutual caring. This is achieved by context-oriented reasoning, rather than by hierarchy of rules.

The theories of moral development by Kohlberg and Gilligan differ in the following respects.

Kohlberg's Theory	Carol Gilligan's Theory
A. Basic Aspects	
1. Is based on the study on men. 2. Men give importance to moral rule. 3. Ethics of rules and rights.	1. Is based on the study on men and women. 2. Women always want to keep up the personal relationships with all the persons involved in the situations. 3. Women give attention to circumstance leading to critical situations rather than rules. (context-oriented and ethics of care)

B. Characteristic Features		
1.	Justice	1. Reasons
2.	Factual	2. Emotional
3.	Right or wrong	3. Impact on relationships
4.	Logic only	4. Compassion too
5.	Logic and rule-based	5. Caring and concern
6.	Less of caring	6. More of caring
7.	Matter of fact (practical)	7. Abstract
8.	Present focus	8. Future focus
9.	Strict rules	9. Making exceptions
10.	Independence	10. Dependence
11.	Rigid	11. Human – oriented
12.	Taking a commanding role	12. Shying away from decision –making
13.	Transactional approach	13. Transformational approach

The difference in these two theories is explained through the well-known example,

Heinz's Dilemma:

Heinz being poor and a debtor could not buy the costly medicine for his sick wife, at ten times the normal cost. Initially he begged the Pharmacist to sell at half the price or allow him to pay for it later. Pharmacist refused to oblige him either way. Finally he forcibly entered the Pharmacy and stole the drug.

According to Kohlberg study, men observed that the theft was morally 'wrong' at the conventional level, because the property right was violated.

But men at the post-conventional level, concluded that the theft was 'right', as the life of the human being was in danger.

But women observed that Heinz was wrong. They observed that instead of stealing he could have tried other solutions (threatening or payment in installments?) to convince the Pharmacist. Gilligan however attributed the decision by women as context-oriented and not on the basis of rules ranked in the order of priority.

2.7 CONSENSUS AND CONTROVERSY

Consensus and controversy are factors relevant to moral autonomy.

Consensus –means agreement.

Controversy – means conflict / disagreement.

Many reasonable solutions are possible to a given ethical problem. The ethics make the engineers realize the importance of tolerance among the agreement and disagreement over a problem.

2.8 MODELS OF PROFESSIONAL ROLES

Promotion of public good is the primary concern of the professional engineers. There are several role models to whom the engineers are attracted. These models provoke their thinking, attitudes and actions.

1. Savior

The engineer as a savior, save the society from poverty, illiteracy, wastage, inefficiency, ill health, human (labor) dignity and lead it to prosperity, through technological development and social planning.

For example, R.L. Stevenson.

2. Guardian

He guards the interests of the poor and general public. As one who is conversant with technology development, is given the authority befitting his expertise to determine what is best suited to the society.

For example, Lawrence of Arabia (an engineer).

3. Bureaucratic Servant

He serves the organization and the employers. The management of an enterprise fixes its goals and assigns the job of problem solving to the engineer, who accepts the challenge and shapes them into concrete achievements.

For example, Jamshedji Tata.

4. Social Servant

It is one who exhibits social responsibility. The engineer translates the interest and aspirations of the society into a reality, remembering that his true master is the society at large.

For example, SirM.Viswesvarayya.

5. Social Enabler and Catalyst

One who changes the society through technology. The engineer must assist the management and the society to understand their needs and make informed decisions on the desirable technological development and minimize the negative effects of technology on people and their living environment. Thus, he shines as a social enabler and a catalyst for further growth.

For example, Sri Sundarlal Bahuguna.

6. Game Player

He is neither a servant nor master. An engineer is an assertive player, not a passive player who may carry out his master's voice. He plays a unique role successfully within the organization, enjoying the excitement of the profession and having the satisfaction of surging ahead in a competitive world.

For example, Narayanamurthy, Infosys and Dr. Kasthurirangan, ISRO.

2.8.1. Profession

2.8.1.1. Definitions

a) ***Profession*** - is defined as any occupation / job / vocation that requires advanced expertise, self regulation. It brings a high status, socially and economically.

The characteristics of profession are:

- Advanced expertise
- Self regulation
- Public good.

b) ***Professional*** – relates to a person or any work that a person does on profession, and it requires expertise, self regulation and results in public good. The term professional means a 'person' as well as a 'status'.

c) ***Professionalism*** – is the status of a professional which implies certain attitudes or typical qualities that are expected to be a professional.

The criteria for achieving and sustaining professional status or professionalism are:

1. ***Advanced expertise:*** The expertise includes sophisticated skills and theoretical knowledge in exercising judgment. This means a professional should analyze the problem in specific known area, in an objective manner.
2. ***Self-regulation:*** One should analyze the problem independent of self-interest and direct to a decision towards the best interest of the clients/customers. An autonomous judgment (unbiased and on merits only) is expected. In such situations, the codes of conduct of professional societies are followed as guidance.
3. ***Public good :*** One should not be a mere paid employee of an individual or a teaching college or manufacturing organization, to execute whatever the employer wants one to do. The job should be recognized by the public. The concerted efforts in the job should be towards promotion of the welfare, safety, and health of the public.

2.8.1.2 Characteristics

The characteristics of the 'profession' as distinct from 'non-professional occupation' are listed as follows:

1. Extensive Training :

Entry into the profession requires an extensive period of training of intellectual (competence) and moral (integrity) character.

The theoretical base is obtained through formal education, usually in an academic institution.

It may be a Bachelor degree from a college or university or an advanced degree conferred by professional schools.

2. Knowledge and Skills:

Knowledge and skills (competence) are necessary for the well-being of the society.

- Knowledge of physicians protects us from disease and restores health.
- The lawyer's knowledge is useful when we are sued of a crime, or if our business is to be merged or closed or when we buy a property.
- The Chartered Accountant's knowledge is important for the success of recording financial transactions or when we file the income return.

The knowledge, study, and research of the engineers are required for the safety of the air plane, for the technological advances and for national defense.

3. Monopoly:

The monopoly control is achieved in two ways:

(a) The profession convinces the community that only those who have graduated from the professional school should be allowed to hold the professional title. The profession also gains control over professional schools by establishing accreditation standards

(b) By persuading the community to have a licensing system for those who want to enter the profession. If practicing without license, they are liable to pay penalties.

4. Autonomy in Workplace:

Professionals engaged in private practice have considerable freedom in choosing their clients or patients.

Even the professionals working in large organizations exercise a large degree of impartiality, creativity and discretion (care with decision and communication) in carrying their responsibilities. Besides this, professionals are empowered with certain rights to establish their autonomy.

Accordingly physicians must determine the most appropriate medical treatments for their patients and lawyers must decide on the most successful defense for their clients. The possession of specialized knowledge is thus a powerful defense of professional autonomy.

5. Ethical Standards:

Professional societies promulgate the codes of conduct to regulate the professionals against their abuse or any unethical decisions and actions (impartiality, responsibility) affecting the individuals or groups or the society.

2.9 THEORIES ABOUT RIGHT ACTION (ETHICAL THEORIES)

2.9.1. Ethical Theories/Approaches

Several ethical theories have been developed over different times, each of them stressing certain ethical principles or features. Each stresses a view and many a times, we find that these theories converge and reinforce the ethics, in deciding upon the actions and justifying the results.

1. Utilitarian Theory :

The term Utilitarianism was conceived in the 19th century by Jeremy Bentham and John Stuart Mill to help legislators determine which laws were morally best. They suggested that the standard of right conduct is maximization of good consequences.

Good consequences mean either 'utilities' or the 'balance of good over evil'. This approach weighs the costs and benefits.

Right actions are the ones that produce the greatest satisfaction of the preferences of the affected persons. In analyzing an issue in this approach, we have to consider the following:

(a) Identify the various courses of action available to us.

(b) Ask who will be affected by each action and what benefits or harms will be derived from each.

(c) Choose the action that will produce the greatest benefits and the least harm. The ethical action is the one that provides the greatest good for the greatest number.

The ACT UTILITARIAN theory proposed by J.S. Mill (1806-73) focuses on actions, rather than on general rules. An action is right, if it generates the most overall good for the most people involved.

The RULE UTILITARIAN theory, developed by Richard Brandt (1910-97), stressed on the rules, such as 'do not steal', 'do no harm others', 'do not bribe', as of primary importance. He suggested that individual actions are right when they are required by set of rules which maximizes the public good.

The act utilitarian theory permitted a few immoral actions. Hence, there was need to develop rule utilitarian theory to establish morality and justice, in the transactions.

For example, stealing an old computer from the employer will benefit the employee more than the loss to the employer. As per Act, utilitarian this action is right. But rule utilitarian observes this as wrong, because the employee should act as 'faithful agent or trustee of the employees'.

2. Duty Ethics :

(a) The duty ethics theory, proposed by Immanuel Kant (1724-1804) states, that actions are consequences of performance of one's duties such as, 'being honest', 'not cause suffering of others', 'being fair to others including the meek and week', 'being grateful', 'keeping promises' etc.

The stress is on the universal principle of respect for autonomy i.e., respect and rationality of persons. As per Kant we have duties to ourselves, as we are rational and autonomous beings.

Kant insisted that moral duties are categorical imperatives. They are commands that we impose on ourselves as well as other rational beings.

For example: We should be honest because honesty is required by duty. A business-

man is to be honest because honesty pays — in terms of profits from customers and from avoiding jail ford is honesty.

(b) On the other hand, the DUTY ethics theory, as enunciated by John Rawl, gave importance to the actions that would be voluntarily agreed upon by all persons concerned, assuming impartiality. His view emphasized the autonomy each person exercises in forming agreements with other rational people.

Rawl proposed two basic moral principles;

1. each person is entitled to the most extensive amount of liberty compatible with an equal amount for others, and
2. differences in social power and economic benefits are justified only when they are likely to benefit everyone, including members of the most disadvantaged groups.
   - The first principle is of prime importance and should be satisfied first. Without basic liberties other economic or social benefits cannot be sustained for long.
   - The second principle insists that to allow some people with great wealth and power is justified only when all other groups are benefited.

In the business scenario, for example, the free enterprise is permissible so far it provides the capital needed to invest and prosper, thereby making job opportunities to the public and taxes to fund the government spending on the welfare schemes on the poor people.

C.W.D. Ross, the British philosopher introduced the term prima facie duties , which means duties might have justified exceptions. In fact, most duties are prima facie ones; some may have obligatory or permissible exceptions.

Ross assumed that the prima facie duties are intuitively obvious (self-evident), while fixing priorities among duties. He noted that the principles such as 'Do not kill' and 'protect innocent life' involve high respect for persons than other principles such as, 'Do not lie' (less harmful).

This theory is criticized on the fact, that the intuitions do not provide sufficient guideline for moral duty. He has listed various aspects of Duty Ethics that reflect our moral convictions, namely:

1. FIDELITY: Duty to keep promises.
2. REPARATION: Duty to compensate others when we harm them.
3. GRATTITUDE: Duty to thank those who help us.
4. JUSTICE: Duty to recognize merit.
5. BENEFICENCE: Duty to recognize inequality and improve the condition of others.
6. SELF – IMPROVEMENT: Duty to improve virtue and intelligence.
7. NON – MALFESANCE: Duty not to injure others.

3. Rights Theory :

Rights are entitlement to act or to have another individual act in a certain way. Minimally, rights serve as a protective barrier, shielding individuals from unjustified infringement of their moral agency by others. For every right, we have a corresponding duty of non interference.

(a) The RIGHTS approach to ethics has its roots in the 18th century philosopher **Immanuel Kant** , who focused on the individual's right to choose for oneself.

According him, what makes human beings different from mere things is, that people have dignity based on their ability to choose freely what they will do with their lives, and they have a fundamental moral right to have these choices respected.

People are not objects to be manipulated; it is a violation of human dignity to use people in ways they do not freely choose. Other rights he advocated are:

1. The right to access the truth: We have a right to be told the truth and to be informed about matters that significantly affect our choices.
2. The right of privacy: We have the right to do, believe, and say whatever we choose in our personal lives so long as we do not violate the rights of others.
3. The right not to be injured: We have the right not to be harmed or injured unless we freely and knowingly do something to deserve punishment or we freely and knowingly choose to risk such injuries.
4. The right to what is agreed: We have a right to what has been promised by those with whom we have freely entered into a contract or agreement.

(b) In deciding whether an action is moral or immoral, we must ask, does the action respect the moral rights of everyone? Actions are wrong to the extent that they violate the rights of individuals; the more serious is the violation, the more wrongful is the action.

The RIGHTS theory as promoted by **John Locke** states that the actions are right, if they respect human rights of every one affected. He proposed the three basic human rights, namely life, liberty, and property . His views were reflected in the modern American society, when Jefferson declared the basic rights as life, liberty, and pursuit of happiness.

(c) As per **A.I. Melden's** theory based on rights, nature mandates that we should not her mothers' life, health, liberty or property. Melden allowed welfare rights also for living a decent human life. He highlighted that the rights should be based on the social welfare system.

(d) **Human rights:** Human rights are explained in two forms, namely liberty rights and welfare rights. Liberty rights are rights to exercise one's liberty and stresses duties on other people not to interfere with one's freedom.

The four features of liberty rights (also called moral rights), which lay the base for Government Administration, are:

1. Rights are natural in so far as they are not invented or created by government.
2. They are universal, as they do not change from country to country.
3. They are equal since the rights are the same for all people, irrespective of caste, race, creed or sex.
4. They are inalienable i.e., one cannot hand over his rights to another person such as selling oneself to slavery. The Welfare Rights are the rights to benefit the needy for a decent human life, when one cannot earn those benefits and when those benefits are available in the society.

(e) Economic rights: In the free-market economy, the very purpose of the existence of the manufacturer, the sellers and the service providers is to serve the consumer. The consumer is eligible to exercise some rights.

The consumers' six basic rights are:

- Right to Information,
- Right to Safety,
- Right to Choice,
- Right to be Heard,
- Right to Redressal, and
- Right to Consumer Education.

A few rights are absolute, i.e., unlimited and have no justifiable exceptions.

Rights ethics is distinctive in that it makes human rights the ultimate appeal — the moral bottom line.

Human rights constitute a moral authority to make legitimate moral demands on others to respect our choices, recognizing that others can make similar claims on us.

Thus, we see that the rights ethics provides a powerful foundation for the special ethical requirements in engineering and other professions.

4. The Virtue Theory:

This emphasizes on the character rather than the rights or duties. The character is the pattern of virtues (morally-desirable features).

The theory advocated by Aristotle, stressed on the tendency to act at proper balance between extremes of conduct, emotion, desire, attitudes to find the golden mean between the extremes of 'excess' or 'deficiency'.

The examples shown below illustrate the theory:

Virtue	Excess	Golden mean	Deficient
Truthfulness (governs communication)	Revealing all in violation of tact and confidentiality	Necessary and sufficient to proper person	Secretive
Courage (face danger, risk)	Roguishness, bold	Firm and humble	Cowardice
Generosity (giving)	Wasting resources	Give in appropriate measure	Miserly
Friendliness (governs relationship)	Without anger, effusive	Within decent limits	Bad-tempered
Green environment	Exploitation	Protection	Neglect
Work and earn	Tiresome work (strained)	Balance of work and leisure.	Lazy (on work) and more pay

On the other hand, the Virtue Theory proposed by **Mac Intyre,** highlighted on the actions aimed at achieving common good and social (internal) good such as social justice, promotion of health, creation of useful and safe technological products and services. Five types of virtues that constitute responsible professionalism, namely public-spirited virtues, proficiency virtues, team-work virtues, self-governance virtues, and cardinal virtues.

5. Self-Realization Ethics :

Right action consists in seeking self-fulfillment. In one version of this theory, the self to be realized is defined by caring relationships with other individuals and society. In another version called ethical egoism , the right action consists in always promoting what is good for oneself. No caring and society relationships are assumed.

6. Justice (Fairness) Theory :

The justice or fairness approach to ethics has its roots in the teachings of the ancient Greek philosopher Aristotle, who said that "equals should be treated equally and unequals unequally."

The basic moral question in this approach is: How fair is an action? Does it treat everyone in the same way, or does it shown favoritism and discrimination?

2.9.2 Case Study: Choice Of The Theory

The choice of the ethical theory to study a problem is illustrated herein with an example. In tackling ethical problems, we can apply all the theories and analyze the actions and results from different angles and see what result each theory gives rise to.

This enables us to examine the problem in different perspectives. Many a time, the result will be the same though we have applied various theories.

CASE

A chemical plant near a small town is discharging hazardous wastes into the fields nearby. The ground water gets contaminated and significant health problems surface in the community. Since harm is caused to the residents, the action is unethical as per rights ethics.

The agriculturists who have the agrarian right of water supply have been over looked. The pollutants may endanger their profession and welfare. Hence, rights ethics also concludes that the action is unethical.

The effects of polluted water and the cost to purify the water by the municipality may outweigh the economic benefits of the plant.

Hence, the utilitarian analysis leads to the same conclusion. The groundwater harms the people and caused health problems. Hence, discharging the pollutants is unethical as per duty ethics.

Generally, because the rights of the individuals should weigh strongly than the needs of the society as a whole, rights and duty ethics take precedence over utilitarian considerations. Caution is necessary in applying theory of virtue ethics.

When we use the word 'honor', we mean it to be a measure of dignity and integrity. It is a positive virtue. When it points to 'pride' it is not a virtue and has a negative connotation.

In using virtue ethics, we have to ensure that the traits of virtue are actually virtuous and will not lead to negative consequences.

2.10 SELF - INTEREST

Self-interest is being good and acceptable to oneself. It is pursuing what is good for oneself. It is very ethical to possess self-interest.

- As per utilitarian theory, this interest should provide for the respect of others also.
- Duty ethics recognizes this aspect as duties to us. Then only one can help others. Right ethicist stresses our rights to pursue our own good.
- Virtue ethics also accepts the importance of self-respect as link to social practices.
- In Ethical Egoism, the self is conceived in a highly individualistic manner. It says that every one of us should always and only promote one's own interest. The ethical egoists do not accept the wellbeing of the community or caring for others.

However this self interest should not degenerate into egoism or selfishness, i.e., maximizing only own well in the pursuit of self-interest.

The ethical egoists hold that the society benefits to maximum when

(a) the individuals pursue their personal good and

(b) The individual organizations pursue maximum profit in a competitive enterprise.

Self-respect includes recognition of our vulnerabilities and interdependencies. Hence, it is compatible with caring for ourselves as well as others. Self-interest is necessary initially to begin with.

But it should be one of the prime motives for action; the other motive is to show concern for others, in the family as well as society. One's self-interest should not harm others. The principles of 'Live and let (others) live', and 'reasonably fair competition' are recommended to professionals by the ethicists.

2.10.1 Ethics and Virtue

The fundamental question of ethics is, "What should I do?" or "How should I act?" Ethics is supposed to provide us with "moral principles" or universal rules that tell us what to do.

Moral principles like these focus primarily on people's actions and doings. We "apply" them by asking what these principles require of us in particular circumstances. We also apply them when we ask what they require of us as professionals, e.g., lawyers, doctors, or business people, or what they require of our social policies and institutions.

In the last decade, dozens of ethics centers and programs devoted to "business ethics", "legal ethics", "medical ethics", and "ethics in public policy" have sprung up. These centers are designed to examine the implications moral principles have for our lives.

In other words, the fundamental question of ethics is not "What should I do?" but "What kind of person should I be?"

According to "virtue ethics", there are certain ideals, such as excellence or dedication to the common good, toward which we should strive and which allow the full development of our humanity. These ideals are discovered through thoughtful reflection on what we as human beings have the potential to become.

Definition:

"Virtues" are attitudes, dispositions, or character traits that enable us to be and to act in ways that develop this potential. They enable us to pursue the ideals we have adopted. Honesty, courage, compassion, generosity, fidelity, integrity, fairness, self-control, and prudence are all examples of virtues.

To develop personal virtues:

How does a person develop virtues? Virtues are developed through learning and through practice. As the ancient philosopher Aristotle suggested, a person can improve his or her character by practicing self-discipline, while a good character can be corrupted by repeated self-indulgence. Just as the ability to run a marathon develops through much training and practice, so too does our capacity to be fair, to be courageous, or to be compassionate.

Virtues are habits. That is, once they are acquired, they become characteristic of a person. For example, a person who has developed the virtue of generosity is often referred to as a generous person because he or she tends to be generous in all circumstances.

Moreover, a person who has developed virtues will be naturally disposed to act in ways that are consistent with moral principles. The virtuous person is the ethical person. At the heart of the virtue approach to ethics is the idea of "community".

2.11 CUSTOMS

Ethical Pluralism:

Various cultures in our pluralistic society lead to tolerance for various customs, beliefs, and outlooks. Accordingly ethical pluralism also exists. Although many moral attitudes appear to be reasonable, the rational and morally concerned people cannot fully accept any one of the moral perspectives.

There are many varied moral values, which allow variation in the understanding and application of values by the individuals or groups in their everyday transactions. It means that even reasonable people will not agree on all moral issues and professional ethics.

Ethical Relativism:

According to this principle, actions are considered morally right when approved by law or custom, and wrong when they violate the laws or customs. The deciding factor is the law or the customs of the society.

Should we accept the principle of relativism or not? A few reasons to accept this are explained in the following points:

1. Laws appear to be objective ways for judging values. The laws and customs tend to be definite, clear and real, but not always. Further moral reasons allow objective criticism of laws, as being morally lacking.

   For example, the Apartheid laws of South Africa violated the human rights of the native Africans. No legal protection was available for native citizens for a long time. Now, of course, these laws have been repealed.

2. Ethical relativism assumes that the values are subjective at the cultural level. Moral standard also vary from culture to culture. The objectivity is supported by the existing laws of that society.

   The relative morality accepted, supports the virtue of tolerance of differences among societies. This argument is also not fully acceptable.

   As per ethical relativism, the actions and laws of the Nazis and Hitler who vowed on Anti-Semitism and killed several million Jews would be accepted as right.

3. Moral relationalism or moral contextualism: According to this, the moral judgments must be made in relation to certain factors, which may vary from case to case.

   The morally important factors for making judgments include the customs and laws. The virtue ethicists hold that the practical wisdom should prevail upon assessing the facts and in the judgment.

   This principle was accepted by the early anthropologists because they had a specific tendency to over-stress the scope of moral difference between cultures. The human sacrifices and cannibalism were accepted.

But the modern anthropologists insist that all cultures shall exhibit the virtue of social welfare and safety against needless death or physical or mental harm. Moral differences were based on the circumstances and facts and not on the difference in moral attitudes.

2.12 RELIGION

Religions have played major roles in shaping moral views and moral values, over geographical regions.

Christianity has influenced the Western countries, Islam in the Middle-East countries, Buddhism and Hinduism in Asia, and Confucianism in China. Further, there is a strong psychological link between the moral and religious beliefs of people following various religions and faiths.

Religions support moral responsibility. They have set high moral standards. Faith in the religions provides trust and this trust inspires people to be moral. The religions insist on tolerance and moral concern for others.

Many professionals who possess religious beliefs are motivated to be morally responsible. Each religion lays stress on certain high moral standards.

For example:

Hinduism holds polytheistic (many gods) view, and virtues of devotion and surrender to high order.

Christianity believes in one deity and emphasizes on virtues of Love, Faith, and Hope.

Buddhism is non-theistic and focuses on compassion and Islam on one deity and adherence of ishan (piety or pursuit of excellence) and prayer.

Judaism stresses the virtue of 'tsedakah' (righteousness). But many religious sects have adopted poor moral standards, e.g., many religious sects do not recognize equal rights for women. The right to worship is denied for some people.

People are killed in the name of or to promote religion. Thus, conflicts exist between the 'secular' and religious people and between one religion and another. Hence, religious views have to be morally scrutinized.

2.12.1 Divine Command Ethics

As per this principle, the right action is defined by the commands by God. It implies that to be moral, a person should believe in God and an action is right only if it is commanded by God. There are some difficulties in this approach, namely,

(a) Whether God exists or not is not clear.

(b) How to know what are the God's commands? and

(c) How to verify the genuineness of the commands?

Further, religions such as Hinduism, Islam, and Christianity accept the existence of God. But Buddhism, Taoism, and Confucianism adopt only faith in a right path and do not believe in God.

Socrates was said to have argued that God, an entity which is responsible, morally good, and beyond fear or favor, would not command murder, torture, immoral activities, and even mass suicide.

Many such crimes were committed in the name of God then and continue even now in different parts of the world. Some Western leaders had claimed that God had commanded them to invade against the Middle-East countries. If anyone claims to have obtained commands from God to kill people merciless, then we have to conclude that the person is not religious but insane.

2.13 USES OF ETHICAL THEORIES

The ethical theories are useful in many respects.

1. In understanding moral dilemma. They provide clarity, consistency, systematic and comprehensive understanding.
2. It provides helpful practical guidance in moral issues towards the solution.
3. Justifying professional obligations and decisions, and
4. In relating ordinary and professional morality.

Different criteria may be applied for evaluating various ethical theories and deciding upon the best.

1. The theory must be clear and (coherent) formulated with concepts that are logically connected.
2. It must be internally consistent, i.e., none of its principles conflicts with any other
3. The theory and its defense must depend, only upon facts.
4. It must organize basic moral values in systematic and comprehensive manner. It is to fix priority of values and provide guidance in all situations
5. It must provide guidance compatible with our moral convictions (judgments) about concrete situations.

For example: if an ethical theory says that it is all right for engineers to make explosive devices without the informed consent of the public, we can conclude that the theory is inadequate.

Theories and judgments are continually adjusted to each other until we reach a reflective equilibrium. Most of the theories converge towards the welfare of the humanity. The duty ethics and right ethics differ in great extent on their emphasis. But they remain complementary always.

TWO MARK QUESTIONS & ANSWERS

1. **What is Ethics?**
   - Study of right or wrong.
   - Good and evil.
   - Obligations & rights.
   - Justice.
   - Social & Political deals.
2. **Define Engineering Ethics?**
   (a) Study of the moral issues and decisions confronting individuals and organizations engaged in engineering / profession.
   (b) Study of related questions about the moral ideals, character, policies and relationships of people and corporations involved in technological activity.
   (c) Moral standards / values and system of morals.
3. **What is the need to study Ethics?**
   - To responsibly confront moral issues raised by technological activity.
   - To recognize and resolve moral dilemma.
   - To achieve moral autonomy.
4. **Differentiate Moral and Ethics?**

   MORAL:
   - Refers only to personal behavior.
   - Refers to any aspect of human action.
   - Social conventions about right or wrong conduct.

   ETHICS:
   - Involves defining, analyzing, evaluating and resolving moral problems and developing moral criteria to guide human behavior.
   - Critical reflection on what one does and why one does it.
   - Refers only to professional behavior.
5. **What is the method used to solve an Ethical problem?**
   - Recognizing a problem or its need.
   - Gathering information and defining the problem to be solved or goal to be achieved.

- Generating alternative solutions or methods to achieve the goal.
- Evaluate benefits and costs of alternate solutions.
- Decision making & optimization.
- Implementing the best solution.

6. What are the Senses of Engineering Ethics?

- An activity and area of inquiry.
- Ethical problems, issues and controversies.
- Particular set of beliefs, attitudes and habits.
- Morally correct.

7. Differentiate Micro-ethics and Macro-ethics?

Micro-ethics : Deals about some typical and everyday problems which play an important role in the field of engineering and in the profession of an engineer.

Macro-ethics : Deals with all the societal problems which are unknown and suddenly burst out on a regional or national level.

8. What are the three types of Inquiry?

- Normative Inquiry – Based on values.
- Conceptual Inquiry – Based on meaning.
- Factual Inquiry – Based in facts.

9. What are the sorts of complexity and murkiness that may be involved in moral situations?

- Vagueness
- Conflicting reasons
- Disagreement

10. What are the steps in confronting Moral Dilemmas?

- Identify the relevant moral factors and reasons.
- Gather all available facts that are pertinent to the moral factors involved.
- Rank the moral considerations in order of importance as they apply to the situation.
- Consider alternative courses of actions as ways of resolving dilemma, tracing the full implications of each.
- Get suggestions and alternative perspectives on the dilemma.
- By weighing all the relevant moral factors and reasons in light of the facts, produce a reasoned judgment.

11. Define Moral Autonomy?

It is the quality of

- Self-determining
- Independent
- Personal Involvement
- Exercised based on the moral concern for other people and recognition of good moral reasons

12. Give the importance of Lawrence Kohlberg's and Carol Gilligan's theory?

1. Kohlberg gives greater emphasis to recognizing rights and abstract universal rules.
2. Gilligan stresses the importance of maintaining personal relationships based on mutual caring.

13. Give the need for Authority?

Authority provides the framework in which learning can take place.

14. What are the criteria required for a Profession?

- Knowledge
- Organization
- Public Good

15. Give the general criteria to become a Professional engineer?

1. Attaining standards of achievement in education, job performance or creativity in engineering that distinguish engineers from engineering technicians and technologists.
2. Accepting as part of their professional obligations as least the most basic moral responsibilities to the public as well as to their employers, clients, colleagues and subordinates.

16. Define Compromise?

- In a negative sense it means to undetermined integrity by violating one's fundamental moral principles.
- In a positive sense, however, it means to settle differences by mutual concessions or to reconcile conflicts through adjustments in attitude and conduct.

17. Give the two aspects of Honesty?

1. ***Truthfulness*** – meeting responsibilities concerning truth-telling.
2. ***Trustworthiness*** – Meeting responsibilities concerning trust.

18. When will you tell an Act as an involuntary one?

1. Act done in ignorance
2. Act performed under compulsion

19. What are the types of Theories about Morality?

1. Virtue ethics – Virtues and vices
2. Utilitarianism – Most good for the most people
3. Duty ethics – Duties to respect people
4. Rights ethics – Human rights

20. Differentiate Hypothetical imperatives and Moral imperatives?

Hypothetical imperatives are based on some conditions whereas Moral imperatives wont based on some condition.

21. State Rawl's principles?

1. Each person is entitled to the most extensive amount of liberty compatible with an equal amount for others.
2. Differences in social power and economic benefits are justified only when they are likely to benefit everyone, including members of the most disadvantaged groups.

22. Give the various tests required to evaluate the Ethical Theories?

- Theory must be clear, and formulated with concepts that are coherent and applicable.
- It must be internally consistent in that none of its tenets contradicts any other.
- Neither the theory nor its defense can rely upon false information.
- It must be sufficiently comprehensive to provide guidance in specific situations of interests to us.
- It must be compatible with our most carefully considered moral convictions about concrete situations.

23. Give the drawbacks of Utilitarianism?

- Sometimes what is best for the community as a whole is bad for certain individuals in the community.
- It is often impossible to know in advance which decision will lead to the most good.

24. Give the drawback of Duty Ethics?

Duty ethics does not always lead to a solution which maximizes the public good.

25. Give the drawbacks of Rights Ethics?

1. How do we prioritize the rights of different individuals?
2. It often promotes the rights of individuals at the expense of large groups / society.

26. Differentiate Ethical Relativism and Ethical Egoism?

1. ***Ethical egoism*** – the view that right action consist in producing one's own good.
2. ***Ethical relativism*** – the view that right action is merely what the law and customs of one's society require.

27. Define Ethical Pluralism?

Ethical pluralism is the view that there may be alternative moral perspectives that are reasonable, but no one of which must be accepted completely by all rational and morally concerned persons.

28. Define Religion?

A religion is any set of articles of faith together with the observances, attitudes, obligations and feelings tied up therewith, which, in so far as it is influential in a person, tends to perform two functions, one social and the other personal.

29. Give the uses of Ethical Theories?

1. In understanding moral dilemmas.
2. Justifying professional obligations and ideals.
3. Relating ordinary and professional morality.

3 UNIT

ENGINEERING AS SOCIAL EXPERIMENTATION

3.0. INTRODUCTION

Experimentation is commonly recognized to play a mandatory role in the design process of any product / project. Engineering is the process of developing a product, deploying a project, or discovering something which is useful to people.

Of course a developing process may be considered as experimentation.

As the products / projects resulting from the engineering experimentations are used by human beings who forms the society. The products benefits as well as consequences are subjected only to the members of the society. Hence the engineering experiments have their impacts totally on society; it is referred as a social – experimentation.

In this chapter we are going to learn about the comparison between standard experiments and engineering experiments, role of engineers as social experimenters, managers and consultants, roles of engineering codes and need for laws and Challenger space shuttle disaster in case study.

3.1. ENGINEERING EXPERIMENTATION

All products of technology exhibit some potential dangers and before manufacturing a product or providing a project, we make several assumptions and trials, design and redesign and test several times till the product is observed to be functioning satisfactorily. Hence Engineering is an inherently risky activity.

Engineering is not an experiment conducted solely in a lab under controlled conditions. It is an experiment on society involving lives of human beings. So engineering can be referred as a social experimentation. It involves design, implementation, testing and re-designing, re-testing, and many other activities.

We try different materials and experiments. From the test data obtained we make detailed design and retests. Thus, design as well as engineering are iterative processes as illustrated in Fig. 3.1.

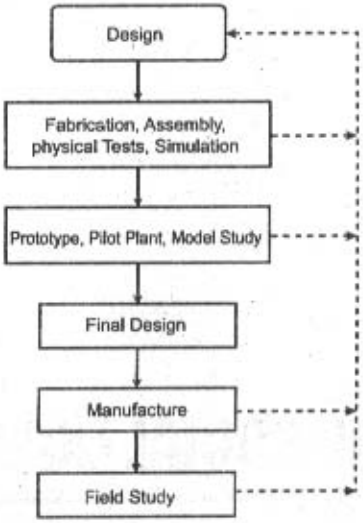


Fig. 3.1 Design as an interactive process

Several redesigns are made upon the feedback information on the performance or failure in the field or in the factory. Besides the tests, each engineering project is modified during execution, based on the periodical feedback on the progress and the lessons from other sources. Hence, the development of a product or a project as a whole may be considered as an experiment.

3.1.1 Engineering Projects Vs. Standard Experiments

Engineering, the profession itself includes various experiments, development of products and projects. Hence it is considered as an act of experimentation which involves engineers as the experimenters, and the experiment is carried out over the society and the people.

Similarly standard experiments such as Medical tests are also conducted on people and other living organisms. We shall now compare the two activities engineering projects and the standard experiments, and identify the similarities and contrasts exist between them.

	SIMILARITIES	CONTRASTS
ENGINEERING PROJECTS vs. STANDARD EXPERIMENTS	• Partial ignorance • Uncertainty • Continuous monitoring • Learning from the past	• Experimental control • Humane touch • Informed consent • Knowledge gained

SIMILARITIES: The following are some similarities between engineering projects and standard experiments,

- Partial ignorance
- Uncertainty
- Continuous monitoring
- Learning from the past

1. Partial ignorance:

Any project is usually executed in partial ignorance. There may be uncertainties exist in the abstract model assumed.

It can be said that, the behavior of materials purchased is uncertain and not constant. They may vary with the suppliers, time, and the process used in shaping the materials.

e.g., sheet or plate, rod or wire, forged or cast or welded.

There may be variations in the grain structure and its resulting failure stress. It is not possible to collect data on all variations of a product / project.

In some cases, extrapolation, interpolation, assumptions of linear behavior over the range of parameters, accelerated testing, simulations, and virtual testing are performed.

2. Uncertainty:

The final outcomes of projects are generally uncertain, same as in experiments. Sometimes unintended results, side effects (bye-products), and unsafe operation have also occurred.

It is not even known what will be the possible outcomes, whether they are safe or may be even risky.

Unexpected risks, may result sometime during engineering experimentations

They may be as follows:

- undue seepage in a storage dam,
- leakage of nuclear radiation from an atomic power plant,
- presence of pesticides in food or soft drinks.
- an new irrigation canal spreading water-borne diseases, and
- an unsuspecting hair dryer causing lung cancer on the user from the asbestos gasket used in the product.

3. Continuous monitoring:

In the case of experimentation, Monitoring is a continuous process that helps in progress and gaining new knowledge that are needed before, during, and after execution of project.

Monitoring is the activity of making periodic observations, tests by checking all possible outcomes as well as side-effects.

The performance of a product is to be monitored even during the use of the product by the end user / beneficiary. Hence it is not restricted inside the laboratory itself.

4. Learning from the past:

Engineers normally learn from their own previous designs and infer from the analysis of operation and results, and sometimes from the reports of other engineers. But this does not happen frequently.

But many failures have been caused due to the following reasons:

- The absence of interest,
- Channels of communication,
- Ego in not seeking information,
- Guilty upon the failure,
- Fear of legal actions, and
- Mere negligence

e.g.,

(i) The Titanic lacked sufficient number of lifeboats—it had only 825 boats for the actual passengers of 2227, the capacity of the ship being3547! In the emergent situation, all the existing life boats could not be launched.

(ii) Forty years back, another steamship Arctic met with same tragedy due to the same problem in the same region. But the lesson was learned at that time.

In most of the hydraulic systems, valves had been the critical components that are least reliable. The confusion on knowing whether the valve was open or closed, was the major cause of the Three-Mile Island accident happened in 1979.

Similar malfunctioning of valves and mis-reading of pressure gauges have been reported to have caused the accidents in some power plants. But in those situations we have not yet learnt the lesson from the past.

CONTRASTS: Engineering projects differs in some aspects from standard experiments. Exploration of these differences helps engineers to think about their moral responsibilities.

The scientific experiments are conducted in the laboratory and the engineering experiments are carried out directly in the field.

They exhibit several contrasts, which are listed below:

- Experimental control
- Humane touch
- Informed consent
- Knowledge gained

1. Experimental control:

In standard experiments, members for study are selected into two groups namely A and B at random.

Group A are given special treatment. The group B is given no treatment and is called the 'controlled group'. But they are placed in the same environment as the other group A. This process is called the experimental control. This practice is adopted in the field of medicine.

In engineering, this does not happen, except when the project is confined to laboratory experiments. This is because it is the clients or consumers who choose the product, exercise the control.

It is not possible to make a random selection of participants from various groups.

In engineering, through random sampling, the survey is made from among the users, to assess the results on the product.

2. Humane touch:

Engineering experiments involve human souls, their needs, views, expectations, and creativities used as in case of social experimentation. For example, testing of drugs on human being violates the act of humane. This should be completely banned and people have to recognize what is happening to them.

Initially this point of view is not agreed by many of the engineers. But now the quality engineers and managers have fully realized this humane aspect.

3. Informed consent:

Consent refers to the agreement or the permission to conduct an engineering experiment. Engineering experimentation is viewed as Societal Experiment, since the subjects and the beneficiary involved are human beings.

In the case of medical practice, moral and legal rights have been recognized while planning for experimentation.

Informed consent is practiced in medical experimentation. Such a practice is not there in scientific laboratory experiments.

Informed consent is said to have two basic elements:

1. Knowledge
2. Voluntariness

Knowledge: The subject (person who involves in the experiment) should be given all relevant information to make the decision whether to participate in the experiment or not

Voluntariness: Subject should take part in the experiment without force, fraud. Respect for rights of minorities to dissent and compensation for harmful effect are assumed here.

For a valid consent, the following four conditions are to be fulfilled:

1. Consent must be voluntary
2. All relevant information shall be presented / stated in a clearly understandable form.
3. Consenter (person who involved in the experiment) shall be capable of processing the information and make rational decisions.
4. The subject's consent may be offered in proxy by a group that represents many subjects of like-interests.

When bringing an engineering product to market ***"Informed consent"*** implies (helps) the customer to know the following:

(a) The knowledge about the product

(b) Risks and benefits of using the product and

(c) All relevant information on the product, such as how to use and how not to use (do's and don'ts).

The relevant factual information implies that the engineers are obliged to obtain and evaluate all the available information related to the fulfillment of one's moral obligations (i.e., wrong or immoral use of a product one designs).

It includes the intended and unintended impacts of the product, on the society.

Still there exists a possibility of a large gap of understanding between the experimenter and the subjects (public).

Sometimes, the managements have not been willing to disseminate the full information about the projector product beyond the legal requirements, because of the fear of potential competitions and likely exposure to potential litigation.

Voluntary and involuntary risks:

Voluntary risks are involved, directly on a participant involuntary is the indirect risk involved during experimentation.

If it is an asbestos plant or nuclear plant to be approved, affected parties expect their consent to be obtained. But they are ready to accept ***voluntary risks*** as in the case of stunts and amazing races.

People object to ***involuntary risks*** wherein the affected individual is neither a direct participant nor a decision maker.

Some examples:

- In case of Koodangulam power project as well as the Sethusamudram Canal Project, in TamilNadu, several citizen groups including Fishermen Forums have responded.
- The Central government was to contain many harsh apprehensions and protracted legal and political battles, by providing all relevant information.

4. Knowledge gained:

Scientific experiments are conducted with an intention to gain new knowledge, but "engineering experiments are not designed to produce much knowledge.

Engineering experiments most help us,

(a) To verify the acceptability of the design,

(b) To check the stability of the design parameters, and

(c) To prepare for the unexpected outcomes, in the actual field environments.

From the models tested in the laboratory to the pilot plant tested in the field, there are differences in performance as well as other outcomes.

3.2 ENGINEERS AS RESPONSIBLE EXPERIMENTERS

Although the engineers conduct experiments, they are not alone in the field. Their responsibility is shared with the organizations, people, government, and others.

No doubt the engineers share a greater responsibility while monitoring the projects, identifying the risks, and informing the clients and the public with facts.

Based on this, they can take decisions to participate or protest or promote. The engineer, as an experimenter, owe several responsibilities to the society, namely,

a. Conscientiousness
b. Comprehensive Perspective
c. Moral Autonomy
d. Accountability

3.2.1 Conscientiousness

Conscientious – act of being diligent (careful) in one's work / duty, may be said as responsibility. People must be conscientious about their responsibilities and as well as, live according to the moral values i.e., moral commitments, which is referred as the term "conscientious moral commitment".

Conscientious moral commitment means:

(a) Being sensitive to full range of moral values and responsibilities relevant to the prevailing situation and
(b) The willingness to develop the skill and put efforts needed to reach the best balance possible among those considerations.

In short, engineers must possess open eyes, open ears, and an open mind (i.e., moral vision, moral listening, and moral reasoning).

Conscientiousness refers to individual differences in following socially prescribed norms for impulse control, to be task- and goal-directed, to be plan-ful, delay gratification, and follow norms and rules.

As can be seen by the definition, conscientiousness is not really a single, unitary entity. Rather, it is better thought of as a conglomeration a group of different things gathered together of more specific traits and trait domains.

3.2.1.1 Replicable Facets:

Researchers have revealed at least 5 replicable facets of conscientiousness on the lower-order structure of conscientiousness:

1. Orderliness: The propensity natural tendency to be organized and neat versus messy and disorganized.

2. Self-control: The propensity to inhibit prepotent responses.
3. Industriousness: The propensity to work hard
4. Responsibility: The propensity to be reliable, especially in social situations
5. Traditionality: The propensity to follow socially proscribed norms and traditions

3.2.1.2 Non-Replicable Facets:

By investigating the underlying structure of conscientiousness, revealed specific facets that have not replicated.

1. Decisiveness: The willingness to make a decision and to be firm in one's commitments
2. Punctuality: The propensity to show up on time to appointments
3. Formality: The propensity to follow the rules of social decorum
4. Virtue: The propensity to be honest and to tell the truth

Conscientiousness is one of five super-ordinate traits in the "Big Five model" of personality which also consists of

- Extraversion,
- Neuroticism,
- Openness to experience, and
- Agreeableness.

3.2.2 Comprehensive Perspective

The Engineers should grasp the context of his work and ensure that the work involved results in only moral ends. One should not ignore his conscience if the product or project that he is involved will results in damaging the nervous system of the people.

A product has built in obsolete or redundant component to boost sales with a false claim. In processing of the perspective of factual information the engineer should exhibit the moral concern and not agree for this design. Sometimes the guilt is transferred to the government or the competitors. Some organization think that they will let the govt., find the fault or let the fraudulent competitor be caught first.

Finally, a full scale environmental or social impact study of a product / project by individual engineers is useful, but not possible in practice.

3.2.3 Moral Autonomy

Moral autonomy is defined as, decisions and actions exercised on the basis of moral concern for other people and recognition of good moral reasons. Alternatively, moral autonomy means 'self determinant or independent'.

The autonomous people hold moral beliefs and attitudes based on their critical reflection rather than on passive adoption of the conventions of the society or profession. Moral autonomy may also be defined as a skill and habit of thinking rationally about the ethical issues, on the basis of moral concern.

Viewing engineering as social experimentation will promote autonomous participation and retain one's professional identity. Periodical performance appraisals, tight-time schedules and fear of foreign competition threatens this autonomy.

The attitude of the management should allow latitude in the judgments of their engineers on moral issues. If management views profitability is more important than consistent quality and retention of the customers that discourage the moral autonomy, engineers are compelled to seek the support from their professional societies and outside organizations for moral support.

It appears that the blue-collar workers with the support of the union can adopt better autonomy than the employed professionals.

Only recently the legal support has been obtained by the professional societies in exhibiting moral autonomy by professionals in this country as well as in the West.

The engineering skills related to moral autonomy are listed as follows:

1. Proficiency in recognizing moral problems in engineering and ability to distinguish as well as relate them to problems in law, economics, and religion,
2. Skill in comprehending, clarifying, and critically - assessing arguments on different aspects of moral issues,
3. Ability to form consistent and comprehensive view points based on facts,
4. Awareness of alternate responses to the issues and creative solutions for practical difficulties,
5. Sensitivity to genuine difficulties and subtleties, including willingness to undergo and tolerate some uncertainty while making decisions,
6. Using rational dialogue in resolving moral conflicts and developing tolerance of different perspectives among morally reasonable people, and
7. Maintaining moral integrity.

Viewing engineering as social experimentation and anticipating unknown consequence should promote an attitude of questioning about the adequacy of the existing economy and safety standards. This proves a greater sense of personal involvement in one's work.

Autonomy which is the independence in making decisions and actions is different from authority. Authority provides freedom for action, specified within limits, depending on the situation.

Moral autonomy and respect for authority can coexist. They are not against each other. If the authority of the engineer and the moral autonomy of the operator are in conflict, a consensus is obtained by the two, upon discussion and mutual understanding their limits.

3.2.4 Accountability

Accountability refers to the act of being willing to be open and responsive to the appropriate situations. An authority must be responsible and willing to take the actions regarding any employee's activity, he must be able to handle the problem situation ethically, with diligence.

Engineers should aware of their personal responsibilities for their work and co-operate in a risky enterprise in which they practice their personal expertise and lead towards goal, for which they are also accountable.

Simply accountability is referred as the personal responsibility and willingness of an authority to handle any unfavorable / risky circumstances.

This makes the engineers as social experimenters, respect foremost the safety and health of the affected, while they seek to enrich their knowledge, rush for the profit, follow the rules, or care for only the beneficiary.

1. A conscientious commitment is necessary to live by moral values.
2. A comprehensive perspective on relevant information. It includes constant awareness of the progress of the experiment and readiness to monitor the side effects, if any.
3. Unrestricted free-personal involvement in all steps of the project/product development (autonomy).
4. Be accountable for the results of the project (accountability).

3.3 CODES OF ETHICS

Engineering is an important and learned profession. As members of this profession, engineers are expected to exhibit the highest standards of honesty and integrity.

Engineering has a direct and vital impact on the quality of life for all people.

Accordingly, the services provided by engineers require honesty, impartiality, fairness, and equity, and must be dedicated to the protection of the public health, safety, and welfare.

Engineers must perform under a standard of professional behavior that requires adherence to the highest principles of ethical conduct.

3.3.1 Purpose of Code of Ethics

a) It provides a framework for ethical judgment for a professional.
b) It also expresses the commitment to ethical conducts by a professional.
c) It do not establish new ethical principles and standards, but re-implement them.
d) It defines roles, and responsibilities of professionals.
e) It serves as a guide, and strengthens a professional by his correct behavior.

3.3.2 Features of Engineering Codes of Ethics

The following are some features of engineering codes of ethics,

- The highest ethical obligation of engineers is to the "safety, health, and welfare of the public."
- Engineers must also act for clients or employers as "faithful agents or trustees,"
- Engineers must practice only in their areas of competence.

- Engineers must act objectively, truthfully, and in a way that avoids deception and misrepresentation, especially to the public.

This includes avoiding bribes or other actions that might compromise an engineer's professional integrity.

- Engineers are encouraged (not required) to participate in civic affairs, such as career guidance for youth, and not only to promote or "work for the advancement of the safety, health, and well-being of their community."
- Engineers are encouraged (not required) to adhere to the principles of sustainable development in order to protect the environment for future generations.

Sustainable development is defined as ***"meeting human needs....*** while conserving and protecting environmental quality and the natural resource base essential for human development".

3.3.3 National Society of Professional Engineers (NSPE)

The code of the National Society of Professional Engineers **(NSPE)** provides most of the other major engineering codes, together with a few comments on features of the codes.

The membership in the NSPE is open to all professional engineers, regardless of their particular engineering discipline, such as electrical, mechanical, or civil engineering. For this reason, the code is applicable to all engineers.

Engineers, as the fulfillment of their professional duties, shall do the following:

1. Hold paramount the safety, health, and welfare of the public.
2. Perform services only in areas of their competence.
3. Issue public statements only in an objective and truthful manner.
4. Act for each employer or client as faithful agents or trustees.
5. Avoid deceptive acts.
6. Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.

3.3.4 Professional Obligations

There are also objections that the engineering codes often have internal conflicts, but do not give a method to resolve those conflicts. The professionals do not compelled to abide by their codes.

The following points are to be kept in mind, while following ethical codes,

1. Engineers shall be guided in all their relations, by the highest standards of honesty and integrity.
2. Engineers shall at all times ready to serve the public interest.
3. Engineers shall not be influenced in their professional duties by conflicting interests.

4. Engineers shall not attempt to injure, maliciously or falsely, directly or indirectly, the professional reputation, prospects, practice, or employment of other engineers.
5. Engineers shall accept personal responsibility for their professional activities, provided.

3.3.5 Other Types of Codes

Many organizations develop their own codes for professionals; say universities have named Student code of ethics, codes for ethical use of computer, corporate codes, and many others.

Some organizations that provides codes for engineers are given below,

- INSTITUTE OF INDUSTRIAL ENGINEERS **(IIE)**
- AMERICAN SOCIETY OF CIVIL ENGINEERS **(ASCE)**
- ASSOCIATION FOR COMPUTING MACHINERY **(ACM)**
- INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS **(IEEE)**

These organizations have several boards of members who formulate the codes and standard to be followed in various disciplines of science and technology.

3.3.6 Role of Codes:

The engineering codes of ethics have the following roles,

1. Inspiration and guidance
2. Support to engineers
3. Deterrence and discipline
4. Education and mutual understanding
5. Create good public image
6. Protect the status quo
7. Promotes business interests

1. Inspiration and guidance:

Codes provide positive motivation and guidance to engineers for their ethical conduct. They provide responsibilities and provide statements and guidelines on interpretations for the professionals and the professional societies, which tell how to apply the code.

2. Support to engineers:

The codes give positive support to professionals for taking stands on moral issues. Further they serve as potential legal support to discharge professional obligations.

3. Deterrence and discipline:

Deterrence is the fact of discouraging to act immorally and discipline is the factor that encourages a person to act morally.

The codes serve as the basis for investigating unethical actions.

The professional societies sometimes revoke membership or suspend/expel the members, when proved to have acted unethical.

This sanction along with loss of respect from the colleagues and the society are bound to act as deterrent.

4. Education and mutual understanding:

Codes are used to prompt discussion and reflection on moral issues.

They develop a shared understanding by the professionals, public, and the government on the moral responsibilities of the engineers.

The Board of Review of the professional societies encourages moral discussion for educational purposes.

5. Create good public image:

The codes present positive image of the committed profession to the public, help the engineers to serve the public effectively.

Engineers promote more of self regulation and lessen the government regulations.

This is bound to raise the reputation of the profession and the organization, in establishing the trust of the public.

6. Protect the status quo:

They create minimum level of ethical conduct and promotes agreement within the profession. Primary obligation namely the safety, health, and welfare of the public, declared by the codes serves and protects the public.

7. Promotes business interests:

The codes offer inspiration to the entrepreneurs, establish shared standards, healthy competition, and maximize profit to investors, employees, and consumers.

3.3.7 Some Limitations in Employing Ethical Codes:

The codes are not remedy for all evils. They have many limitations, namely:

1. General and vague wordings. Many statements are general in nature and hence unable to solve all problems.
2. Not applicable to all situations. Codes are not sacred, and need not be accepted without criticism. Tolerance for criticisms of the codes themselves should be allowed.
3. Often have internal conflicts. Many times, the priorities are clearly spelt out, e.g., codes forbid public remarks critical of colleagues (engineers), but they actually discovered a major bribery , which might have caused a huge loss to the exchequer.
4. They cannot be treated as final moral authority for professional conduct. Codes have flaws by commission and omission. There are still some grey areas undefined by codes.

5. They cannot be equated to laws. After all, even laws have loopholes and they invoke creativity in the legal practitioners.
6. Only a few enroll as members in professional society and non-members cannot be compelled.
7. Even as members of the professional society, many are unaware of the codes.
8. Different societies have different codes. The codes can not be uniform or same! Unifying the codes may not necessarily solve the problems prevailing various professions, but attempts are still made towards this unified codes.
9. Codes are said to be coercive. They are sometimes claimed to be threatening and forceful.

3.4 A BALANCED OUTLOOK ON LAW

The 'balanced outlook on law' in engineering practice stresses the necessity of laws and regulations and also their limitations in directing and controlling the engineering practice.

3.4.1 Need for Laws:

- Laws are necessary because, people are not fully responsible by themselves and because of the competitive nature of the free enterprise, which does not encourage moral initiatives.
- Laws are needed to provide a minimum level of compliance.
- The following codes are typical examples of how they were enforced in the past:
- Code for Builders by Hammurabi
- Steam Boat Code in USA

3.4.2 Code for Builders by Hammurabi

Hammurabi the king of Babylon in 1758 framed the following code for the builders:

- "If a builder has built a house for a man and has not made his work sound and the house which he has built has fallen down and caused the death of the householder, that builder shall be put to death.
- If it causes the death of the householder's son, they shall put that builder's son to death.
- If it causes the death of the householder's slave, he shall give slave for slave to the householder.
- If it destroys property, he shall replace anything it has destroyed; and because he has not made the house sound which he has built and it has fallen down, he shall rebuild the house which has fallen down from his own property.
- If a builder has built a house for a man and does not make his work perfect and the wall bulges, that builder shall put that wall in sound condition at his own cost"
- This code was expected to put in self-regulation seriously in those years.

3.4.3 Steam Boat Code in USA

Whenever there is crisis we claim that there ought to be law to control this. Whenever there is a fire accident in a factory or fire cracker's store house or boat capsize we make this claim, and soon forget.

Laws are meant to be interpreted for minimal compliance. On the other hand, laws when amended or updated continuously would be counterproductive.

Laws will always lag behind the technological development. The regulatory or inspection agencies such as Environmental authority of India can play a major role by framing rules and enforcing compliance.

In the early 19th century, a law was passed in USA to provide for inspection of the safety of boilers and engines in ships. It was amended many times and now the standards formulated by the American Society of Mechanical Engineers are followed.

3.4.4 Proper Role of Laws

Good laws when enforced effectively produce benefits. They establish minimal standards of professional conduct and provide a motivation to people.

Further they serve as moral support and defense for the people who are willing to act ethically.

Thus, it is concluded that:

- The rules which govern engineering practice should be construed as of responsible experimentation rather than rules of a game. This makes the engineer responsible for the safe conduct of the experiment.
- Precise rules and sanctions are suitable in case of ethical misconduct that involves the violation of established engineering procedures, which are aimed at the safety and the welfare of the public.
- In situations where the experimentation is large and time consuming, the rules must not try to cover all possible outcomes, and they should not compel the engineers to follow rigid courses of action.
- The regulation should be broad, but make engineers accountable for their decisions, and
- Through their professional societies, the engineers can facilitate framing the rules, amend wherever necessary, and enforce them, but without giving-in for conflicts of interest.

3.5 CASE STUDY: THE CHALLENGER

OVERVIEW:

On 28 January, 1986 the Challenger space shuttle blew up 73 seconds after launch. Seven lives and three billion dollars worth of equipment was lost.

The Challenger accident was the result of a faulty sealing system which allowed exhaust flames from the Solid-Fuel Rocket Boosters (SRB) to vent directly on the external tank, rupturing the tank and causing the explosion.

NASA identified the failure due to the improper sealing of the O-rings, the giant black rubber loops that help seal the segments of the SRBs.

The O-ring is made of a fluoro elastomer, which seals the joint between two solid rocket booster sections. An elastomer is a material that can be deformed dramatically and recover its shape completely. A rubber band is an example of an elastomer.

In almost half of the shuttle flights there was O-ring erosion in the booster field joints. The launch took place in untested temperature conditions and in spite of serious warnings on the part of the engineers of Thiokol, the company that manufactured the SRBs.

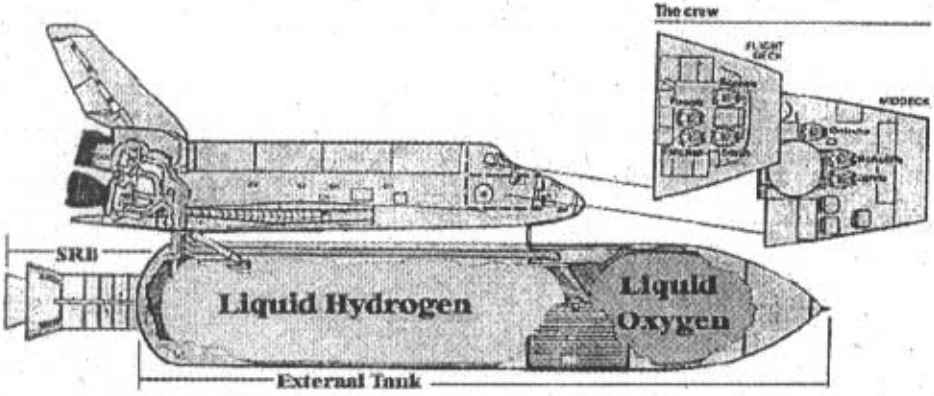


Figure showing the arrangement of fuel tank if challenger space shuttle:

3.5.1 WHAT HAPPENED?

- The orbiter of the Challenger had three main engines fuelled by liquid hydrogen.
- The fuel was carried in an external fuel tank which was jettisoned when empty.
- During lift-off, the main engines fire for about nine minutes, although initially the thrust was provided by the two booster rockets.
- These booster rockets are of the solid fuel type, each burning a million pound load of aluminum, potassium chloride, and iron oxide.
- The casing of each booster rocket is about 150 feet long and 12 feet in diameter. This consists of cylindrical segments that are assembled at the launch site.
- There are four-field joints and they use seals consisting of pairs of O-rings made of vulcanized rubber.
- The O-rings work with a putty barrier made of zinc chromate.
- The engineers were employed with Rockwell International (manufacturers for the orbiter and main rocket), **Morton-Thiokol** (maker of booster rockets), and they worked for NASA.

- After many postponements, the launch of Challenger was set for morning of Jan 28, 1986. **Allan J. McDonald** was an engineer from Morton-Thiokol and the director of the Solid Rocket Booster Project.
- He was skeptic about the freezing temperature conditions forecast for that morning, which was lower than the previous launch conditions.
- A teleconference between NASA engineers and MT engineers was arranged by Allan.
- **Arnold Thompson** and **Roger Boisjoly,** the seal experts at MT explained to the other engineers how the booster rocket walls would bulge upon launch and combustion gases can blow past the O-rings of the field joints.
- (Fig. 3.2). shows the cross sectional view of the space shuttle engine.

On many of the previous flights the rings have been found to have charred and eroded. In freezing temperature, the rings and the putty packing are less pliable.

From the past data gathered, at temperature less than 65°F the O-rings failure was certain. But these data were not deliberated at that conference as the launch time was fast approaching.

The engineering managers **Bob Lund** and **Joe Kilminster** agreed that there was a safety problem. Boisjoly testified and recommended that no launch should be attempted with temperature less than 53°F.

These managers were annoyed to postpone the launch yet again. The top management of MT was planning for the renewal of contract with NASA, for making booster rocket.

The managers told Bob Lund "to take-off the engineering hat and put on your management hat". The judgment of the engineers was not given weight age.

The inability of these engineers to substantiate that the launch would be unsafe was taken by NASA as an approval by Rockwell to launch. At 11.38 a.m. the rockets along with Challenger rose up the sky.

The cameras recorded smoke coming out of one of the filed joints on the right booster rocket. Soon there was a flame that hit the external fuel tank. At 76 seconds into the flight, the Challenger at a height of 10 miles was totally engulfed in a fireball.

The crew cabin fell into the ocean killing all the seven aboard. Some of the factual issues, conceptual issues and moral/normative issues in the space shuttle challenger incident are highlighted hereunder for further study.

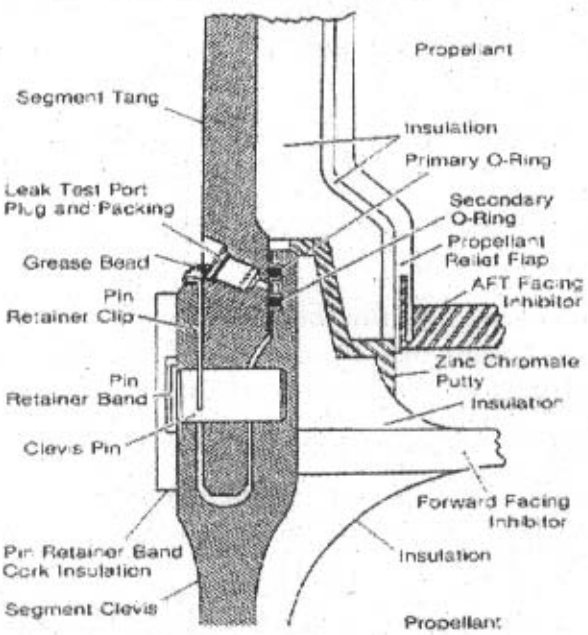


Fig. 3.2 a) Challenger engine (cross sectional view)

3.5.2 The Reusable Space Shuttle:

In the post-Apollo era of the lunar landing the idea of a reusable space shuttle was born.

The goal was to make access to space a routine matter, similar to flying an airplane.

The space shuttle had to be reusable and economical to develop and operate.

The design of the space shuttle was shaped by engineering considerations but also by pressure from the White House and Congress to reduce the cost.

There are three main components of a space shuttle:

1. The orbiter.
2. The external fuel tank.
3. The solid-fuel rocket boosters.

The orbiter is the vehicle which transports the astronauts into space.

The orbiter is propelled by thrusters at the back of the orbiter and the purpose of the external fuel tank is to pump a combination of hydrogen and oxygen fuel to the orbiter's thrusters.

The SRBs provide the majority of the thrust in order to place the orbiter in orbit.

When the orbiter is close to orbit, the SRBs detach and the orbiter is propelled only by the thruster.

The SRBs fall to earth, where they are collected to be reused in future missions. When the orbiter is in orbit the external fuel tank is also detached. The external fuel tank is not reused.

3.5.3 Events Leading to The Launch:

- The decision by NASA to launch the Challenger space shuttle on 28 January, 1986 was controversial at best. There were plenty of warning signs during the launches that preceded the launch.
- In November 1981, after the shuttle's second mission, the O-rings seemed to have been eroded by hot gasses.
- The January 24, 1985 launch took place in similar cold-weather conditions as the fatal launch of January 28, 1986.
- After the mission the booster joints were examined by engineers at Thiokol who found traces of soot and grease caused by passage of hot combustion gases past the O-ring before it has completely sealed the joint.
- As a result Thiokol started studying the resiliency of O-rings at low temperatures.
- In July 1985 Thiokol ordered steel billets which would be used for a redesigned case field joint.
- The steel billets were not ready at the time of the Challenger launch.
- The events a few days prior to the fatal launch are worth looking into.
- The Challenger was first scheduled to be launched on 22 January at 15:43.
- This was rescheduled for 23 January and then again rescheduled for 24 January.
- The launch was reset for 25 January because of bad weather at abort landing site in Dakar, Senegal.
- Launch was rescheduled for 27 January at 09:37 due to the prediction of unacceptable weather at Kennedy Space Center.
- Launch was delayed for 24 hours when ground servicing equipment hatch closing fixture could not be removed from orbiter hatch.
- In a conference call the night of the 27 January, 1986, engineers at Thiokol recommended against launching below 53 F, which was the coldest temperature at which a previous flight had launched.
- On the night before the launch, the temperature was expected to be as low as 18 F, more than 30 degrees colder than any other launch.
- Thiokol engineering was overruled by its management and the go-ahead was given to proceed with the launch.
- The table 3.2 depicts various space shuttle launch failures due to O-Ring failures.

3.5.4 Causes of the Challenger Accident

A commission was appointed by the president of the US to investigate the accident. The Rogers Commission as it was called addressed the problems in the following two areas:

1. Mechanical problems.
2. Administrative problems.

1. Mechanical problems:

The mechanical fault that led to the explosion of the Challenger was identified in the right solid rocket booster.

A field joint between the sections of the SRB allowed exhaust flames to leak through the field joint.

A field joint is a joint between the sections of the SRB that was assembled in the field at the Kennedy Space Center during the final construction of the booster.

The leaked flames impinged upon the external fuel tank.

The flames managed to penetrate and ignite the fuel in the external fuel tank, causing the explosion.

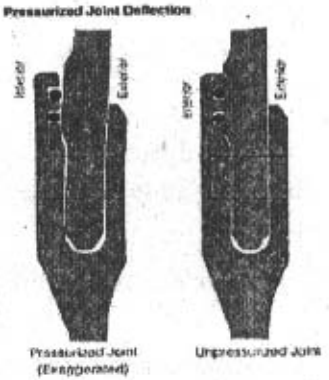
Problems due to the failure of sealing system:

There were a few causes that were found that could have lead to joint seal failure. The causes are:

1. **Assembly damage/ Contamination;** The joint seal could have been damaged or contaminated during assembly of the SRB.
2. **Gap opening;** The gap between the joints open as the pressures are applied.
3. **O-ring compression;** This depends on the width of the gap.
4. **Joint temperature;** The temperature has effects on the sealing ability of the O-ring.
5. **Putty performance;** Putty, Zinc chromate is applied before assembly inside the joint to stop gases going to the O-rings.

The failure of the sealing system on the field joint that led to the explosion of the Challenger was a result of the combination of four problems:

1. The tendency for holes to form in the putty which protected the seals from the high temperature exhausts gases.
2. The decomposition of the seals due to contact with the hot exhaust gases.
3. An instantaneous increase in the size of the gap between mating sections of the booster caused by the high internal pressures of the SRB.
4. The inability of the seal to quickly respond to the changing gap size during low temperature operating conditions.



(Figure showing the pressurized and unpressurized joints)

Table 3.2: O-Ring Failures of 24 Space Shuttle Launches

Flight Number	Date	Temperature (F)	O-Ring Failures
1	04/12/81	66	0
2	11/12/81	70	1
3	03/22/82	69	0
4	06/27/82	80	*
5	11/11/82	68	0
6	04/04/83	67	0
7	06/18/83	72	0
8	08/30/83	73	0
9	11/28/83	70	0
10	02/03/84	57	1
11	04/06/84	63	1
12	08/30/84	70	1
13	10/05/84	78	0
14	11/08/84	67	0
15	01/24/85	53	1
16	04/12/85	67	0
17	04/29/85	75	0
18	06/17/85	70	0
19	07/29/85	81	0
20	08/27/85	76	0
21	10/03/85	79	0
22	10/30/85	75	1
23	11/26/85	76	0
24	01/12/86	58	1

Administrative problems:

The Administrative problems were more profound due to the simple fact that all mechanical problems associated with the field joint had been identified by the Thiokol engineers.

All problems were identified as a potential risk, but there was difficulty in communicating these problems to the managers who were responsible for the launch.

The decision to launch the Challenger despite the identified risks was a combination of poor communication and a difference in the evaluation of the risk.

3.5.4.1 Risk issues

Risk is largely subjective. If it wasn't subjective, it would be possible to accurately identify the risk and account for its effect, or even take the appropriate measures for eliminating the risk.

In the case of the SRB project, risk was assessed mainly by two categories of people, the engineers and the managers.

1. Engineers based their risk assessment largely on their technical experience and facts.
2. Managers were more inclined to take a risk due mainly to the fact that they were a bit removed from the technical issues and due to the fact that their job was to ensure that business proceeded without delays.

It was clear that engineers and managers were not of the same view regarding the risk associated with the use of the O-rings at untested low temperatures.

Managers were happy to accept low temperature tests that were performed in laboratory conditions, while on the other hand engineers dismissed these tests as unrealistic. There was no way to get rid of the subjective nature in evaluating risk since at both NASA and Thiokol there was no method for quantifying risk.

On the one hand you had the engineers saying "I believe there is a big danger" and on the other hand the managers were saying "I believe that there is a smaller danger." It may be amazing to note that NASA did not employ a quantitative method of risk assessment for such a high-profile project.

The main reason is the expense associated with the data collection and statistical model generation. NASA employed no engineers trained in statistical sciences. Thiokol managers held misconceptions regarding the safety issues related to the O-rings. They believed that the SRBs could be operated at temperatures ranging between 31 F and 99 F, although Thiokol engineering noted that there was no real-condition testing at these temperatures.

The debate centered mainly on the lowest temperatures at which the SRBs could operate, since neither Thiokol nor NASA had official launch data that matched the conditions of the fatal launch.

There were other reasons who contributed to the optimistic approach by management compared to that by engineering. There was clear evidence that there was O-ring erosion on previous shuttle flights. Since this did not give rise to any catastrophic results, a false sense of security was developed.

O-ring erosion was therefore something to be expected. The fact that there were relatively few accidents at NASA re-enforced the subjective approach to risk assessment.

Since the risk assessors were right on so many occasions, what were the chances of being wrong on this occasion? The difference in the manner that risk is assessed by managers and engineers lies primarily in their objectives.

Managers are in the business of management or administration, while engineers have more interaction with the day-to-day activities. Managers needed to keep the shuttle program going in order to be able to justify their budget and were willing to take bigger risks.

3.5.4.2. Communication issues

The Roger Commission identified a breakdown in the communication as a contributing factor in the Challenger accident. Important information was not from Thiokol engineering regarding the SRBs did not find its way to the appropriate people at NASA in charge of the launch.

The management structure that was followed at both NASA and Thiokol was that followed by the traditional organization, with a single chain of command.

Every employee could report to his manager and his manager to his manager and so on. This reporting structure is inefficient and is not suited for communicating important issues quickly to the appropriate management level for consideration.

3.5.4.3. Ethical Issues of the Space Shuttle Challenger

The following questions raise several ethical issues related to challenger space shuttle accident.

1. Did NASA knowingly take extra risks because of pressure to maintain Congressional funding?
2. Did Thiokol knowingly take extra risks because of fear of losing its contract with NASA?
3. Was the Principle of Informed Consent Violated?
4. What role did whistle blowing have in the Challenger story?
5. Who had the right to Thiokol documents relating to the Challenger disaster?

The following ethical concerns of the events leading up to the incident will be discussed in the case study:

a) Professional responsibility of the design engineers.

b) The engineers also have a responsibility to communicate effectively with the NASA management.

c) NASA management acted as if keeping to the schedule was more important than the safety of the astronauts.

d) The engineers did not stress the severity of problems created by the cold weather enough. Because the O-rings were never tested at temperatures as low as the conditions during the actual launch, they should have taken a "better safe than sorry" approach to the situation rather than a "let's see what happens" approach, especially when people's lives are at stake.

e) Because each O-ring had a backup O-ring in place, it was assumed that any failure would not cause any problems because it would be unlikely for the backups to fail as well. However, because this component is so critical, the backups were in place solely for redundancy, not to act as the primary part.

f) NASA was aware of the design flaws of the O-rings and that there was a potential for disaster

a) Professional Responsibility

- One of the main ethical issues that our group examined was the professional responsibility of the design engineers.
- Design engineers in any field have the sole responsibility and expectation of keeping a design flawless and professional. Some things that keep the design from becoming flawless and professional can be economical statistics and various increases on the expense to build and obtain items / resources needed to complete the project.
- Since NASA and the design team's project of modifying the O-ring design had the potential of keeping the Challenger shuttle from completing its scheduled missions, the implementation window was very short.
- Pressure and time limits did not help in completing the project. In fact the rushed schedule seemed to portray the management team as though they were not even concerned about the astronaut's safety.

b) Effective Communication

- The other major contributing ethical factor to the Space Shuttle Challenger disaster was a lack of effective communication between the NASA engineers and management. Communication between Morton Thiokol (the company that designed the Solid Rocket Boosters) engineers and NASA management was also very poor.
- After the incident, Roger Boisjoly, a Morton Thiokol engineer, stated that the meetings preceding the Challenger launch were filled with "intense customer intimidation" (Boisjoly 1).
- Obviously, this was not conducive to creating an atmosphere where everyone was comfortable expressing their opinions and making thoughtful decisions. The truth of the matter is that Morton Thiokol did not have any data on how its Solid Rocket Boosters and O-rings would perform at temperatures lower than 51 °F.
- The night before the launch, the temperature outside fell to 18 °F, and the morning of the launch the temperature was at 36 °F. While some engineers believed that the boosters would still be able function safely under these conditions, many were very worried that the temperature would cause a failure.
- The inability of the Morton Thiokol engineers to effectively convey their concerns to the NASA management and convince them to postpone the shuttle's launch is one factor that ultimately led to the disastrous outcome.

- However, this vital information was never conveyed to NASA's managers or the engineers because the grounds crew was only instructed to report on the thickness of the ice on the shuttle

c) Flight Rate Plan

- One of the ethical issues that we examined as part of this case study was relating to NASA's flight rate plan and the excessive pressure on NASA to increase their flight rate. The increase would ultimately reduce NASA's ability to safely address any urgent issues due to decreased personnel dedicated to specific launch schedules.
- In turn, it also created undue pressure on NASA's management team to rush judgment relating to critical issues that would potentially delay any shuttle launch schedules. This rigorous flight plan schedule made it seem like the management team was acting as if keeping to the schedule was more important than the safety of the astronauts.
- As part of the Presidential Commission's recommendation report on this matter, it was suggested that NASA establishes a flight rate consistent with its resources. A firm payload assignment policy was also recommended to be established including controls on cargo manifest changes to limit pressures such changes exert on schedules and crew training (NASA, 1986)

d) Apparent Unsafe Launch Conditions

- Another ethical issue that the Challenger disaster puts into light is the issue of cutting corners. As is mentioned earlier, there was a major lapse in communication between NASA and Morton Thiokol engineers and the managers in the position to make decisions.
- Although some engineers felt that the extremely cold temperatures on the day of the shuttle's launch could pose major problems, some engineers believed that the O-rings would still function properly. This inability to come to a consensus is what ultimately led to the launch of the shuttle.
- The major ethical flaw in decision making arises in the fact that NASA chose to take a risk and launch the shuttle despite numerous requests to delay it.
- Although further delaying the launch would not please anyone, in order to protect the safety of the seven astronauts aboard the Challenger, it was a decision that needed to have been made.
- According to the National Society of Professional Engineers, the most important ethical principle is to "hold paramount the safety, health, and welfare of the public" (NSPE). NASA did not give adequate attention to the concerns of the engineers that believed the O-rings might fail in the cold weather.
- Due to the weather, the O-rings were unable to properly seal the solid fuel within the Solid Rocket Booster and this allowed for flames to pass through the small hole. This eventually led to the booster breaking loose from the body of the shuttle and colliding with and piercing an external fuel tank.

- This led to both liquid hydrogen and liquid oxygen being released into the atmosphere, mixing, and igniting. When any human life is potentially at stake, it is vital that no corners are cut, and every conceivable issue is dealt with before the mission takes place.

e) NASA's Reliance on Emergency Safety Controls

- There is really something to say and seems very shocking about the death of a whole shuttle crew. It is more than just a seven deaths in plane crash or even a road side disaster, these astronauts helped to research and develop unknown things.
- In the actual event of the Challenger shuttle disaster, an issue with a leak in the O-ring seals on the SRB unit was ultimately blamed for the loss of shuttle and crew. Interestingly enough, the design engineers were already aware of the issue with O-ring sealing problems from inspections of previously used SRB units.
- However, the situation was not deemed critical since there was a secondary O-ring which was originally designed as a backup safety control measure in the event of the primary seal's failure.

f) Ignorance of Known Design Faults

- A significant cause for the eventual loss of space shuttle challenger was the actual ignorance of potential problems with the O-rings that are required to form a seal between two sections of the Solid Rocket Boosters (SRB).
- Roger Boisjoly, an engineer who worked for Morton Thiokol (the manufacturer of the SRBs), was highly concerned about the safety of the O-rings after discovering damage to the components during an investigation of an SRB unit from a shuttle flight in January 1985.
- The investigation revealed a critical flaw in the design of the O-rings that would prevent a proper seal at low temperatures.
- As we can see from this information provided above, both Morton Thiokol and NASA were both aware of the issues presented by the faulty design of the O-ring / SRB joint approximately six months prior to the challenger incident. However, both management teams decided to continue the shuttle launches as scheduled.
- Afterwards, Biosjoly continued to stress the urgency of the issue and proceeded to write a series of reports concerning the issue and lack of management support.
- After the incident, the investigation team looked into the chain of events leading up to this decision. As part of the Presidential Commission's recommendation report on this matter and the actions leading up to the launch, it was suggested that the Shuttle Program Management Structure should be reviewed.
- NASA was also asked to establish a Shuttle Safety Panel which would report to the program manager on any issues involving operational issues, launch commitment criteria, flight rules, flight readiness, and risk management.
- It was also recommended that the panel should include an astronaut with space flight experience.

3.5.6 Conclusions

NASA was very anxious to proceed with the launch for a variety of reasons including, economic considerations and political pressure.

The European Space Agency was providing added competition and there was political pressure for the Challenger to be in space when the president of the US gave the State of the Union address.

There were plenty of advanced warnings regarding the SRBs, from previous missions.

Concerns had been voiced by Thiokol, the SRB manufacturing company, as to whether the fatal launch should have taken place.

The cold weather, some of the coldest in Florida history, provided uncharted waters for the operation of the SRBs.

- What went wrong?
- Why did NASA launch in spite of the evidence and warnings from Thiokol engineers?
- Should the launch have been cancelled?

3.5.7 Discussion Points

1. Identify the project.
2. Identify the players and Chronological account of events.
3. Description of environment on the day of the launch.
4. Pressure to launch: There was a push to have 15 shuttle launches in 1986 and 24 launches by 1990.
5. Communication issues: Communication within Thiokol and between Thiokol and NASA. Management issues where reporting could only be done one level up.
6. Pressure to launch so that the launch schedule would proceed uninterrupted.
7. Political pressure to launch so that Challenger was to be in orbit while President Reagan gave the State of the Union address.
8. Risk: There was no process in place to quantify risk. Managers and Engineers had differing views based largely on their objectives.
9. Identify the interdependencies between the project and the project environment.
10. Was NASA taking an acceptable risk?
11. Why did NASA managers together with Thiokol managers overrule Thiokol engineers?
12. Was there miscommunication between NASA and Thiokol?
13. What were the causes of the accident?
14. Should NASA have proceeded with the launch?
15. Was there ample information to warrant the cancellation of the launch?
16. Was the SRB project a success or a failure?

TWO MARKS QUESTIONS & ANSWERS:

1. What are the conditions required to define a valid consent?

- The consent was given voluntarily.
- The consent was based on the information that rational person would want, together with any other information requested, presented to them in understandable form.
- The consenter was competent to process the information and make rational decisions.

2. What are the two main elements which are included to understand informed consent?

Informed Consent is including two main elements:

a. **Knowledge** [Subjects should be given not only the information they request, but all the information needed to make a reasonable decision].

b. **Voluntariness** [Subjects must enter into the experiment without being subjected to force, fraud, or deception].

3. What are the general features of morally responsible engineers?

a. Conscientiousness.

b. Comprehensive perspective.

c. Moral Autonomy.

d. Accountability.

4. What is the purpose of various types of standards?

a. Accuracy in measurement, interchangeability, ease of handling.

b. Prevention of injury, death and loss of income or property.

c. Fair value of price.

d. Competence in carrying out tasks.

e. Sound design, ease of communications.

f. Freedom from interference.

5. Define Code? Enumerate the roles of codes?

Code is a set of standards and laws. The roles of codes are...

- Inspiration and Guidance
- Support
- Deterrence and Discipline

- Education and Mutual Understanding
- Contributing to the Profession's Public Image
- Protecting the Status Quo
- Promoting Business Interests

6. Give the limitations of codes?

- Codes are restricted to general and vague wording.
- Codes can't give a solution or method for solving the internal conflicts.
- Codes cannot serve as the final moral authority for professional conduct.
- Codes can be reproduced in a very rapid manner.

7. What are the problems with the law in engineering?

a. Minimal compliance

b. Many laws are without enforceable sanctions.

8. What is the need to view engineering projects as experiments?

i. Any project is carried out in partial ignorance.

ii. The final outcomes of engineering projects, like those of experiments, are generally uncertain.

iii. Effective engineering relies upon knowledge gained about products before and after they leave the factory – knowledge needed for improving current products and creating better ones.

9. Differentiate scientific experiments and engineering projects?

Scientific experiments are conducted to gain new knowledge, while "engineering projects are experiments that are not necessarily designed to produce very much knowledge".

10. What are the uncertainties occur in the model designs?

a. Model used for the design calculations.

b. Exact characteristics of the materials purchased.

c. Constancies of materials used for processing and fabrication.

d. Nature of the pressure, the finished product will encounter.

11. What is the need for laws?

- Laws are necessary because, people are not fully responsible by themselves and because of the competitive nature of the free enterprise, which does not encourage moral initiatives.
- Laws are needed to provide a minimum level of compliance.

12. Mention the forums or organizations that formulate codes for engineers.

Some organizations that provides codes for engineers are given below,

- Institute of Industrial Engineers **(Iie)**
- American Society of Civil Engineers **(Asce)**
- Association for Computing Machinery **(Acm)**
- Institute of Electrical And Electronics Engineers **(IEEE)**

13. What are the purposes of engineering codes?

1. It provides a framework for ethical judgment for a professional.
2. It also expresses the commitment to ethical conducts by a professional.
3. It do not establish new ethical principles and standards, but re-implement them.
4. It defines roles, and responsibilities of professionals.
5. It serves as a guide, and strengthens a professional by his correct behavior.

14. Define conscientiousness.

Conscientious – act of being diligent (careful) in one's work / duty, may be said as responsibility. People must be conscientious about their responsibilities and as well as live according to the moral values

15. Define Accountability.

Accountability refers to the act of being willing to be open and responsive to the appropriate situations.

An authority must be responsible and willing to take the actions regarding any employee's activity, he must be able to handle the problem situation ethically, with diligence.

16. What is voluntary and involuntary risk?

People object to involuntary risks wherein the affected individual is neither a direct participant nor a decision maker.

e.g., side effect due to a medicine.

Voluntary risks- are accepted by the people directly; they know the factor that causes risks and ready to accept the risk.

e.g., residing near a nuclear plant, stunts and amazing races.

17. Define Informed Consent.

Consent refers to the agreement or the permission to conduct an engineering experiment.

In the case of medical practice, moral and legal rights have been recognized while planning for experimentation. Informed consent is practiced in medical experimentation

18. What are the elements of informed consent?

Informed consent is said to have two basic elements:

1. Knowledge
2. Voluntariness

Knowledge: The subject (person who involves in the experiment) should be given all relevant information to make the decision whether to participate in the experiment or not.

Voluntariness: Subject should take part in the experiment without force, fraud. Respect for rights of minorities to dissent and compensation for harmful effect.

19. Mention some similarities between engineering and standard experiments.

- Partial ignorance
- Uncertainty
- Continuous monitoring
- Learning from the past

20. Mention some contrasts between engineering and standard experiments.

- Experimental control
- Humane touch
- Informed consent
- Knowledge gained

21. What is monitoring?

Monitoring is a continuous process that helps in progress and gaining new knowledge that are needed before, during, and after execution of project.

Monitoring is the activity of making periodic observations, tests by checking all possible outcomes as well as side-effects.

22. Why engineering is referred as social experimentation?

Engineering, the profession itself includes various experiments, development of products and projects.

Hence it is considered as an act of experimentation which involves engineers as the experimenters, and the experiment is carried out over the society and the people.

23. What Conscientious moral commitment means?

- Being sensitive to full range of moral values and responsibilities relevant to the prevailing situation and
- The willingness to develop the skill and put efforts needed to reach the best balance possible among those considerations.

In short, engineers must possess open eyes, open ears, and an open mind (i.e., moral vision, moral listening, and moral reasoning).

24. What are the major components of a Space shuttle?

There are three main components of a space shuttle:

1. The orbiter.
2. The external fuel tank.
3. The solid-fuel rocket boosters.

25. What are the major causes for the failure of Challenger Space Shuttle?

- The failure of the sealing system on the field joint that led to the explosion of the Challenger.
- The unfavorable cold weather during the launch
- The improper functioning of the O-ring component which holds the shield joints
- Mainly, the political urge to launch the shuttle.

4 UNIT

SAFETY RESPONSIBILITIES AND RIGHTS

4.0 INTRODUCTION

Safety has different definitions and the perceptions are different for different persons. A product or any situation is perceived to be safe by one person, and unsafe by another one. In engineering experimentation every product or project has its own safety limit and risk factor. Each product has its risk factor defined within it.

For example:

A hair drier is used by most people. It is safe and easy to use, but continuous use of it may cause hair fall, bald head some even may lead to cancer due to the frequent exposure of heat. So we have to realize the risk involved in using every product.

In this chapter we are going to know about the definitions of safety and risk, how the risk is analyzed. The methods for risk reducing, and case studies Chernobyl nuclear reactor disaster, and Bhopal gas leakage disaster in case studies.

4.1 SAFETY DEFINITION

As said in the introduction, safety has different definitions. A product or project is said to be safe, with respect to a person or a group of individuals, at a given time, if its risks are fully known, and if they are acceptable. Risk is objective in some factors and as well as subjective in some perspectives.

Awareness and maintenance of a particular situation is called safety. The safety can be incorporated during design, pre-testing, operation, field applications, analog tests, and learning from the past.

The perception of risk and safety varies from person to person, based on one's physical condition, age, experience, expertise and wisdom.

Eg.,

- A coil type electric heater is a product, which is safe when being handled by an adult, and risky in hands of a child, because it might give electric shock .

- Chlorinated municipal water may be considered as unsafe because, it might cause some harm to the stomach of human being, thereby affects the health. But it is really safe against "gastroenteritis".
- A scissor in a child's hand may be unsafe, but with an adult it can be safe.
- Some may think, motorbike riding is unsafe and scooter riding is safe.

There are various factors that influence the perception of risk:

1. Probability of risk (the possibility for occurrence of risk).
2. Consequence of the risk. (a quantitative measure). Physical damage or death, economic loss, damage to property, loss of money, and degradation of environment may be caused.
3. Voluntary risk. (Some people may take risk voluntarily for thrill or fun).
4. Magnitude of risk. (it refers to the number of people / area involve in risk)
5. Proximity of the risk. i.e., the closeness of effects caused by risk.
6. Method of information widely spreaded on risk.
7. Job related risk. (Whether the risk is compulsorily / forcibly taken by persons).

The knowledge about acceptance level of risk is useful to the engineers. The Designer can redesign the product / project to include safety measures, so as to

a) Allow the product fail safely.

b) Abandon it safely, and

c) Provide for safe escape / evacuation from the product or site, and thus eliminate or minimize the human loss.

4.2 SAFETY AND RISK

Safety was defined as the risk that is known and judged as acceptable. But, risk is a potential that something unwanted and harmful may occur. It is the result of an unsafe situation, sometimes unanticipated, during its use.

Probability of safety = 1 – Probability of risk Risk

= Probability of occurrence × Consequence in magnitude

Different methods are available to determine the risk (testing for safety)

1. Testing on the functions of the safety-system components.

2. Destructive testing:

In this approach, testing is done till the component fails. It is too expensive, but very realistic and useful.

3. Prototype testing:

In this approach, the testing is done on a proportional scale model with all vital components fixed in the system. Dimensional analysis could be used to project the results at the actual conditions.

4. Simulation testing:

With the help of computer, the simulations are done. The safe boundary may be obtained. The effects of some controlled input variables on the outcomes can be predicted in a better way.

4.3 ASSESSMENT OF SAFETY AND RISK

4.3.1 Uncertainties in Assessment

There are many possible uncertainties exist while determining risk of a product / service:

- Restricted access to knowledge on risk: Some organizations do not include the statistical data and legal restrictions of the product.
- Uncertainty in behavior of materials: The overall behavior of a product may vary from the individual behavior of the parts, i.e., the statistical test data may differ from behavioral results.
- Variation in behavior of product may include components failure due to, a thermal shock, Creep, impulse, self-excited vibrations and rains causes sudden failure of the overall system.
- The use / misuse of materials / products likely to change the properties / behavior of the system.
- Newer applications of technologies may sometimes remain unpublished, public may not have awareness about the update.
- Replacing new products whose behavior is not fully tested, lead to increased hazard, and risk potentiality.
- The unexpected outcome of a product / project.
- All these aspects make the risk estimation as complex and unreliable. Hence the data are to be monitored continuously and risk estimation must be updated periodically.

Example:

1. A few friends live near a cement plant, as they are unable to choose better location for housing. They work as motor mechanics in a nearby automobile service station. The air is full of dust and some drainage canals cut across their house sites. They hold that they are exposed to involuntary risk, from dust and drain. But the same persons have previously-owned motorcycles, with which they travel during weekends to their villages through muddy roads.

Now they are willing to take ***risk voluntarily,*** i.e., they have no apprehensions on this travel. Statistical study indicates that individuals are more ready to accept voluntary risks (hunting, skiing, fighting in wars) than the ***involuntary risks*** (electric shock, natural calamity).

Even though the voluntary risks are thousand times more fatal than involuntary ones, individuals meet them, for the thrill or adrenal quest or for achievement and for a page in the Guinness record. Another stand or perception closely related to this example is that of 'Control'.

2. There are people who choose to play stunts such as jumping through fire gates, skiing and flying, car racing through tortuous terrains. Most of these people exhibit extraordinary confidence in them and on their gadgets and also believe that the hazards are under their control.

4.4 RISK – BENEFIT ANALYSIS

The major reasons for the analysis of the risk benefit are:

1. To know risks and benefits and weigh them each
2. To decide on designs, advisability of product/project
3. To suggest and modify the design so that the risks are eliminated or reduced.

There are some limitations that exist in the risk-benefit analysis. The economic and ethical limitations are presented as follows:

a) Primarily the benefits may go to one group and risks may go to another group. Is it ethically correct?

b) Is an individual or government empowered to impose a risk on someone else on behalf of supposed benefit to somebody else? Sometimes, people who are exposed to maximum risks may get only the minimum benefits. In such cases, there is even violation of rights.

c) The units for comparison are not the same, e.g., commissioning the express highways may add a few highway deaths versus faster and comfortable travel for several commuters. The benefits may be in terms of fuel, money and time saved, but lives of human being sacrificed. How do we then compare properly?

d) Both risks and benefits lie in the future. The quantitative estimation of the future benefits, using the discounted present value (which may fluctuate), may not be correct and sometime misleading.

e) Both risks and benefits may have uncertainties. The estimated probability of risks may vary from time to time and region to region.

4.4.1 Personal Risk:

Accessing the involuntary personal risk is a difficult task. For example, a group residing near the cement plant is exposed to a lot of risk. If suppose a cement plant or refinery was to come up in the area where this group already reside, they will object the proposal.

There are persons who dared to serve people in dire straits (means an urgent or serious, difficult situation), in spite of the risky situations where their lives were in stakes.

For example: ***Mahatma Gandhi*** served people during ***NAVAKALI YATRA,*** when dangers were present all over. For such saviors, there was no personal risk. However, any of the following methodologies may be adopted to access quantitatively, the personal risk.

1. Access the voluntary activities(e.g., life insurance policy taken)
2. Access the degree of occupational hazard (e.g., dust, radiation and asbestosis) and its effect on health.
3. Loss of sense such as sight (eyes), hearing (ears) and loss of limbs (immobility by the loss / damage of organs of disfigurement of the limbs or body).
4. Loss of earning capability, especially due to physical disability and
5. Get assistance by trained arbiters.

4.4.2 Public Risk

Assessing the public risk is relatively easy, as in society the cost of disability can be calculated as an average value. To assess the public risk, the loss of assets and the correction costs are estimated.

For example:

- Loss of reduction in future income or earning capacity due to loss of their capability / physical disability.
- Cost associated with an accident, includes the transportation / reinforcement of body parts and medical treatment, etc.,
- Cost of welfare, which includes rehabilitation, providing loss-demanding alternate jobs, and other benefits.

4.5 REDUCING RISK (IMPROVING SAFETY)

Several techniques have been adopted to reduce the risks and to improve safety in a product or project development, as follows:

1. An application with inherent safety while designing, e.g., LPG cylinder is provided with a protective frame, the valve handle that avoid the gas leakage.
2. Use of redundancy principle in instrument protection / design. For eg., use of standby device, backup for computer storage.
3. Periodical monitoring (inspection) and testing of safety system to ensure reliability, e.g., Fire extinguishers, 'earth' system in electric circuits are checked periodically.
4. Issue of operation manuals, training of the operating personnel and regular audits are adopted to ensure that the procedures are understood, followed and the systems are kept in working condition.

5. Development of well-designed emergency evacuation plan and regular rehearsal/ drills to ensure preparedness, in case of emergency.

4.5.1 Voluntary Risk

Voluntary risk is the involvement of people in risky actions, although they know that these actions are unsafe. The people take these actions for thrill, amusement or fun. They also believe that they have full control over their actions (including the outcomes!) and equipments or animals handled.

e.g., people participate in car racing and risky stunts.

Testing becomes inappropriate when the products are

1. Tested destructively
2. When the test duration is long and
3. When the components failing by tests are very costly. Alternate methods such as design of experiments, accelerated testing and computer-simulated tests are adopted in these circumstances.

4.5.2 Safety Lessons From 'The Challenger'

The safety lessons one can learn in the Challenger case involved many risky situations which are as follows:

1. **Negligence in design efforts.** The booster rocket casing recovered from earlier flights indicated the failure of filed-joint seals. No deign changes were incorporated. Instead of two O-rings, three rings should have been fixed. But there was no time for testing with three rings. At least three rings could have been tried while launching.
2. **Tests** on O-rings should have been conducted down to the expected ambient temperature i.e., to 20F. No normalization of deviances should have been allowed.
3. **NASA** was not willing to wait for the weather to improve. The weather was not favorable on the day of launch. A strong wind shear might have caused the rupture of the weakened O-rings.
4. **The final decision making** of launch or no-launch should have been with the engineers and not on the managers. Engineers insisted on 'safety' but the managers went ahead with the 'schedule'.
5. **Informed consent:** The mission was full of dangers. The astronauts should have been informed of the probable failure of the O-rings (field joints). No informed consent was obtained, when the engineers had expressed that the specific launch was unsafe.
6. **Conflict of interest (Risk Vs. Cost):** There were 700 criticality-1 items, which included the field joints. A failure in any one of them would have cause the tragedy. No back-up or stand-bye had been provided for these criticality-1 components.
7. **Escape mechanism or 'safe exit'** should have been incorporated in the craft.

4.6 RESPECT FOR AUTHORITY

Decisions can be taken by a few people, but putting into action requires larger participation from different groups of people, such as operation, purchase, sales, accounts, maintenance, finance etc. The authority plays a great role in transferring decisions into actions, efficiently.

Otherwise the individual discretions may ruin the activities. Further the authority fixes the personal responsibility and accountability uniquely on each person. This is necessary to ensure progress in action.

4.6.1 Institutional Authority

It is the authority exercised within the organization.

It is the right given to the employees...

- to exercise power,
- to complete the task and
- force them to achieve their goals.

Duties such as resource allocation, policy dissemination, recommendation, supervision, issue orders (empower) or directions on sub-ordinates are vested to institutional authority.

E.g., Line Managers and Project Managers have the institutional duty to make sure that the products/projects are completed successfully.

The characteristics features of institutional authority are that they allocate money and other resources and have liberty in execution.

4.6.2 Expert Authority

On the other hand, the Expert Authority is...

(a) the possession of special knowledge, skills and competence to perform a job thoroughly (expertise),

(b) the advice on jobs, and

(c) is a staff function.

It is also known as 'authority of leadership'. These experts direct others in effective manner.

E.g., advisers, experts, and consultants are engaged in an organization for a specific term.

4.7 COLLECTIVE BARGAINING

It is the bargain by the trade union for improving the economic interests of the worker members. The process includes negotiation, threatening verbally, and declaration of 'strike'.

It is impossible to endorse fully the collective bargaining of unions or to condemn. There exist always conflicting views between the professionalism and unionism.

a. Faithful Agent or Trustee?

Professional societies such as NSPE and IEI refuse to accept the 'collective coercive action' of unionism, holding the principles of professional integrity as right.

E.g., as per NSPE code III, i.e., engineers shall not promote their own interest at the expense of the dignity and integrity of the profession.

The engineers are said to exhibit a higher standard than self – interest, and they are expected to perform an ethical duty to their employer as faithful agent or trustee.

It is concluded, that:

- The duty of the employee to his employer means not sacrificing their self – interest.
- Trustee or faithful agents mean completing the assigned tasks properly, and maintaining safety.
- On the other hand, the employee has the right to negotiate for safe and hygienic work conditions.

An employee has also the right to disobey, illegal or unethical activities.

b. Service To The Public

- Servicing the public is the most important thing, but most of the unions doesn't consider the public welfare.
- Eg., if the doctors, teachers, go on strike means, then the entire society will get affected by this.
- Collective bargaining by engineers through unions or associations, should act with public concerns. Professional societies play an important role in the promotion and establishment of principles and practices towards, public welfare.
- The collective bargaining cannot be judged as an unethical activity, it is acceptable, but the reasons should be constructive, based on mutual understanding between the people and the organization.
- It should not be a destructive and harming one to the people lives and property.

c. Assessment On Unionism

The moral assessment on unions is a complex process. All relevant moral facts are to be considered, inquired, and judged.

Unionism has different views, hence it cannot be generalized. The supporting and anti-view of unionism are summarized in the following table 4.1.

Table 4.1 Pro- and anti-views on unionism

For Unionism	Against Unionism
1. Unions have been useful in improving the standard of living and economic benefits of the workers. Even non – union members leading to inflationary condition are able to get those benefits.	1. Unions have lead to disturb the economy of state of salaries, and increases salaries and expenses, leading to inflationary conditions.
2. Unions have obtained greater participation in organization by participative management. Union members are appointed as Directors in the Board and credited to act as bridge between the employers and employees.	2. Instead of being cooperative they act in negative and destructive ways, causing loss of man-days. Opinions of the individual workers is suppressed and used as pawns.
3. Unions have contributed to the job security, and protection against arbitrary treatment to the employees.	3. Unions encourage mediocrity and act in favor of seniority based promotion. Merit-based promotion and awards for personal achievement are disregarded.
4. They are able to put resistance to unethical orders and supports to ethical actions.	4. Union thrive on prolonged unrest, dissatisfied, and tense relations between workers and management.
5. They have provided for effective grievance redressal mechanism for employees.	5. They cause pigeon-holding of employee in narrow job classification to which the salary scales are attached.
6. They act to safeguard against the possible political interference, exploitation and alienation in the company affairs.	

4.8 CONFIDENTIALITY

Confidentiality means keeping the information on the employer and clients, as secrets. It is one of the important aspects of team work.

4.8.1 Justification for Confidentiality

Confidentiality can be justified by various ethical theories.

According to Rights-based theory, rights of the stakeholders, right to the intellectual property of the company are protected by this practice.

Based on Duty theory, employees and employers have duty to keep up mutual trust.

The Utilitarian theory holds good, only when confidentiality produce most good to most people. Act utilitarian theory focuses on each situation, when the employer decides on some matters as confidential.

Further, the following moral principles also justify the concept of 'confidentiality':

1. Respect for Autonomy

It means respecting the freedom and self-determination of individuals and organizations to identify their legitimate control over the personal information of themselves. In the absence of this, they cannot keep their privacy and protect their self-interest.

2. Respect For Promises

This means giving respect for the promises made by the employers and the employees. Employees should not disclose the promises given to the employers. This information may be considered as sensitive by the employer.

3. Trustworthiness

It is concept of maintaining confidential information of individual persons, by lawyers, doctors, accountants, etc., The professionals should develop confidence and welfare of the individuals and the organizations.

4. Respect For Public Welfare

For the benefit of public welfare, professionals should keep respect for public. The medical practitioners should keep confidentiality about the patients health problems, and make them feel free to reveal their problems, without being shy. This increases the chances of being cured.

4.8.2 Types of Confidential Information:

On the basis of acquisition, there are two types of confidential information as follows:

1. Privileged information. 2. Proprietary information.

Privileged information:

It is the information available and accessed by virtue of a privilege. i.e., privilege of being employed. An engineer working on a defense project, know the confidential information about the missile attacks against terrorists camps.

The security maintenance system of an organization, should keep the employee information safely.

Proprietary information:

It is the information owned by the organization. It refers to the knowledge and procedures established by and in the organization. Sometimes the internal communication inside an organization may also be marked as proprietary – confidential. So those information should be protected from other employees.

Eg., the quality manual of a company is a proprietary confidential information.

The confidential information is divided as follows on the basis of severity of risk involved.

a) Obvious information – refers to the data, information, and test results on the products, designs, formulae, and technical processes of the products.

b) Information of lesser confidentiality – relates the business information such as number of employees working on a project, the identity of suppliers, vendors, customers, marketing strategies, yield obtained, cost of manufacture, substitution of materials.

The risk or loss involved is relatively less. In competitive business situations, this information also plays a vital role.

4.8.3 More on Confidentiality

a. Is Switching Job Ethical?

When persons change jobs (employers), what happens to their moral obligation? The obligation to protect the information does not cease, when one shifts to another employee.

Otherwise, the former employee will reveal this information to the new employer or sell it to a competitor of the former employer. The integrity of the employee, even upon switching the employer demands that he maintains confidentiality and does not to divulge the information.

The professional integrity of engineers is more valuable than the loyalty to the current employer. Many engineers value professional advancement than long-term tie and loyalty to a single employer. The engineers involved in research and development and expert contribution change jobs.

Normally they are familiar with the innovative developments in the parent organizations.

For example, one manufacturing expert along with his colleagues as well as with some secret documents left General Motors and joined Volkswagen. This violation of trade secret, lead the V W to pay huge compensation to GM in cash and compulsion to buy parts from GM for seven subsequent years.

Employees, who change jobs, will not able to withhold their knowledge and expertise. They are sought after only for their expertise. They may not carry the papers and but their active brain always carry memories.

Although some organizations hold that this is unethical, the individuals can not be prevented from divulging the facts to benefit the current employer. The courts have held a moral verdict.

Even though the previous employers had the right to maintain their trade secrets confidential, the personal rights of the employees, who switched job in pursuit of career advancement, had to be honored and balanced.

b. Management Policies

How can we protect the rights of the employers and at the same time recognize the genuine personal rights and other rights of the engineers/employees?

Some of the management practices and their limitations are discussed here:

1. One way is to restrict the future employment of employees, by using employment contracts at the time of their exit. Details such as the restriction on geographical location, time gap between the departure from one place and engagement with the other employer, and on the type of jobs that one can perform with future employer, are entered in to contracts. But such contracts have not been given legal sanction.
2. An incentive instead of threatening their rights by the employment contract, may offer some positive benefits in exchange for the restrictions listed. A lump sum post-employment payment or compensation over a specific period may offered as incentive to restrict him.
3. Another approach by the management is to affect tighter control on internal information flow on trade secrets and other vital features. But this is likely to create a mutual distrust in the organization and to throttle the creativity of engineers involved in the research and development.

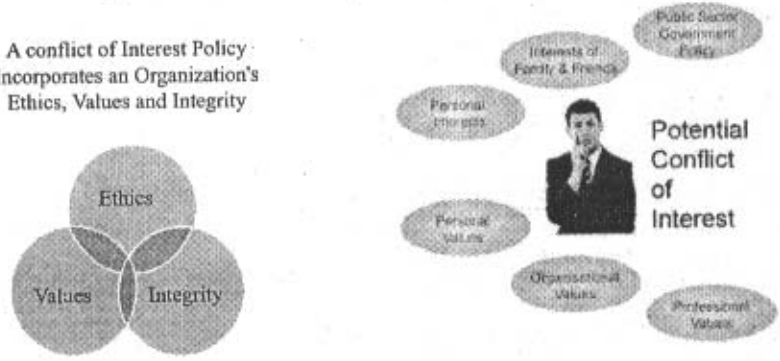
A better understanding between the ethical management and the professional responsibility of the engineers will fulfill both professional concerns and employee loyalty.

4.9 CONFLICTS OF INTEREST

1. A situation that has the potential to undermine the impartiality of a person because of the possibility of a clash between the person's self-interest and professional interest or public interest.
2. A situation in which a party's responsibility to a second-party limits its ability to discharge its responsibility to a third-party

A conflict of interest (COI) occurs when an individual or organization is involved in multiple interests, one of which could possibly corrupt the motivation for an act in the other.

A conflict of interest can only exist if a person or testimony is entrusted with some impartiality; a modicum of trust is necessary to create it. The presence of a conflict of interest is independent from the execution of impropriety. Therefore, a conflict of interest can be discovered and voluntarily defused before any corruption occurs.



The above figures clearly depict the concept of Conflicts of interest.

4.9.1 Types of Conflicts of Interest

Actual conflicts of interest.

1) Apparent conflict of interest.
2) Potential conflict of interest.

1. **Actual Conflict of interest:** This refers to the situation where the objectivity is lost while making a decision, and the inability to discharge the duty to the employer. It is the result of weaker judgment and service.
2. **Apparent conflict of interest:** Consider a situation like; an engineer is making more expensive designs to get more commission. This leads to the engineer's interest and ability for professional attitude.
3. **Potential conflict of interest:** There may be situations like; the interest of an employee extends beyond the employer. The interest changes into intimacy, and non-moral judgments against the interest of the employer, and in favor of the outside potential competitor.

It includes

a) Favorable contact
b) Bribe and gift
c) Moonlighting
d) Insider information.

(a) Favorable Contact

If an engineer is supposed to give a subcontract to the contractor / vendor, a conflict arises and it is referred as making favorable contacts, based on interests.

(b) Bribe and Gift

The conflict arises when accepting large gifts from the suppliers. Bribe is different from a gift. The following table shows a comparison of the nature of bribe and gift.

Table 4.2: How does bribe differ from gift?

Tests	Bribe	Gift
1. Timing	Given before	Given after
2. Cost of item	Large amount	Small amount, articles of daily use
3. Quality of product	Poor	Good/high
4. Giver is a friend	Yes	No
5. Transparency	Made in secret	Made in open
6. Movie	Expect undue favor	Expect a favor or thanking for the favor
7. Consequence on organization's goodwill	Damaging the goodwill and reputation	No damage is involved

Codes of ethics do not encourage even gifts, but employees have set forth flexible policies. Government and company policies generally ban gifts more than a nominal value (>Rs.1000?) An additional thumb rule is that the acceptance of gift should not influence one's judgment on merit.

(c) Moonlighting

It is a situation when a person is working as employee for two different companies in the spare time. This is against the right to pursue one's legitimate self-interest. It will lead to conflict of interests, if the person works for competitors, suppliers or customers, while working under an employer.

Another effect of moonlighting is that it leaves the person exhausted and harms the job performance in both places.

(d) Insider Information

Another potential conflict of interest is when using 'inside' information to establish a business venture or get an advantage for oneself or one's family or friends. The information may be either of the parent company or its clients or its business partners.

Engineers might inform the decision on the company's merger with another company or acquisition or an innovative strategy adopted.

In such cases, their friends get information on stock holding and decide on trading their stocks to sell or buy quickly, so that gain more or prevent a loss.

For example:

In WorldCom USA, the insider information was used to manipulate and sell a large amount of stock holding by the Director, upon knowing that the government has declined to admit their product.

4.9.2 Organizational Conflict of Interest

An organizational conflict of interest (OCI) may exist in the same way as described above, in the realm of the private sector providing services to the Government, where a corporation provides two types of services to the Government that have conflicting interest or appear objectionable (i.e.: manufacturing parts and then participating on a selection committee comparing parts manufacturers).

Corporations may develop simple or complex systems to mitigate the risk or perceived risk of a conflict of interest. These risks are typically evaluated by a governmental office (for example, in a US Government RFP) to determine whether the risks pose a substantial advantage to the private organization over the competition or will decrease the overall competitiveness in the bidding process.

Relationship to Medical Research

The influence of the pharmaceutical industry on medical research has been a major cause for concern. In 2009 a study found that "a number of academic institutions" do not have clear guidelines for relationships between Institutional Review Boards and industry.

4.9.3 Other Types of Conflicts of Interests

The following are the most common forms of conflicts of interests:

- Self-dealing, in which an official who controls an organization causes it to enter into a transaction with the official, or with another organization that benefits the official. The official is on both sides of the "deal."
- Outside employment, in which the interests of one job contradict another.
- Family interests, in which a spouse, child, or other close relative is employed (or applies for employment) or where goods or services are purchased from such a relative or a firm controlled by a relative. For this reason, many employment applications ask if one is related to a current employee. If this is the case, the relative could then recues from any hiring decisions. Abuse of this type of conflict of interest is called nepotism.
- Gifts from friends who also do business with the person receiving the gifts. (Such gifts may include non-tangible things of value such as transportation and lodging.)
- Pump and dump, in which a stock broker who owns a security artificially inflates the price by "upgrading" it or spreading rumors, sells the security and adds short position, then "downgrades" the security or spreads negative rumors to push the price down.

Other improper acts that are sometimes classified as conflicts of interests are probably better classified elsewhere. Accepting bribes can be classified as corruption; almost everyone in a position of authority, particularly public authority, has the potential for such wrongdoing.

Similarly, use of government or corporate property or assets for personal use is fraud, and classifying this as a conflict of interest does not improve the analysis of this problem. Nor should unauthorized distribution of confidential information, in itself, be considered a conflict of interest.

COI is sometimes termed competition of interest rather than "conflict", emphasizing a connotation of natural competition between valid interests rather than violent conflict with its connotation of victim hood and unfair aggression. Nevertheless, denotatively, there is too much overlap between the terms to make any objective differentiation.

4.9.4 Examples

1. A person working as the equipment purchaser for a company may get a bonus proportionate to the amount he's under budget by year end. However, this becomes an incentive for him to purchase inexpensive, substandard equipment. Therefore, this is counter to the interests of those in his company who must actually use the equipment.

2. Representatives, in general, have different interests than their constituents. Thus, accepting bribes to vote a certain way is in their interest (assuming they don't get caught), while not in their constituents' interest.

   These actions are sometimes illegal, but often not, as in the case of a politician accepting large amounts of money for a political campaign, and in return, granting the contributor access to political leaders. This is often cited as an argument for direct democracy (the replacement of representatives' votes with referenda).

3. Revolving door (politics), government workers or elected officials quitting public service to work for the companies they used to regulate. Regulators are accused of using inside information for their new employers, or compromising laws and regulations in hopes of securing employment in the private sector.

4.9.5 Ways to Mitigate Conflicts of Interests

1) Removal

The best way to handle conflicts of interests is to avoid them entirely. For example, someone elected to political office might sell all corporate stocks that they own before taking office, and resign from all corporate boards. Or that person could move their corporate stocks to a special trust, which would be authorized to buy and sell without disclosure to the owner.

This is referred to as a "blind trust". With such a trust, since the politician does not know in which companies they have investments, there should be no temptation to act to their advantage.

2) Disclosure

Commonly, politicians and high-ranking government officials are required to disclose financial information - assets such as stock, debts such as loans, and/or corporate positions held, typically annually. To protect privacy (to some extent), financial figures are often disclosed in ranges such as "$100,000 to $500,000" and "over $2,000,000".

Certain professionals are required either by rules related to their professional organization, or by statute, to disclose any actual or potential conflicts of interest. In some instances, the failure to provide full disclosure is a crime.

3) Recusal

Those with a conflict of interest are expected to recuse themselves from (i.e., abstain from) decisions where such a conflict exists. The imperative for recusal varies depending upon the circumstance and profession, either as common sense ethics, codified ethics, or by statute.

For example, if the governing board of a government agency is considering hiring a consulting firm for some task, and one firm being considered has, as a partner, a close relative of one of the board's members, then that board member should not vote on which firm is to be selected. In fact, to minimize any conflict, the board member should not participate in any way in the decision, including discussions.

Judges are supposed to recuse themselves from cases when personal conflicts of interest may arise.

For example, if a judge has participated in a case previously in some other judicial role he/she is not allowed to try that case.

Recusal is also expected when one of the lawyers in a case might be a close personal friend, or when the outcome of the case might affect the judge directly, such as whether a car maker is obliged to recall a model that a judge drives.

This is required by law under Continental civil law systems and by the Rome Statute, organic law of the International Criminal Court.

4) Third-Party Evaluations

Consider a situation where the owner of a majority of a publicly held corporation decides to buy out the minority shareholders and take the corporation private.

What is a fair price? Obviously it is improper (and, typically, illegal) for the majority owner to simply state a price and then have the (majority-controlled) board of directors approve that price.

What is typically done is to hire an independent firm (a third party), well-qualified to evaluate such matters, to calculate a "fair price", which is then voted on by the minority shareholders.

Third-party evaluations may also be used as proof that transactions were, in fact, fair ("arm's-length").

5) Codes of Ethics

Generally, codes of ethics forbid conflicts of interests. Often, however, the specifics can be controversial.

- Should therapists, such as psychiatrists, be allowed to have extra-professional relations with patients, or ex-patients?
- Should a faculty member be allowed to have an extra-professional relationship with a student, and should that depend on whether the student is in a class of, or being advised by, the faculty member?

Codes of ethics help to minimize problems with conflicts of interests because they can spell out the extent to which such conflicts should be avoided, and what the parties should do where such conflicts are permitted by a code of ethics (disclosure, recusal, etc.).

Thus, professionals cannot claim that they were unaware that their improper behavior was unethical. As importantly, the threat of disciplinary action (for example, a lawyer being disbarred) helps to minimize unacceptable conflicts or improper acts when a conflict is unavoidable.

4.10 OCCUPATIONAL CRIME

An occupational crime may be committed by

1. wrong actions of a person through one's lawful employment or
2. crime by an employee to promote ones own or employer's interest or
3. theft or pilferage (act of stealing small / cheap things) of employee, or
4. Damage to the property or an employee of one's organization.

These are also called as ***White – Collared Crimes.***

Many of these crimes are expels of conflicts of interest. These are motivated by greed, corporate ambition, and misguided loyalty.

Some other examples of occupational crimes are:

1. Price fixing.
2. Industrial Espionage
3. Bootlegging
4. Endangering lives.

1) Price Fixing

This is an occupational crime, i.e., fixing the bidding rate by companies in collision with other companies especially for contract / services is called price fixing.

2) Industrial Espionage

It means the act of spying for personal or company benefits. It includes, pilferage, spying of design information, or bidding quotations, or any other confidential information from the competitor.

3) Bootlegging

It refers to working on projects which are prohibited or not properly authorized. It involves manufacturing, selling or transporting products (narcotics / diamonds) that are prohibited by law.

4) Endangering lives (Occupational Hazards)

It refers to the act of endangering the lives of employees by involving them in hazardous manufactures, such as asbestos, fire crackers, etc., the people who got continuous exposure to those hazardous things, get suffered from serious health effects such as cancer. Occupational Health and Safety Assessment Series, OHAS-18001 Certification has been adopted in many Indian Industries.

As per the Annual report of RIL 10 , an initiative called Project CASH, Change Agent for Safety and Health, had been formed to bring about a positive change and continual improvement in occupational health practices at the work place, besides attitudinal and behavior changes. This is claimed to have prevented work-related diseases, injuries, reduced absenteeism, and ultimately increased the productivity level.

4.11 PROFESSIONAL RIGHTS

Under professional rights, the following provisions are protected:

1. Right to form and express professional judgment :

It is also called the right of professional conscience. In pursuing professional responsibilities, this empowers one to form and exercise the professional judgment. Both technical and moral judgments are included. This right is bound by the responsibilities to employers and colleagues.

2. Right to refuse to participate in unethical activities:

It is also called the right of conscientious refusal. It is the right to refuse to engage in unethical actions and to refuse to do so solely because one views that as unethical.

The employer cannot force or threaten the employee to do something that is considered by that employee as unethical or unacceptable.

For example, unethical and illegal activities that can be refused are: falsifying data, forging documents, altering test results, lying, giving or taking bribe etc.

There may be situations, when there is a disagreement or no shared agreement among reasonable people over whether an act is unethical.

Medical practitioners have a right not to participate in abortions. Similarly, the engineers must have a right to refuse assignments that violate their personal conscience, such as when there exists a threat to human life or moral disagreement among reasonable people.

3. Right to fair recognition and to receive remuneration for professional services:

Engineers have a right to professional recognition for their work and achievements. This includes fair monetary and non-monetary forms of recognition. It is related to morality as well as self-interest.

They motivate them to concentrate their energy on jobs and to update their knowledge and skills through continuing education. This will prevent the engineers from diversion such as moonlighting or bother on money matters.

Many times, the engineers who have labored to get patents on the organizations are not adequately remunerated. Based on the resources of the organization and the bargaining power of the engineers, the reasonable salary or remuneration for patent discovery can be worked out.

4. Right to warn the public about dangers:

It should be done without damaging the reputation of the employer. The views can be expresses through the professional society to get a backing.

5. Right to talk publicly about the job:

This should be done within limits of decency, confidentiality, and loyalty.

6. Right to engage in the activities of professional societies:

Attending membership campaign and seminars are typical activities to promote the professional society.

4.12 EMPLOYEE RIGHTS

Employee rights are moral and legal rights that are obtained by the status of being an employee.

The provisions made to the employees under this category are:

1. Professional rights.
2. Basic Human rights
3. Institutional rights / contractual employee rights
4. Non contractual employee rights.

The non contractual employee rights include:

1. **Right to privacy:** It is the right to control the access and use of one's information. Only authorized persons can get the personal information.
2. **Right to choose outside activities:** It is the right to have a private life outside the job. There are some situations in which this right can be curbed. For eg.,

- When those activities lead to violation.
- When the activities of the employees form a conflict or interest (e.g., when moonlighting)
- When the interest of the employer is getting damaged (if the employee transfers some vital information on plans or strategies to the competitor).

3. Right to Due Process from Employer:

It is the right to fair process or procedures in firing, demotion and in taking any disciplinary actions against the employees. Written explanation should be initially obtained from the charged employee and the orders are given in writing, with clearly-stated reasons.

Simple appeal procedures should be framed and made available to all those affected. Fairness here is specified in terms of the process rather than the outcomes.

4. Right to Equal Opportunity—Non-discrimination:

Discrimination because of caste, sex, religion, creed, and language are regressive actions. Discrimination which means a morally unjust treatment of people in the workplace is damaging to the human dignity.

For example,

(a) A senior manager post is vacant. There is competent and proven candidate from outside the state. A local engineer with lesser competence is promoted.

(b) Prize amounts for the winners in the world sport events are not the same for men and women.

5. Right to Equal Opportunity—Sexual Harassment in the Workplace:

The sexual harassment is a display of arrogance and misuse of power through sexual means. It is against the moral autonomy i.e., freedom to decide on one's own body. It is also an assault on one's human dignity and trust. Sexual harassment may be defined as the unwanted compulsion or attack on sexual requirements (gratification) in the context of unequal power.

It includes physical as well as psychological attack or coercion and indecent gestures by men shown on women or by women on men. Two such forms of harassment are found to exist. In one type called 'exchange of favors', senior officers demand sexual favor as a condition for giving a job, or granting a promotion or increment.

It may be either in the form of a physical or verbal threat or sexual offer. In another type called 'hostile work environment', it is the sexually-oriented work environment that threatens the employee's right to equal opportunity.

Undesirable sexual proposals, advances, lewd remarks, mailing obscene photographs are some of the typical examples of this type of harassment. A rights ethicist interprets this as a serious violation of human right to pursue one's job free from extraneous force, compulsion, punishment or threat or insult.

A duty ethicist would call it as a blatant violation of duty to treat human being with dignity and individual freedom, and not to treat as in animate object for immoral gratifications. The utilitarian would expose the effect on the happiness and the welfare of the victims, especially of women.

6. Right to Equal Opportunity—Affirmative Action or Preferential Treatment:

It means giving a preference or advantage to a person of a group that was denied equal treatment in the past. Such treatments are given especially to women and minorities all over the world. It is also called 'reverse preferential treatment', because it reverses the historical preferences.

There are arguments in favor and against the action of preferential treatments, which are summarized in the following Table 4.3.

Table 4.3: Pro and anti-view of preferential treatment

In favor of preferential treatment	Against reverse preferential treatment
1. Compensatory justice: Violations of rights in the past must be compensated. Usually this treatment is extended to all in the group rather than individuals.	1. It violate the rights to equal opportunity for majority to complete on merits.
2. Racial and sexual violation and violence still exist today. To counterbalance this, the reverse preferential treatment is necessary to ensure equal opportunity to minorities and women.	2. Compensation may be given only to specific individuals and not for all.
3. It has produced desirable consequences it has raised the social and economic status and provided then role models and has promoted self - esteem.	3. Provide special funding and education for the disadvantaged but jobs should not be used as a compensatory tool.
	4. Reduces the productivity as the merit is the casually. Self-doubts and indecision affect others morale and efficiency.

4.13 INTELLECTUAL PROPERTY RIGHTS: (IPR)

4.13.1 Intellectual Property:

It is the information and the original expression that derives its original value from creative ideas, and is with a commercial value. IP permits people to have fully independent ownership for their inventions and creativity, like that of own physical property.

This encourages the IP owners towards innovation and benefit to the society. It is an asset that can be bought or sold, licensed, and exchanged. It is intangible i.e., it cannot be identified by specific parameters.

The agreements with World Trade Organization (WTO) and Trade-Related aspects of Intellectual Property System (TRIPS) have been adopted effective from January 2005. Besides the minimum standards set for protection of IP rights, appropriate laws framed by the member countries are expected to reduce distortions and barriers for and promote the international trade.

The global IPR system strengthens protection, increases the incentives for innovation, and raises returns on international technology transfer. However, it could raise the costs of acquiring new technology and products, shifting the global terms of trade in favor of technology producers.

4.13.2 Need for protection of IP:

IP plays an essential role to stabilize and develop the economy of a nation. This protection actually stimulates creativity, research, and innovation by ensuring freedom to individuals and organizations to benefit from their creative intellectual investments.

The IP serves many purposes, namely

(a) It prevents others using it,

(b) Prevent using it for financial gain,

(c) Prevent plagiarism,

(d) Fulfill obligation to funding agency.

ICICI Bank has advanced loan against IP as security to Shopper's Stoppe, New Delhi, and

(e) Provides a strategy to generate steady income.

Some of the challenges in the acquisition of IP are:

1. Shortage of manpower in the industry. Educational institutions can play a vital role in providing the same.
2. High cost of patenting and lengthy procedure. This was being considered by the Government and a simpler and faster procedure is expected, and
3. Lack of strong enforcement mechanism.

4.13.3 Types and Norms

The agreements establish norms and conditions for the following instruments of intellectual properties:

a) Patents

b) Copyright

c) Trademark.

d) Trade secret.

1. PATENTS:

- Patent is a contract between the individual (inventor) and the society (all others).
- Patents protect legally the specific products from being manufactured or sold by others, without permission of the patent holder.
- Patent holder has the legally-protected monopoly power as one's own property.
- The validity is 20 years from the date filing the application for the patent. It is a territorial right and needs registration. The Patent (Amendment) Act 2002 guarantees such provisions.
- Patent is given to a product or a process, provided it is entirely new, involving an inventive method and suitable for industrial application.
- While applying for a patent, it is essential to submit the documents in detail regarding the problem addressed, its solution, extent of novelty or innovation, typical applications, particulars of the inventor, and the resources utilized.
- Inventions are patentable and the discoveries are not.

Types of Patents:

a) Utility patent

b) Industrial Design patent

a) Utility patent:

It is granted to anyone who invents or discovers any new and useful process, machine, manufacture or chemical composition of any manner or any new and useful improvement. The utility patent is valid for a time period of 20 years.

b) Industrial Design patent:

It is an idea or conception regarding features of shape, configuration, pattern, ornamental including lines or colors applied to any article.

Eg., Designs applied to electronic items, textiles, etc...

2. COPYRIGHT

The copyright is a specific and exclusive right, describing rights given to creators for their literary and artistic works.

This protects literary material, aesthetic material, music, film, sound recording, broadcasting, software, multimedia, paintings, sculptures, and drawings including maps, diagrams, engravings or photographs.

There is no need for registration and no need to seek lawyer's help for settlement. The life of the copyright protection is the life of the inventor or author plus 50 years.

Copyright gives protection to particular expression and not for the idea.

Copyright is effective in,

(a) preventing others from copying or reproducing or storing the work,

(b) publishing and selling the copies,

(c) performing the work in public, commercially

(d) to make film

(e) to make translation of the work, and

(f) to make any adaptation of the work.

Copying the idea is called 'plagiarism' and it is dealt with separately. Can software be protected through copyright? Indian copyright Act amended in 1984 included the rights of in a computer program as literary work.

Many countries protect software as a copyright. Some holds the view that copyright is not the right type of protection for software.

They held that the patents and trade secrets are more appropriate forms of protecting software. While trade secret is the most conventional form of protection of software, in the recent years, both patents and copyrights are adopted to protect software.

Copyright (Amendment) Act 1999, India ensures fair dealing of broadcasting through the internet. The concerns of Book industry, Music Industry, Film and Television Industry, Computer Industry and Database Industry are sufficiently met by this updated Act.

3. TRADEMARK :

Trademark is a wide identity of specific good and services, permitting differences to be made among different trades. It is a territorial right, which needs registration. Registration is valid initially for 10years, and renewable.

The trademark or service mark may be registered in the form of a device, a heading, a label, a ticket, a letter, a word or words, a numeral or any combination of these, logos, designs, sounds, and symbols.

Trademark should not be mistaken for a design.

e.g., the shape of a bottle in which a product is marketed, can not be registered as a trademark.

Trademarks Act 1999 made in compliance with TRIPS agreement, provides further details.

There are three functions of trademark:

1. Just as we are identified by our names, good are identified by their trademarks. For example, the customer goes to the shop and asks for Lux soap. The word 'Lux' is a trade mark. In other words it shows the origin or source of the goods.
2. The trademark carries with it an inherent indication or impression on the quality of goods, which indirectly demonstrates that it receives the customer's satisfaction.
3. The trademark serves as silent sales promoter. Without a trademark there can be no advertisement. In other words, it serves as a medium for advertising the goods.

The marks should be distinctive i.e., it should be able to distinguish from one good to the other.

The terms used for trademarks are usually generic, descriptive, and suggestive. Some of the term which are not distinctly distinguishing the goods or services from others, are called ***generic term*** and are eligible for protection under trademarks.

The ***descriptive term*** should clearly indicate or convey the specific purpose, function, physical characteristic and the end use of the product.

4. TRADE SECRET

- A trade secret is the information which is kept confidential as a secret. This information is not accesses by the any other competitor, than the owner and thus gives a commercial advantage over the competitors.
- The trade secrets are not registered but only kept as confidential.
- These are given limited legal protection. The trade secrets may be formulae, or methods, or programs, or processes, or test results, or data collected, analyzed, and synthesized.
- These are related to designs, technical processes, list of suppliers or customers, etc., this information should not be disclosed or used by any other person.

4.14 DISCRIMINATION

Discrimination is the prejudicial treatment of an individual based on their membership in a certain group or category. It involves the actual behaviors towards groups such as excluding or restricting members of one group from opportunities that are available to another group. The term began to be used as an expression of derogatory racial prejudice in the 1830s from Thomas D. Rice's performances as "Jim Crow".

Since the American Civil War the term 'discrimination' generally evolved in American English usage as an understanding of prejudicial treatment of an individual based solely on their race, later generalized as membership in a certain socially undesirable group or social category.

Discriminatory laws such as redlining exist in many countries. In some places, controversial attempts such as racial quotas have been used to redress negative effects of discrimination.

It should be noted that discrimination is not always against a disadvantaged group. When a majority group (white, male, heterosexual, rich etc.) is discriminated against because they are a member of this group this is usually called reverse discrimination.

4.14.1 Definitions

Within sociology, 'discrimination' is the prejudicial treatment of an individual based on their membership in a certain group or category. Discrimination is the actual behavior towards members of another group. It involves excluding or restricting members of one group from opportunities that are available to other groups. Moral philosophers have defined it as disadvantageous treatment or consideration.

This is a comparative definition. An individual need not be actually harmed in order to be discriminated against. He or she just needs to be treated worse than others for some arbitrary reason.

If someone decides to donate to help orphan children, but decides to donate less, say, to black children out of a racist attitude, he or she will be acting in a discriminatory way even if he or she actually benefits the people he discriminates against by donating some money to them.

The United Nations stance on discrimination includes a statement that: "Discriminatory behaviors take many forms, but they all involve some form of exclusion or rejection."

4.14.2 Racial and ethnic discrimination

Racial discrimination differentiates between individuals on the basis of real and perceived racial differences, and has been official government policy in several countries, such as South Africa in the apartheid era, the Occupied Palestinian Territories with the apartheid separation wall and the USA.

In the United States, racial profiling of minorities by law enforcement officials has been called racial discrimination As early as 1865, the Civil Rights Act provided a remedy for intentional race discrimination in employment by private employers and state and local public employers.

The Civil Rights Act of 1871 applies to public employment or employment involving state action prohibiting deprivation of rights secured by the federal constitution or federal laws through action under color of law.

Title VII is the principal federal statute with regard to employment discrimination prohibiting unlawful employment discrimination by public and private employers, labor organizations, training programs and employment agencies based on race or color, religion, gender, and national origin.

Title VII also prohibits retaliation against any person for opposing any practice forbidden by statute, or for making a charge, testifying, assisting, or participating in a proceeding under the statute.

The Civil Rights Act of 1991 expanded the damages available in Title VII cases and granted Title VII plaintiffs the right to a jury trial. Title VII also provides that race and color discrimination against every race and color is prohibited.

Legislation: The following are the laws passed in various countries against discrimination.

Australia

- Sex Discrimination Act 1984

Canada

- Ontario Human Rights Code 1962
- Canadian Human Rights Act 1977

Hong Kong

- Sex Discrimination Ordinance (1996)

United Kingdom

- Equal Pay Act 1970 – provides for equal pay for comparable work
- Sex Discrimination Act 1975 – makes discrimination against women or men, including discrimination on the grounds of marital status, illegal in the workplace.
- Human Rights Act 1998 – provides more scope for redressing all forms of discriminatory imbalances

United States

- Equal Pay Act of 1963– (part of the Fair Labor Standards Act) – prohibits wage discrimination by employers and labor organizations based on sex
- Title VII of the Civil Rights Act of 1964 – broadly prohibits discrimination in the workplace including hiring, firing, workforce reduction, benefits, and sexually harassing conduct.
- Pregnancy Discrimination Act, which amended Title VII of the Civil Rights Act of *1964 – covers discrimination based upon pregnancy in the workplace[*
- Violence Against Women Act

4.14.3 Caste discrimination

According to UNICEF and Human Rights Watch, caste discrimination affects an estimated 250 million people worldwide.

Discrimination based on caste, as perceived by UNICEF, is prevalent mainly in parts of Asia (India, Sri Lanka, Bangladesh, Nepal, Japan) and Africa.[26] Currently, there are an estimated 160 million Dalits or Scheduled Castes (formerly known as "untouchables") in India.

4.14.4 Employment discrimination

Employment discrimination refers to disabling certain people to apply and receive jobs based on their race, age, gender, religion, height, weight, nationality, disability, sexual orientation or gender identity. In relationship to sociology, employment discrimination usually relates to what events are happening in society at the time. For example, it would have seemed ludicrous to hire an African American male and absolutely unheard of to hire an African American woman over 50 years ago. However, in our society today, it is the absolute norm to hire any qualified person.

Many laws prohibit employment discrimination. If a person uses discriminatory hiring practices, they can be sued for hate crimes. However, some minority groups (notably LGBT people) remain unprotected by U.S. federal law from employment discrimination.

The American federal laws that protect against:

- Race, color and national origin discrimination include the Civil Rights Act of 1964, Executive Order Number 11478 among other numerous laws that protect people from race, color and national origin discrimination.
- Sex and gender discrimination include the Civil Rights Act of 1964 and Equal Pay Act of 1963.
- age Discrimination include the Age Discrimination in Employment Act of 1967.
- Physical and mental disability discrimination includes the Americans with Disabilities Act of 1990.
- Religious discrimination includes the Civil Rights Act of 1964.
- Military status discrimination include the Vietnam Era Veterans Readjustment Assistance Act of 1974
- Most other western nations have similar laws protecting these groups.

4.14.5 Language discrimination

Diversity of language is protected and respected by most nations who value cultural diversity. However, people are sometimes subjected to different treatment because their preferred language is associated with a particular group, class or category. Commonly, the preferred language is just another attribute of separate ethnic groups. Discrimination exists if there is prejudicial treatment against a person or a group of people who speak a particular language or dialect.

Language discrimination is suggested to be labeled linguicism or logocism. Anti-discriminatory and inclusive efforts to accommodate persons who speak different languages or cannot have fluency in the country's predominant or "official" language is bilingualism such as official documents in two languages, and multiculturalism in more than two languages.

4.14.6 Reverse discrimination

Some attempts at antidiscrimination have been criticized as reverse discrimination. In particular, minority quotas (for example, affirmative action) discriminate against members of a dominant or majority group. In its opposition to race preferences, the American Civil Rights Institute's Ward Connerly stated, "There is nothing positive, affirmative, or equal about 'affirmative action' programs that give preference to some groups based on race."[39] There are cases, however, such as the Noack v. YMCA case in U.S. Fifth Circuit Court, which include outright anti-male gender bias in a traditionally female work environment like childcare. That former employee claims to have suffered even physical assaults, and was allegedly also told to not hire too many blacks or men.

4.14.7 Disability discrimination

Discrimination against people with disabilities in favor of people who are not is called ableism or disablism. Disability discrimination, which treats non-disabled individuals as the standard of 'normal living', results in public and private places and services, education, and social work that are built to serve 'standard' people, thereby excluding those with various disabilities.

In the United States, the Americans with Disabilities Act mandates the provision of equality of access to both buildings and services and is paralleled by similar acts in other countries, such as the Equality Act 2010 in the UK.

4.14.8 Religious discrimination

Religious discrimination is valuing or treating a person or group differently because of what they do or do not believe. For instance, the indigenous Christian population of Balkans (known as "rayah" or "protected flock") lived under the Ottoman Kanun–i–Rayah. The word is sometimes translated as 'cattle' rather than 'flock' or 'subjects' to emphasize the inferior status of the rayah. In the Ottoman Empire, in accordance with the Muslim dhimmi system, Christians were guaranteed limited freedoms (such as the right to worship), but were treated as second-class citizens. Christians and Jews were not considered equals to Muslims: testimony against Muslims by Christians and Jews was inadmissible in courts of law. They were forbidden to carry weapons or ride atop horses, their houses could not overlook those of Muslims, and their religious practices would have to defer to those of Muslims, in addition to various other legal limitations.

Restrictions upon Jewish occupations were imposed by Christian authorities. Local rulers and church officials closed many professions to Jews, pushing them into marginal roles considered socially inferior, such as tax and rent collecting and money lending, occupations only tolerated as a "necessary evil".

The number of Jews permitted to reside in different places was limited; they were concentrated in ghetto sand were not allowed to own land. The Fourth Lateran Council in 1215 decreed that Jews must wear distinguishing clothing.

In a 1979 consultation on the issue, the United States commission on civil rights defined religious discrimination in relation to the civil rights guaranteed by the Fourteenth Amendment to the United States Constitution.

Whereas religious civil liberties, such as the right to hold or not to hold a religious belief, are essential for Freedom of Religion (in the United States secured by the First Amendment).

Religious discrimination occurs when someone is denied " the equal protection of the laws, equality of status under the law, equal treatment in the administration of justice, and equality of opportunity and access to employment, education, housing, public services and facilities, and public accommodation because of their exercise of their right to religious freedom."

The tax-exempt status of religious organizations discriminates against atheists or people who do not believe in organized religions, in much the same way that mobility allowance for people who can't walk discriminates against those who simply have bad knees but can still walk.

4.14.9 Theories

Discrimination

Social theories such as Egalitarianism claim that social equality should prevail. In some societies, including most developed countries, each individual's civil rights include the right to be free from government sponsored social discrimination.

Due to a belief in the capacity to perceive pain and/or suffering shared by all animals, 'abolitionist' or 'vegan' egalitarianism maintains that the interests of every individual (regardless its species), warrant equal consideration with the interests of humans, and that not doing so is "speciesist".

Conservative and anarcho-capitalist

In contrast, conservative writer and law professor Matthias Storme has claimed that the freedom of discrimination in human societies is a fundamental human right, or more precisely, the basis of all fundamental freedoms and therefore the most fundamental freedom. Author Hans-Hermann Hoppe, in an essay about his book Democracy: The God That Failed, asserts that a natural social order is characterized by increased discrimination.

Labeling theory

Discrimination, in labeling theory, takes form as mental categorization of minorities and the use of stereotype. This theory describes difference as deviance from the norm, which results in internal devaluation and social stigma that may be seen as discrimination. It is started by describing a 'natural' social order.

It is distinguished between the fundamental principle of fascism and social democracy. The Nazis in 1930's-era Germany, the pre-1990 Apartheid government of South Africa used racial discriminatory agendas for their political ends. This practice continues with some present day governments.

4.15 CASE STUDY: POWER PLANT DISASTER

4.15.4 Bhopal Disaster

The Bhopal disaster also known as Bhopal Gas Tragedy was a gas leak accident in India, considered one of the world's worst industrial catastrophes] It occurred on the night of December 2–3, 1984 at the Union Carbide India Limited (UCIL) pesticide plant in Bhopal, Madhya Pradesh, India.

A leak of methyl isocyanate gas and other chemicals from the plant resulted in the exposure of hundreds of thousands of people. Estimates vary on the death toll. The official immediate death toll was 2,259 and the government of Madhya Pradesh has confirmed a total of 3,787 deaths related to the gas release. Others estimate 3,000 died within weeks and another 8,000 have since died from gas-related diseases.

A government affidavit in 2006 stated the leak caused 558,125 injuries including 38,478 temporary partial and approximately 3,900 severely and permanently disabling injuries.

4.15.4.1 Summary

The UCIL factory was built in 1969 to produce the pesticide Sevin (UCC's brand name for carbaryl) using methyl isocyanate (MIC) as an intermediate. An MIC production plant was added in 1979.

During the night of December 2–3, 1984, water entered a tank containing 42 tons of MIC. The resulting exothermic reaction increased the temperature inside the tank to over 200 °C (392 °F) and raised the pressure.

The tank vented releasing toxic gases into the atmosphere. The gases were blown by northwesterly winds over Bhopal.

Theories differ as to how the water entered the tank.SSS At the time, workers were cleaning out a clogged pipe with water about 400 feet from the tank. The operators assumed that owing to bad maintenance and leaking valves, it was possible for the water to leak into the tank.

However, this water entry route could not be reproduced. UCC also maintains that this route was not possible, but instead alleges water was introduced directly into the tank as an act of sabotage by a disgruntled worker via a connection to a missing pressure gauge on the top of the tank. Early the next morning, a UCIL manager asked the instrument engineer to replace the gauge.

UCIL's investigation team found no evidence of the necessary connection; however, the investigation was totally controlled by the government denying UCC investigators access to the tank or interviews with the operators. The 1985 reports give a picture of what led to the disaster and how it developed, although they differ in details.

Factors leading to the magnitude of the gas leak include:

a) Storing MIC in large tanks and filling beyond recommended levels

b) Poor maintenance after the plant ceased MIC production at the end of 1984

c) Failure of several safety systems (due to poor maintenance)

d) Safety systems being switched off to save money—including the MIC tank refrigeration system which could have mitigated the disaster severity

The problem was made worse by the mushrooming of slums in the vicinity of the plant, non-existent catastrophe plans, and shortcomings in health care and socio-economic rehabilitation.

4.15.4.2 Contributing Factors

Other factors identified by the inquiry included: use of a more dangerous pesticide manufacturing method, large-scale MIC storage, plant location close to a densely populated area, undersized safety devices, and the dependence on manual operations.[3]

Plant management deficiencies were also identified – lack of skilled operators, reduction of safety management, insufficient maintenance, and inadequate emergency action plans.

The chemical process, or "route", used in the Bhopal plant reacted methylamine with phosgene to form MIC (methyl isocyanate), which was then reacted with 1-naphthol to form the final product, carbaryl.

This route differs from MIC-free routes used elsewhere, in which the same raw materials are combined in a different manufacturing order, with phosgene first reacted with the naphthol to form a chloroformate ester, which is then reacted with methyl amine. In the early 1980s, the demand for pesticides had fallen, but production continued, leading to buildup of stores of unused MIC.

4.10.4.3 Equipment and Safety Regulations

It emerged in 1998, during civil action suits in India, that the plant was not prepared for problems. No action plans had been established to cope with incidents of this magnitude. This included not informing local authorities of the quantities or dangers of chemicals used and manufactured at Bhopal.

1. The MIC tank alarms had not worked for four years.
2. There was only one manual back-up system, compared to a four-stage system used in the US.
3. The flare tower and the vent gas scrubber had been out of service for five months before the disaster. The gas scrubber therefore did not treat escaping gases with sodium hydroxide (caustic soda), which might have brought the concentration down to a safe level.
4. The maximum pressure the scrubber could handle, provided it had been operating, was only a quarter of the pressure during the leak.

5. The flare tower could only hold a quarter of the gas that leaked in 1984. To reduce energy costs, the refrigeration system was idle. The MIC was kept at 20 degrees Celsius, not the 4.5 degrees advised by the manual.
6. The steam boiler, intended to clean the pipes, was out of action for unknown reasons.
7. Slip-blind plates that would have prevented water from pipes being cleaned from leaking into the MIC tanks through faulty valves were not installed. Their installation had been omitted from the cleaning checklist.
8. The water pressure was too weak to spray the escaping gases from the stack. They could not spray high enough to reduce the concentration of escaping gas.
9. According to the operators the MIC tank pressure gauge had been malfunctioning for roughly a week. Other tanks were used rather than repairing the gauge. The build-up in temperature and pressure is believed to have affected the magnitude of the gas release. UCC investigation studies have disputed this hypothesis.
10. Carbon steel valves were used at the factory, even though they corrode when exposed to acid. UCC admitted in their own investigation report that most of the safety systems were not functioning on the night of December 3, 1984.
11. The design of the MIC plant, following government guidelines, was "Indianized" by UCIL engineers to maximize the use of indigenous materials and products. Mumbai based Humphreys and Glasgow Consultants PVT. Ltd. were the main consultants, Larsen and Toubro fabricated the MIC storage tanks, and Taylor of India Ltd. provided the instrumentation.

4.15.4.4 Health Effects

Short term health effects

- The leakage caused many short term health effects in the surrounding areas. Apart from MIC, the gas cloud may have contained phosgene, hydrogen cyanide, carbon monoxide, hydrogen chloride, oxides of nitrogen, monomethyl amine (MMA) and carbon dioxide, either produced in the storage tank or in the atmosphere.
- The gas cloud was composed mainly of materials denser than the surrounding air, stayed close to the ground and spread outwards through the surrounding community.
- The initial effects of exposure were coughing, vomiting, severe eye irritation and a feeling of suffocation.
- People awakened by these symptoms fled away from the plant. Those who ran inhaled more than those who had a vehicle to ride.
- Owing to their height, children and other people of shorter stature inhaled higher concentrations. Many people were trampled trying to escape.
- Thousands of people had succumbed by the morning hours. There were mass funerals and mass cremations as well as disposal of bodies in the Narmada river.

- 170,000 people were treated at hospitals and temporary dispensaries. 2,000 buffalo, goats, and other animals were collected and buried.
- Within a few days, leaves on trees yellowed and fell off. Supplies, including food, became scarce owing to suppliers' safety fears. Fishing was prohibited causing further supply shortages.
- A total of 36 wards were marked by the authorities as being "gas affected", affecting a population of 520,000. Of these, 200,000 were below 15 years of age, and 3,000 were pregnant women. In 1991, 3,928 deaths had been certified. Independent organizations recorded 8,000 dead in the first days.
- Other estimations vary between 10,000 and 30,000. Another 100,000 to 200,000 people are estimated to have permanent injuries of different degrees.
- The acute symptoms were burning in the respiratory tract and eyes, blepharospasm, breathlessness, stomach pains and vomiting. The causes of deaths were choking, reflexogenic circulatory collapse and pulmonary oedema.
- Findings during autopsies revealed changes not only in the lungs but also cerebral oedema, tubular necrosis of the kidneys, fatty degeneration of the liver and necrotising enteritis. The stillbirth rate increased by up to 300% and neonatal mortality rate by 200%.

4.15.4.5 Safety And Equipment Issues

The corporation denies the claim that the valves on the tank were malfunctioning, claiming that "documented evidence gathered after the incident showed that the valve close to the plant's water-washing operation was closed and leak-tight.

Furthermore, process safety systems—in place and operational—would have prevented water from entering the tank by accident". Carbide states that the safety concerns identified in 1982 were all allayed before 1984 and "none of them had anything to do with the incident". The company admits that "the safety systems in place could not have prevented a chemical reaction of this magnitude from causing a leak".

According to Carbide, "in designing the plant's safety systems, a chemical reaction of this magnitude was not factored in" because "the tank's gas storage system was designed to automatically prevent such a large amount of water from being inadvertently introduced into the system" and "process safety systems—in place and operational—would have prevented water from entering the tank by accident".

Instead. they claim that "employee sabotage—not faulty design or operation—was the cause of the tragedy".

4.15.4.6 A Report From Union Carbide Corporation:

a) First steps at control

- In those frustrating first days, as the dimensions of the tragedy gradually were learned, vital decisions were made:

- A Union Carbide facility in West Virginia was quickly closed because it manufactured methyl isocyanate. It remained closed until safety measures were reexamined and more light shed on the cause of the Bhopal tragedy.
- A management task force, headed by Anderson, was set up to deal with the crisis. President Flamm took over running the company's day-to-day business. That decision by Anderson permitted his Bhopal team to concentrate on the facts of the tragedy and its aftermath.
- To provide an immediate aid offer of $1 million UCIL also pledged the Indian equivalent of $840,000.
- A medical and technical team was dispatched to Bhopal within 24 hours of the disaster. Their tasks: to help arrange for immediate and long-term relief; to assist in the safe disposal of remaining methyl isocyanate supplies at the plant; and to investigate the incident.
- Because of the obstacles placed in our way by Indian authorities, it would be March 1985 before we could point with certainty to the cause. In the interim, we took the heat.

b) What did we learn?

- The contemporary Union Carbide Corporation is a different company from what it was at the time of the Bhopal incident in 1984. It is a smaller company. In 1992, its 75th anniversary year, the company spun off its industrial gases division to stockholders.
- The gases operation was the last tangible reflection of the giant conglomerate of the past. Gone are the metals, consumer products, and other diverse businesses. The restructured Union Carbide is a closely focused $5 billion basic chemicals and plastics company with advanced process technologies and efficient, large-scale production facilities.
- The company has kept pace with the accelerating changes of the times -- changes in markets, economic patterns, and technologies. It has weathered a bitter and costly takeover attempt. It has tackled the basic problems of productivity and cost control that bedevil modern American businesses.
- At the time of Bhopal, the company was rated among those manufacturers with the best worker safety records. To a degree, we were smug about our record. Bhopal put an end to that attitude. It spurred new cycles of process monitoring and a fresh look at risk management.
- In the months and years after Bhopal, Union Carbide focused a microscope on every operation. There was an unprecedented search for every risk, any risk. We discovered that there was still more that we could accomplish in maintaining safer operations. And money and staff were committed to those objectives.

- The impact of Bhopal went well beyond Union Carbide. It changed views and practices among the entire U.S. chemical industry. It provided impetus to the development and enactment of federal laws requiring companies to notify government and the public about toxic substances they make or use.
- The EPA's Federal Superfund Reauthorization, spurred by the Bhopal tragedy, helped bring about a network of local emergency planning councils, in which corporate specialists work with their neighboring communities to safely deal with unthinkable environmental disasters.
- The Chemical Manufacturers Association has established Community Action Emergency Response (CAER), a program to prevent or respond to industrial emergencies. Responsible Care is an industry initiative designed to establish basic standards for safe, healthy, and environmentally sound operations. It is being established in some 22 countries around the world. Union Carbide has been an active participant in these and other programs.

TWO MARK QUESTIONS AND ANSWERS

1. **Define Risk?**

   A risk is the potential that something unwanted and harmful may occur.

   Risk = Probability X Consequences.

2. **Define a Disaster?**

   A DISASTER = A seriously disruptive event + A state of unprepared ness.

3. **Give the criteria which helps to ensure a safety design?**

   - The minimum requirement is that a design must comply with the applicable laws.
   - An acceptable design must meet the standard of "accepted engineering practice."
   - Alternative designs that are potentially safer must be explored.
   - Engineer must attempt to foresee potential misuses of the product by the consumer and must design to avoid these problems.
   - Once the product is designed, both the prototypes and finished devices must be rigorously tested.

4. **What are the factors for safety and risk?**

   - Voluntary and Involuntary risk
   - Short-term and Long-term risk
   - Expected probability
   - Reversible effects
   - Threshold levels to risk
   - Delayed or Immediate risk etc

5. **What are the drawbacks in the definition of Lawrence?**

   - Underestimation of risks
   - Overestimation of risks
   - No estimation of risks

6. **Give the categories of Risk?**

   - Low consequence, Low probability (which can be ignored)
   - Low consequence, High probability
   - High consequence, Low probability
   - High consequence, High probability

7. What are the factors that affect Risk Acceptability?

- Voluntarism and control
- Effect of information on risk assessment
- Job related pressures
- Magnitude and proximity of the people facing risk

8. How will an engineer assess the safety?

- The risks connected to a project or product must be identified.
- The purposes of the project or product must be identified and ranked in importance.
- Costs of reducing risks must be estimated.
- The costs must be weighed against both organizational goals and degrees of acceptability of risks to clients and the public.
- The project or product must be tested and then either carried out or manufactured.

9. What is ERM?

Enterprise risk management (ERM) in business includes the methods and processes used by organizations to manage risks and seize opportunities related to the achievement of their objectives. ERM provides a framework for risk management,

10. What are the reasons for Risk-Benefit Analysis?

- Risk-benefit analysis is concerned with the advisability of undertaking a project.
- It helps in deciding which design has greater advantages.
- It assists the engineers to identify a particular design scores higher with that of the another one.

11. Are the engineers responsible to educate the public for safe operation of the equipment? How?

Yes, as per the engineers are concerned with they should have their duty as to protect for the safety and well being of the general public. Analyzing the risk and safety aspects of their designs can do this.

12. Define Safety?

In the definition stated by William W. Lawrence safety is defined, as a thing is safe if its risks are acceptable.

A thing is safe with respect to a given person or group, at a given time, if its risk is fully known, if those risks would be judged acceptable, in light of settled value principles. In the view of objective, safety is a matter of how people would find risks acceptable or unacceptable.

13. What is the definition of risk?

A risk is the potential that something unwanted and harmful may occur. Risk is the possibility of suffering harm or loss. It is also defined as the probability of a specified level of hazardous consequences, being realized. Hence Risk (R) is the product of Probability (P) and consequence(C)

(i.e) R = P * C

14. Define Acceptability of risks?

A risk is acceptable when those affected are generally no longer apprehensive about it. Doubtfulness depends mainly on how the people take the risk or how people perceive it.

15. What are the safety measures an engineer must know before assessing a risk of any product?

The factors are:

- Does the engineer have the right data?
- Is he satisfied with the present design?
- How does he test the safety of a product?
- How does he measure and weigh the risks with benefits for a product.

16. What is the use of knowledge of risk acceptance to engineers?

Though past experience and historical data give better information about safety of products designing there are still inadequate. The reasons are

a. The information is not freely shared among industries

b. There also new applications of old technologies that provides available data, which are less useful.

c. So, in order to access the risk of a product, the engineers must share their knowledge and information with others in a free manner.

17. What is meant by Disaster? Give an example.

A disaster does not take place until a seriously disruptive event coincides with a state of insufficient preparation. Example: The Titanic collision with an iceberg constituted an emergency, which turned into a disaster because there were too few lifeboats.

18. What are the positive uncertainties in determining risks?

There are three positive uncertainties. They are:

a. Purpose of designing

b. Application of the product

c. Materials and the skill used for producing the product.

19. Define Risk-Benefit Analysis?

Risk benefit analysis is a method that helps the engineers to analyze the risk in a project and to determine whether a project should be implemented or not. In risk benefit analysis, the risks and benefits of a product are allotted to money amounts, and the most benefit able ratio between risks and benefits is calculated.

20. Explain the two types of Risk?

i. Personal Risk:

An individual, who is given sufficient information, will be in a position to decide whether to take part in a risky activity or not. They are more ready to take on voluntary risks than involuntary risks.

ii. Public Risks:

Risks and benefits to the public are more easily determined than to individuals, as larger number of people is taken into account. Involuntary risks are found here.

21. What does Strict Liability mean?

Strict liability means if the sold product is defective; the manufacturer concerned is liable for any harm that results to users. Negligible is not at all an issue based.

22. What is the main barrier to educational attempts?

An important barrier to educational attempt is that people belief change slow and are extraordinarily resistant to new information.

23. What happens to the products that are not safe?

Products that are not safe incur secondary costs to the manufacturer beyond the primary costs that must also be taken into account costs associated with warranty expenses, loss of customer will and even loss of customers and so.

24. What does Open-mindedness refer to?

Open-mindedness refers once again not allowing a preoccupation with rules to prevent close examination of safety problems that may not be covered by rules.

25. What happened in Bhopal disaster?

The Bhopal disaster also known as Bhopal Gas Tragedy was a gas leak accident in India, considered one of the world's worst industrial catastrophes] It occurred on the night of December 2–3, 1984 at the Union Carbide India Limited (UCIL) pesticide plant in Bhopal, Madhya Pradesh, India.

A leak of methyl isocyanate gas and other chemicals from the plant resulted in the exposure of hundreds of thousands of people.

26. Define Institutional Authority?

Institutional Authority is acquired, exercised and defined within organizations. It may be defined as the institutional right given to a person to exercise power based on the resources of the institution.

27. Define Expert Authority?

Expert authority is the possession of special knowledge, skill or competence to perform task or give sound advice.

28. Define confidential information?

Confidential information is information deemed desirable to keep secret. It should not be disclosed to unauthorized persons.

Only persons who have the authority to view, or edit the information can able to access the confidential information.

Eg., A government Tender allocation details, Military weapon details, etc.,

29. What are the criteria for identifying that information is "labeled" confidential at the workplace?

- Engineers shall treat information coming to them in the course of their as confidential.
- Identify any information which if it became known would cause harm to the corporation or client.
- Confidential information is any information that the employer or client would like to have kept secret in order to compete effectively against business rivals.

30. What are the terms associated with Confidentiality?

i. Privileged Information

ii. Proprietary Information

iii. Patents

iv. Trade secrets

31. How will you justify the obligation of confidentiality?

The obligation of confidentiality can be justified at two levels.

- First level : Moral Considerations

  i. Respect for autonomy

  ii. Respect for promises

  iii. Regard for public well-being

- Second level : Major Ethical Theories

  i. Rights Ethicists

  ii. Duty Ethicists

  iii. Rule-utilitarians

  iv. Act-utilitarians

32. Define Conflicts of Interest?

Conflict of interests is a situation in which two or more interests are not simultaneously realizable. It is the disagreement between public obligation and self-interest of an official.

33. Why does a conflict of interests arise?

a. Financial Investments

b. Insider Trading

c. Bribe

d. Gifts

e. Kickbacks

34. What is a Bribe?

A Bribe is a substantial amount of money or goods offered beyond a stated business contract with the aim of winning an advantage in gaining or keeping the contract.

35. What is a Gift?

Gifts are not bribes as long as they are small gratuities offered in the normal conduct of business.

36. What is called Kickbacks?

Prearranged payments made by contractors to companies or their representatives in exchange for contracts actually granted are called kickbacks.

37. What are the types of Conflicts of interest?

i. Actual conflict of interest

ii. Potential conflict of interest

iii. Apparent conflict of interest

38. What are the forms of Conflicts of interest?

i. Interest in other companies

ii. Moonlighting

iii. Insider information

39. How will you solve the Conflict problems?

i. Finding the creative middle way.

ii. Employing Lower-level considerations.

iii. Making the hard choice.

40. What is called 'White-collar crime'?

Occupational crimes are illegal acts made possible through one's lawful employment. It is the secret violation of laws regulating work activities. When committed by office workers of professionals, occupational crime is called 'white-collar crime'.

41. What are the essential elements of IPR?

i. Patents

ii. Copyrights

iii. Trademarks

iv. Trade secrets

42. What are the requirements of Patents?

a) Problem of invention

b) Current report of the problems to address

c) Solution or procedure to the problem

d) Extent of novelty or inventive

e) Application or uses

f) Details of the inventor

g) Resources of funds

43. What are the types of Patents?

a. Utility patents

b. Design patents

c. Plant patents

44. What is the need for Protection to IPR?

a) Prevent plagiarism.

b) Prevent others using it.

c) Prevent using it for financial gain.

d) Fulfill as an obligation to funding agency.

e) Support income generation strategy.

45. What is the Importance of IPR?

a) Give the inventors exclusive rights of dealing.

b) Permit avoiding pf competitors and raise entry barriers.

c) Permit entry to a technical market.

Generate steady income by issuing license.

46. What are the two general ways to apply ethical theories to justify the basic right of professional conscience?

i. Proceed piecemeal by reiterating the justifications given for the specific professional duties.

ii. Justify the right of professional conscience, which involves grounding it more directly in the ethical theories.

47. Define Employee Rights?

Employee rights are rights, moral or legal, that involve the status of being an employee. They include some professional rights that apply to the employer-employee relationship.

48. Define Discrimination?

Discrimination means morally unjustified treatment of people on arbitrary or irrelevant grounds.

49. What are the general procedures for implementing the right to due process?

- Written explanations should be established that is available to all employees who believe their rights have been violated.
- An appeals procedure should be established that is available to all employees who believe their rights have been violated.

50. Differentiate Human Rights and Professional Rights?

Human Rights – Possessed by virtue of being people or moral agents.

Professional Rights – Possessed by virtue of being professional having spcial moral responsibilities.

51. Differentiate Weak Preferential Treatment and Strong Preferential Treatment?

Weak preferential treatment involves giving an advantage to members of traditionally discriminated-against groups over equally qualified applicants who are members of other groups.

Strong preferential treatment involves giving preference to minority applicants or women over better qualified applicants from other groups.

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UNIT 5

GLOBAL ISSUES

5.0 INTRODUCTION

In today's world, the technology has been changing very rapidly. The range of projects, concerned with education, health care, government, public works and many other areas have greatly increased, over those undertaken in previous centuries. We also have to consider the change in population, nature and the environment. Technological developments, increase the sources of power, and also lead to various issues in weapons development, as well as the codes of ethical conduct. Those concepts are discussed, in this chapter, along with role of ethics in business, environment, computer, etc.,

5.1 GLOBALIZATION

Globalization - means integration of countries through commerce, transfer of technology, and exchange of information and culture. In a way, it includes acting together and interacting economies through trade, investment, loan, development schemes and capital across countries.

- In a different sense, these flows include knowledge, science, technology, skills, culture, information, and entertainment, besides direct human resource, tele-work, and outsourcing.
- This interdependence has increased the complex tensions and ruptures among the nations.
- For the engineers, the issues such as multinational organizations, computer, internet functions, military development and environmental ethics have assumed greater importance for their very sustenance and progress.

5.2 MULTINATIONAL CORPORATIONS

Organizations, who have established business in more than one country, are called Multinational Corporation. The headquarters are in the home country and the business is extended in many host countries.

The Western organizations doing business in the less-economically developed (developing, and overpopulated) countries gain the advantage of inexpensive labor, availability of natural resources, conducive-tax atmosphere, and virgin market for the products.

At the same time, the developing countries are also benefited by fresh job opportunities, jobs with higher remuneration and challenges, transfer of technology, and several social benefits by the wealth developed.

But this happens invariably with some social and cultural disturbance. Loss of jobs for the home country, and loss or exploitation of natural resources, political instability for the host countries are some of the threats of globalization.

5.2.1 International Human Rights:

To know what are the moral responsibilities and obligations of the multinational corporations operating in the host countries, let us discuss with the framework of rights ethics. Common minimal rights are to be followed to smoothen the transactions when the engineers and employers of MNCs have to interact at official, social, economic and sometimes political levels.

At international level, the organizations are expected to adopt the minimum levels of

(a) Values, such as mutual support, loyalty, and reciprocity,

(b) The negative duty of refraining from harmful actions such as violence and fraud, and

(c) Basic fairness and practical justice in case of conflicts.

The ten international rights to be taken care of, in this context are:

1. Right of freedom of physical movement of people
2. Right of ownership of properties
3. Freedom from torture
4. Right to fair trial on the products
5. Freedom from discrimination on the basis of race or sex. If such discrimination against women or minorities is prevalent in the host country, the MNC will be compelled to accept. MNCs may opt to quit that country if the human rights violations are severe.
6. Physical security. Use of safety gadgets have to be supplied to the workers even if the laws of the host country do not suggest such measures.
7. Freedom of speech and forming association
8. Right to have a minimum education
9. Right to political participation
10. Right to live and exist (i.e., coexistence). The individual liberty and sanctity of the human life are to be respected by all societies.

5.2.2 Technology Transfer

It is a process of moving technology to a new setting and implementing it there. Technology includes hardware (machines and installations) and the techniques (technical, organizational, and managerial skills and procedures).

It may mean moving the technology applications from laboratory to the field/factory or from one country to another. This transfer is effected by governments, organizations, universities, and MNCs.

5.2.3 Appropriate Technology

Identification, transfer, and implementation of most suitable technology for a set of new situations, is called appropriate technology.

Technology includes both hardware (machines and installations) and software (technical, organizational and managerial skills and procedures). Factors such as economic, social, and engineering constraints are the causes for the modification of technology.

Depending on the availability of resources, physical conditions (such as temperature, humidity, salinity, geographical location, isolated land area, and availability of water), capital opportunity costs, and the human value system (social acceptability) which includes their traditions, beliefs, and religion, the appropriateness is to be determined.

For example, small farmers in our country prefer to own and use the power tillers, rather than the high-powered tractors or sophisticated harvesting machines.

On the other hand, the latest technological device, the cell phones and wireless local loop phones have found their way into remote villages and hamlets, than the landline telephone connections.

Large aqua-culture farms should not make the existing fishermen jobless in their own village.

The term appropriate is value based and it should ensure fulfillment of the human needs and protection of the environment.

5.2.4 How Appropriate is Aptech?

1. A case against the technology transfer is that the impact of borrowed or transferred technology has been threatening the environment beyond its capacity and sustainable development of the host countries. Large plantations that orient their efforts to exports leave the small farmers out of jobs and at the mercy of the foreign country.

   For example, genetically-modified cotton have shown sufficient disturbance in Europe and Africa. This has made the European Union to oppose the entry of G.M. cotton into Europe.
2. The high technology has contributed to large-scale migration from villages to the cities where corporations are located, leading to the undesirable side-effects of overcrowding of cities, such as the scarcity of water, insanitation, poverty, and the increase in crimes.

3. The term 'appropriate' should emphasize the social acceptability and environmental protection of the host countries, and this need to be addressed while transferring technology. Thus, we confirm the view that engineering is a continual social experimentation with nature.

5.2.5 MNCs and Morality:

The economic and environmental conditions of the home and host countries may vary. But the multinational institutions have to adopt appropriate measures not to disturb or dislocate the social and living conditions and cultures of the home countries.

A few principles are enlisted here:

1. MNC should respect the basic human rights of the people of the host countries.
2. The activities of the MNC should give economic and transfer technical benefits, and implement welfare measures of the workers of the host countries.
3. The business practices of the multinational organizations should improve and promote morally justified institutions in the host countries.
4. The multinationals must respect the laws and political set up, besides cultures and promote the cultures of the host countries.
5. The multinational organizations should provide a fair remuneration to the employees of the host countries. If the remuneration is high as that of home country, this may create tensions and if it is too low it will lead to exploitation.
6. Multinational institutions should provide necessary safety for the workers when they are engaged in hazardous activities and 'informed consent' should be obtained from them. Adequate compensation should be paid to them for the additional risks undertaken.

5.2.6. Case Study: Bhopal Gas Tragedy:

- The Union Carbide had 51% and the Indian subsidiary UC India Ltd. had 49% of stock. In 1983, there were 14 plants in India manufacturing chemicals, pesticides, and other hazardous products.
- The Bhopal plant had a license to make Methyl isocyanate-based pesticides. In November 1984, they had decided to close down the plant. For quite some years before the production rate was going down.
- In the history of chemical plants disasters, three other wake-up calls were reported. Flix borough accident in 1974 in U.K. when certain modifications carried out in the plant led to the leakage and explosion of cyclohexane, which killed 28 people.
- The Piper Alpha offshore oil platform disaster in1988, near Scotland, killed 167 people and resulted in $ 2 billion losses. The third occurred in Toulouse, France in 2001, killing 29 people, and injuring thousands.

- A warehouse holding 300 tones of ammonium nitrate fertilizer exploded and damaged 10000 buildings, including schools, a university, and a hospital. But we have not learnt from the past.
- The cumulative effects of the following factors caused the tragedy in Bhopal on December 3, 1984.

1. Maintenance was neglected and the trained maintenance personnel were reduced as economy measure. Need for quick diagnosis aggravates the situation by causing considerable psychological stress on the plant personnel.
2. Training activities for the supervisory personnel were stopped. This led to inadequate training of the personnel to handle emergencies.
3. Periodical Safety Inspection teams from U.S. which visited previously were also stopped. From the initial U.S. Standards, the safety procedures were reduced to low level Indian standards. The procedures had been deteriorating at these sites for weeks or months, prior to the accident. There was clear lack of management systems and procedures to ensure safety.
4. Vital spares for equipments and machineries were not available
5. Absence of capital replacement led to the stagnant economy of the plant.
6. The high turnover of the experienced engineers and technicians, who were demoralized by the lack of development.
7. Lack of experienced personnel to operate and control the vital installations.
8. They have not conducted a thorough process hazards analysis that would have exposed the serious hazards which resulted in disaster later.
9. No emergency plan was put in practice, during the shutdown and maintenance.
10. Above all, the commitment of top-level management to safety was lacking. They have been paying only lip service to safety of people of the host country.

5.2.7 ETHICAL BALANCE

Should an organization adopt the rules and practices of the host country fully and face dangers and other serious consequences or adopt strictly their own country's standards and practices in the host country? There is a saying, "When in Rome do as Romans do". Can this be applied in the case of MNCs? This is called ethical relativism.

The actions of corporation and individuals that are accepted by law, custom and other values of a society can be morally right in that society. It is morally false, if it is illogical.

It means, the corporation (and the engineers) functioning in other countries must understand their law, customs, and beliefs and act in line with those prevailing in that country.

This will lead to disaster if the country is a developing one where the safety standards are given a go-bye. Laws and conventions are not morally self-sustaining. In a overpopulated country, the loss of human lives may not physically affect them, but the tragedy cast shadow for over decades, as it happened in Bhopal in1984.

This will be criticized from the points of view of human rights, public welfare, and respect to people. On the other hand, the organizations may practice laws of the home country, without adjustments to the host culture. This stand is called ethical absolutism.

This is again false, since the moral principles in a different culture come into conflicts, and implementation in the 'hostile' culture is almost impossible. Hence, MNCs may adopt ethical relationalism (contextualize) as a compromise.

Moral judgments are made in relation to the factors prevailing locally, without framing rigid rules. The judgments should be contextual and in line with the customs of other cultures. The ethical pluralism which views more than one justifiable moral solution is also adaptable. This principle accepts cultural diversity and respects the legitimate cultural differences among individuals and groups, of the host country.

5.3 ENVIRONMENTAL ETHICS

Environmental ethics is the study of

a) moral issues concerning the environment, and

b) moral perspectives, beliefs, or attitudes concerning those issues. Engineers in the past are known for their negligence of environment, in their activities.

It has become important now that engineers design eco-friendly tools, machines, sustainable products, processes, and projects. These are essential now to

a) ensure protection (safety) of environment

b) prevent the degradation of environment, and

c) slow down the exploitation of the natural resources, so that the future generation can survive.

The American Society of Civil Engineers (ASCE) code of ethics, has specifically requires that "engineers shall hold paramount the safety, health, and welfare of the public and shall strive to comply with the principles of sustainable development in the performance of professional duties"

The term sustainable development emphasizes on the investment, orientation of technology, development and functioning of organizations to meet the present needs of people and at the same time ensuring the future generations to meet their needs.

Engineers as experimenters have certain duties towards environmental ethics, namely:

1. Environmental impact assessment :

One major but sure and unintended effect of technology is wastage and the resulting pollution of land, water, air and even space. Study how the industry and technology affects the environment.

2. Establish standards:

Study and to fix the tolerable and actual pollution levels.

3. Counter measures:

Study what the protective or eliminating measures are available for immediate implementation.

4. Environmental awareness:

Study on how to educate the people on environmental practices, issues, and possible remedies.

Environmental ethics is the part of environmental philosophy which considers extending the traditional boundaries of ethics from solely including humans to including the non-human world. It exerts influence on a large range of disciplines including environmental law, environmental sociology, ecotheology, ecological economics, ecology and environmental geography.

There are many ethical decisions that human beings make with respect to the environment. For example:

- Should we continue to clear cut forests for the sake of human consumption?
- Should we continue to propagate?
- Should we continue to make gasoline powered vehicles?
- What environmental obligations do we need to keep for future generations?
- Is it right for humans to knowingly cause the extinction of a species for the convenience of humanity?

5.3.1 Categories Of Environmental Ethics

The following are the categories of environmental ethics:

1. Libertarian Extension,
2. The Ecologic Extension and
3. Conservation Ethics.

Libertarian extension:

'Libertarian extension' echoes a civil liberty approach (i.e. a commitment to extend equal rights to all members of a community). In environmentalism, though, the community is generally thought to consist of non-humans as well as humans.

Ecologic extension:

'Ecologic extension' places emphasis not on human rights but on the recognition of the fundamental interdependence of all biological (and some abiological) entities and their essential diversity. Whereas Libertarian Extension can be thought of as flowing from a political reflection of the natural world, Ecologic Extension is best thought of as a scientific reflection of the natural world.

Conservation ethics:

'Conservation ethics' is an extension of use-value into the non-human biological world. It focuses only on the worth of the environment in terms of its utility or usefulness to humans. It contrasts the intrinsic value ideas of 'deep ecology', hence is often referred to as 'shallow ecology', and generally argues for the preservation of the environment on the basis that it has extrinsic value – instrumental to the welfare of human beings. Conservation is therefore a means to an end and purely concerned with mankind and intergenerational considerations.

5.3.2 Disasters

1. Plastic Waste Disposal :

In our country, several crores of plastic bottles are used as containers for water and oil, and plastic bags are used to pack different materials ranging from vegetables to gold ornaments.

Hardly any of these are recycled. They end up in gutters, roadsides, and agricultural fields. In all these destinations, they created havoc.

The worse is the burning of plastic materials in streets and camphor along with plastic cover in temples, since they release toxic fumes and threaten seriously the air quality.

2. "e-Waste Disposal":

The parts of computers and electronic devices which have served its useful life present a major environmental issue for all the developing countries including India. This scrap contains highly toxic elements such as lead, cadmium, and mercury.

Even the radioactive waste will lose 89% of its toxicity after 200 years, by which time it will be no more toxic than some natural minerals in the ground. It will lose 99% of its remaining toxicity over the next 30,000 years. The toxic chemical agents such as mercury, arsenic, and cadmium retain toxicity undiminished forever.

A recent report of the British Environment Agency has revealed that the discarded computers, television sets, refrigerators, mobile phones, and electrical equipments have been dispatched to India and Pakistan in large quantity, for ultimate disposal in environmentally-unacceptable ways and at great risk to the health of the labour.

Even in the West, the electronic junk has been posing problems. Strong regulation including

(a) pressure on industries to set up disassembling facilities,

(b) ban on disposal in landfill sites,

(c) legislation for recycling requirements for these junk and

(d) policy incentives for eco-friendly design are essential for our country.

Indian Government expressed its concern through a technical guide on environmental management for IT Industry in December, 2004. It is yet to ratify the ban on movement of hazardous waste according to the Basel Convention.

Our country needs regulations to define waste, measures to stop illegal imports, and institutional structures to handle safe disposal of domestic industrial scrap.

3. Industrial Waste Disposal :

There have been a lot of complaints through the media, on

(a) against the Sterlite Copper Smelting Plant in Thuthukkudi (1997) against its pollution, and

(b) when Indian companies imported the discarded French Warship Clemenceau for disposal, the poisonous asbestos compounds were expected to pollute the atmosphere besides exposing the labor to a great risk, during the disposal. The government did not act immediately. Fortunately for Indians, the French Government intervened and withdrew the ship, and the serious threat was averted!

4. Depletion of Ozone Layer :

The ozone layer protects the entire planet from the ill-effects of ultraviolet radiation and is vital for all living organisms in this world. But it is eaten away by the Chloro-fluro-carbons (CFC) such as Freon emanating from the refrigerators, air conditioners, and aerosol can spray.

This has caused also skin cancer to sun-bathers in the Western countries. Further NO and NO_2 gases were also found to react with the ozone.

Apart from engineers, the organizations, laws of the country and local administration and market mechanisms are required to take up concerted efforts to protect the environment.

5. Global Warming :

Over the past 30 years, the Earth has warmed by 0.6 °C. Over the last 100 years, it has warmed by0.8 °C. It is likely to push up temperature by 3degree Celcius by 2100, according to NASA's studies.

The U.S. administration has accepted the reality of global climate change, which has been associated with stronger hurricanes, severe droughts, intense heat waves and the melting of polar ice. Greenhouse gases, notably carbon dioxide emitted by motor vehicles and coal-fired power plants, trap heat like the glass walls of a greenhouse, cause the Earth to warm up.

Delegates from the six countries — Australia, China, India, Japan, South Korea and US met in California in April 2006 for the first working session of the Asia-Pacific Partnership on Clean Development and Climate. These six countries account for about half of the world's emissions of climate-heating greenhouse gases.

Only one of the six, Japan, is committed to reducing greenhouse gas emissions by at least 5.2 per cent below 1990 levels by 2012 under the Kyoto Agreement.

6. Acid Rain :

Large emissions of Sulphur oxides and nitrous oxides are being released in to the air from the thermal power stations using the fossil fuels, and several processing industries.

These gases form compounds with water in the air and precipitates as rain or snow on to the earth. The acid rain in some parts of the world has caused sufficient damage to the fertility of the land and to the human beings.

5.3.3 Human-Centered Environmental Ethics:

This approach assumes that only human beings have inherent moral worth duly to be taken care of. Other living being and ecosystems are only instrumental in nature. Utilitarianism aims to maximize good consequences for human beings.

Most of the goods are engineered products made out of natural resources. Human beings have also

(a) recreational interests (enjoy leisure through mountaineering, sports),

(b) aesthetic interests (enjoy nature as from seeing waterfalls and snow-clad mountains),

(c) scientific interests to explore into nature or processes, and

(d) a basic interest to survive, by preservation as well as conservation of nature and natural resources.

Rights ethicists favor the basic rights to live and right to liberty, to realize the right to a live in a supportive environment. The nature-centered ethics, which ensures the worth of all living beings and organisms, seems to be more appropriate in the present-day context.

In a human centered environmental ethics, concerns about nature are based on the value it may have for humans in some way or another. In this context, nature (or the environment) is seen as something with instrumental value – its value lies in the use that humans can make of it. Intrinsic value, that is value that something has in and of itself, is, for various reasons, reserved for humans alone.

Conservationists, however, emphasize that there are limits to our resources, and that we should use it wisely, i.e. sustainably. Preservationists argue that some parts of nature, particularly pristine wilderness, should be left to function with minimal human intrusion, and that non-consumptive "use" of it as wild-life sanctuaries, for example, where we can go to contemplate and enjoy the beauty and wonder of nature should be the only activities allowed.

5.3.4 Nature centered environmental ethics:

In a nature centered environmental ethics, the intrinsic value of some parts of non-human nature, or the whole of nature is emphasized. Within this context, some bio-centrists argue that life itself should be our central object of moral respect, regardless of whether it manifests itself in an individual living entity, a species, or in a population of species living together and interacting with one another. Some eco-centered thinkers, on the other hand, takes it one step further and claim that ecosystems and all of its components, including the non-living and inorganic parts there-of should be the "unit of concern" of environmental ethics.

5.4 COMPUTER ETHICS

Computer ethics is defined as

(a) study and analysis of nature and social impact of computer technology,

(b) formulation and justification of policies, for ethical use of computers. This subject has become relevant to the professionals such as designers of computers, programmers, system analysts, system managers, and operators.

The use of computers has raised a host of moral concerns such as free speech, privacy, intellectual property right, and physical as well as mental harm.

5.4.1 Types of Issues

Different types of problems are found in computer ethics.

1. Computer as the Instrument of Unethical Acts:

(a) The usage of computer replaces the job positions. This has been overcome to a large extent by readjusting work assignments, and training everyone on computer applications such as word processing, editing, and graphics.

(b) Breaking privacy. Information or data of the individuals accessed or erased or the ownership changed.

(c) Defraud a bank or a client, by accessing and withdrawing money from other's bank account.

2. Computer as the Object of Unethical Act :

The data are accessed and deleted or changed.

(a) Hacking:

The software is stolen or information is accessed from other computers. This may cause financial loss to the business or violation of privacy rights of the individuals or business. In case of defense information being hacked, this may endanger the security of the nation.

(b) Spreading virus:

Through mail or otherwise, other computers are accessed and the files are erased or contents changed altogether. 'Trojan horses' are implanted to distort the messages and files beyond recovery.

This again causes financial loss or mental torture to the individuals. Some hackers feel that they have justified their right of free information or they do it for fun. However, these acts are certainly unethical.

(c) Health hazard :

The computers pose threat during their use as well as during disposal.

3. Problems Related to the Autonomous Nature of Computer :

(a) Security risk :

Recently the Tokyo Stock Exchange faced a major embarrassment. A seemingly casual mistake by a junior trader of a large security house led to huge losses including that of reputation.

The loss to the securities firm was said to be huge, running into several hundred thousands. More important to note, such an obvious mistake could not be corrected by some of the advanced technology available.

(b) Loss of human lives:

Risk and loss of human lives lost by computer, in the operational control of military weapons. There is a dangerous instability in automated defense system.

An unexpected error in the software or hardware or a conflict during interfacing between the two, may trigger a serious attack and cause irreparable human loss before the error is traced.

The Chinese embassy was bombed by U.S. military in Iraq a few years back, but enquiries revealed that the building was shown in a previous map as the building where in sergeants stayed.

(c) In flexible manufacturing systems, the autonomous computer is beneficial in obtaining continuous monitoring and automatic control.

5.4.2 Computers in Workplace:

The ethical problems initiated by computers in the workplace are:

1. Elimination of routine and manual jobs:

This leads to unemployment, but the creation of skilled and IT-enabled service jobs are more advantageous for the people.

Initially this may require some up gradation of their skills and knowledge, but a formal training will set this problem right.

For example, in place of a typist, we have a programmer or an accountant.

2. Health and safety:

The ill-effects due to electromagnetic radiation, especially on women and pregnant employees, mental stress, wrist problem known as Carpel Tunnel Syndrome , and back pain due to poor ergonomic seating designs, and eye strain due to poor lighting and flickers in the display and long exposure, have been reported worldwide.

Over a period of long exposure, these are expected to affect the health and safety of the people. The computer designers should take care of these aspects and management should monitor the health and safety of the computer personnel.

3. Computer failure:

Failure in computers may be due to errors in the hardware or software. Hardware errors are rare and they can be solved easily and quickly. But software errors are very serious as they can stop the entire network.

Testing and quality systems for software have gained relevance and importance in the recent past, to avoid or minimize these errors.

5.4.3 Property Issues

The property issues concerned with the computers are:

1. Computers have been used to extort money through anonymous telephone calls.
2. Computers are used to cheat and steal by current as well as previous employees.
3. Cheating of and stealing from the customers and clients.
4. Violation of contracts on computer sales and services.
5. Conspiracy as a group, especially with the internet, to defraud the gullible, stealing the identity and to forge documents.
6. Violation of property rights: The software could be either a Program (an algorithm, indicating the steps in solving a problem) or a Source code (the algorithm in a general computer language such as FORTAN, C and COBOL or an Object code (to translate the source code into the machine language).

How do we apply the concept of property here?

Property is what the laws permits and defines as can be owned, exchanged, and used. The computer hardware (product) is protected by patents. The software (idea, expression) is protected by copyrights and trade secrets.

But algorithms can not be copyrighted, because the mathematical formulas can be discovered but not owned. The object codes which are not intelligible to human beings can not be copyrighted.

Thus, we see that reproducing multiple copies from one copy of (licensed) software and distribution or sales are crimes. The open source concepts have, to a great extent, liberalized and promoted the use of computer programs for the betterment of society.

5.4.4 Computer Crime

The ethical features involved in computer crime are:

1. Physical Security :

The computers are to be protected against theft, fire, and physical damage. This can be achieved by proper insurance on the assets.

2. Logical security:

The aspects related are

(a) The privacy of the individuals or organizations,

(b) Confidentiality,

(c) Integrity, to ensure that the modification of data or program are done only by the authorized persons,

(d) Uninterrupted service. This is achieved by installing appropriate uninterrupted power supply or back-up provisions, and

(e) Protection against hacking that causes dislocation or distortion. Licensed anti-virus packages and firewalls are used by all computer users to ensure this protection.

(f) Passwords and data encryption have been incorporated in the computer software as security measures.

But these have also been attacked and bye-passed. But this problem is not been solved completely. Major weaknesses in this direction are:

(a) The difficulty in tracing the evidence involved and

(b) Absence of stringent punishment against the crime.

5.4.5 Privacy and Anonymity

The data transmission and accessibility have improved tremendously by using the computers, but the right to privacy has been threatened to a great extent.

Some issues concerned with the privacy are listed here:

1. **Records of Evidence** - Service records or criminal records and the details of people can be stored and accessed to prove the innocence or guilty. Records on psychiatric treatment by medical practitioners or hospital, or records of membership of organizations may sometime embarrass the persons in later years.

2. **Hacking** - There are computer enthusiasts who willfully or for fun, plant virus or "Trojan horses" that may fill the disc space, falsify information, erase files, and even harm the hardware. They breakdown the functioning of computers and can be treated as violation of property rights. The proprietary information and data of the organizations are to be protected so that they can pursue the goals without hindrance.

3. **Legal Response** - In the Indian scene, the Right to Information Act 2005 provides the right to the citizens to secure access to information under the control of public authorities , including the departments of the central government, state governments, government bodies, public sector companies and public sector banks, to promote transparency and accountability of public authorities.

Right to information: Under the Act, section 2 (j), the right to information includes the right to…

1. Inspect works, documents, records,
2. Take notes, extracts or certified copies of documents or records,
3. Take certified samples of material, and
4. Obtain information in the form of printouts, diskettes, floppies, tapes, video cassettes or in any other electronic mode.

What is not Open to Disclosure?

1. Information, disclosure of which would prejudicially affect the sovereignty and integrity of India, the security, strategic, scientific or economic interests of the state, relation with, foreign state or lead to incitement of an offence.
2. Information which has been expressly forbidden to be published by any court of law or tribunal or the disclosure of which may constitute contempt of court.
3. Information, the disclosure of which would cause a breach of privilege of Parliament or the State Legislature.
4. Information including commercial confidence, trade secrets or intellectual property the disclosure of which would harm the competitive position of a third party, unless the competent authority is satisfied that larger public *interest warrants the disclosure of such information.
5. Information available to a person in his fiduciary relationship, unless the competent authority is satisfied that *the larger public interest warrants the disclosure of such information.
6. Information received in confidence from foreign government.
7. Information, the disclosure of which would endanger the life or physical safety of any person or identify the source of information or assistance given in confidence for law enforcement or security purposes.
8. Information which would impede the process of investigation or apprehension or prosecution of offenders.
9. Information which relates to personal information the disclosure of which has no relationship to any public activity or interest, or which would cause unwarranted invasion of the privacy of the individual.

10. Notwithstanding anything in the Official Secrets Act 1923 nor any of the exemptions listed above, a public authority may allow access to information, if public interest in disclosure outweighs the harm to the protected interests.

11. Where the Information Officer, intends to disclose any information or record, on a request, which relates to or has been supplied by a third party and has been treated as confidential by that third party, the officer shall give a written notice to such third party of the request and of the fact that the officer intends to disclose the information, and invites the third party to make a submission in writing or orally, regarding whether the information should be disclosed, and such submission of the third party shall be kept in view while taking a decision about disclosure of information:

    - Provided that except in the case of trade or commercial secrets protected by law,
    - Disclosure may be allowed if the public interest in disclosure outweighs in importance any possible harm or injury to the interests of such third party.
    - Laws to regulate the access to information are very expensive to enforce and inconvenient to genuine users such as accessing records of people for medical research.

4. **Anonymity** - Anonymity in the computer communication has some merits as well as demerits. While seeking medical or psychological counseling or discussion (chat) on topics, such as AIDS, abortion, gay rights, the anonymity offers protection (against revealing their identity).

But frequently, anonymity is misused by some people for money laundering, drug trafficking and preying upon the vulnerable.

5.4.6 Professional Responsibility

The computer professionals should be aware of different conflicts of interests as they transact with other at different levels. The IEEE and Association for Computing Machinery (ACM) have established the codes of ethics to manage such responsibilities.

5.5 WEAPONS DEVELOPMENT

Military activities including the world wars have stimulated the growth of technology. The growth of Internet amply illustrates this fact.

The development of warfare and the involvement of engineers bring out many ethical issues concerned with engineers, such as

- the issue of integrity in experiments as well as expenditure in defense research and development,
- issue of personal commitment and conscience, and
- the issues of social justice and social health.

Engineers involve in weapons development because of the following reasons:

1. It gives one job with high salary.
2. One takes pride and honor in participating in the activities towards the defense of the nation (patriotic fervor).
3. One believes the he fights a war on terrorism and thereby contribute to peace and stability of the country. Ironically, the wars have never won peace, only peace can win peace!
4. By research and development, the engineer is reducing or eliminating the risk from enemy weapons, and saving one's country from disaster.
5. By building-up arsenals and show of force, a country can force the rogue country, towards regulation.

5.6 ENGINEERS AS MANAGERS

5.6.1 Characteristics

The characteristics of engineers as managers are:

1. Promote an ethical climate, through framing organization policies responsibilities and by personal attitudes and obligations.
2. Resolving conflicts, by evolving priority, developing mutual understanding, generating various alternative solutions to problems.
3. Social responsibility to stakeholders, customers and employers. They act to develop wealth as well as the welfare of the society.

Ethicists project the view that the manager's responsibility is only to increase the profit of the organization, and only the engineers have the responsibility to protect the safety, health, and welfare of the public.

But managers have the ethical responsibility to produce safe and good products (or useful service), while showing respect for the human beings who include the employees, customers and the public. Hence, the objective for the managers and engineers is to produce valuable products that are also profitable.

5.6.2 Managing Conflicts

In solving conflicts, force should not be resorted. In fact, the conflict situations should be tolerated, understood, and resolved by participation by all the concerned. The conflicts in case of project managers arise in the following manners:

(a) Conflicts based on schedules: This happens because of various levels of execution, priority and limitations of each level.

(b) Conflicts arising out of fixing the priority to different projects or departments. This is to be arrived at from the end requirements and it may change from time to time.

(c) Conflict based on the availability of personnel.

(d) Conflict over technical, economic, and time factors such as cost, time, and performance level.

(e) Conflict arising in administration such as authority, responsibility, accountability and logistics required.

(f) Conflicts of personality, human psychology and ego problems.

(g) Conflict over expenditure and its deviations.

Most of the conflicts can be resolved by following the principles listed here:

1. People

Separate people from the problem. It implies that the views of all concerned should be obtained. The questions such as what, why, and when the error was committed is more important than to know who committed it. This impersonal approach will lead to not only early solution but also others will be prevented from committing errors.

2. Interests

Focus must be only on interest i.e., the ethical attitudes or motives and not on the positions (i.e., stated views). A supplier may require commission larger than usual prevailing rate for an agricultural product.

But the past analysis may tell us that the material is not cultivated regularly and the monsoon poses some additional risk towards the supply. Mutual interests must be respected to a maximum level. What is right is more important than who is right!

3. Options

Generate various options as solutions to the problem. This helps a manager to try the next best solution should the first one fails. Decision on alternate solutions can be taken more easily and without loss of time.

4. Evaluation

The evaluation of the results should be based on some specified objectives such as efficiency, quality, and customer satisfaction. More important is that the means, not only the goals, should be ethical.

5.7 CONSULTING ENGINEERS

The consulting engineers work in private. There is no salary from the employers. But they charge fees from the sponsor and they have more freedom to decide on their projects. Still they have no absolute freedom, because they need to earn for their living. The consulting engineers have ethical responsibilities different from the salaried engineers, as follows:

1. Advertising:

The consulting engineers are directly responsible for advertising their services, even if they employ other consultants to assist them. But in many organizations, this responsibility is with the advertising executives and the personnel department. They are allowed to advertise but to avoid deceptive ones.

Deceptive advertising such as the following are prohibited:

(a) By while lies

(b) Half-truth, E.g., a product has actually been tested as prototype, but it was claimed to have been already introduced in the market. An architect shows the photograph of the completed building with flowering trees around but actually the foundation of the building has been completed and there is no real garden.

(c) Exaggerated claims. The consultant might have played a small role in a well-known project. But they could claim to have played a major role.

(d) Making false suggestions. The reduction in cost might have been achieved along with the reduction in strength, but the strength details are hidden.

(e) Through vague wordings or slogans.

2. Competitive Bidding:

It means offering a price, and get something in return for the service offered. The organizations have a pool of engineers. The expertise can be shared and the bidding is made more realistic. But the individual consultants have to develop creative designs and build their reputation steadily and carefully, over a period of time.

The clients will have to choose between the reputed organizations and proven qualifications of the company and the expertise of the consultants. Although competent, the younger consultants are thus slightly at a disadvantage.

3. Contingency Fee:

This is the fee or commission paid to the consultant, when one is successful in saving the expenses for the client. A sense of honesty and fairness is required in fixing this fee.

The NSPE Code III 6 (a) says that the engineers shall not propose or accept a commission on a contingent basis where their judgment may be compromised.

The fee may be either as an agreed amount or a fixed percentage of the savings realized. But in the contingency fee-agreements, the judgment of the consultant may be biased. The consultant may be tempted to specify inferior materials or design methods to cut the construction cost.

This fee may motivate the consultants to effect saving in the costs to the clients, through reasonably moral and technological means.

4. Safety and Client's Needs:

The greater freedom for the consulting engineers in decision making on safety aspects, and difficulties concerning truthfulness are the matters to be given attention. For example, in design-only projects, the consulting engineers may design something and have no role in the construction.

Sometimes, difficulties may crop-up during construction due to non-availability of suitable materials, some shortcuts in construction, and lack of necessary and adequate supervision and inspection.

Properly-trained supervision is needed, but may not happen, unless it is provided. Further, the contractor may not understand and / or be willing to modify the original design to serve the clients best.

A few on-site inspections by the consulting engineers will expose the deficiency in execution and save the workers, the public, and the environment that may be exposed to risk upon completion of the project.

The NSPE codes on the advertisement by consultants provide some specific regulations. The following are the activities prohibited in advertisement by consultant:

1. The use of statement containing misrepresentation or omission of a necessary fact.
2. Statement intended or likely to create an unjustified expectation.
3. Statement containing prediction of future (probable) success.
4. Statement intended or likely to attract clients, by the use of slogans or sensational language format.

5.8 ENGINEERS AS EXPERT WITNESS

Frequently engineers are required to act as consultants and provide expert opinion and views in many legal cases of the past events. They are required to explain the causes of accidents, malfunctions and other technological behavior of structures, machines, and instruments.

For Example: Personal injury while using an instrument, defective product, traffic accident, structure or building collapse, and damage to the property, is some of the cases where testimonies are needed. The focus is on the past. The functions of eye-witness and expert-witness are different as presented in the Table 5.1.

The engineers, who act as expert-witnesses, are likely to abuse their positions in the following manners:

1. ***Hired Guns:*** Mostly lawyers hire engineers to serve the interest of their clients. Lawyers are permitted and required to project the case in a way favorable to their clients. But the engineers have obligations to thoroughly examine the events and demonstrate their professional integrity to testify only the truth in the court. They do not serve the clients of the lawyers directly. The hired guns forward white lies and distortions, as demanded by the lawyers. They even withhold the information or shade the fact, to favor their clients.

Table 5.1 Eye-witness VS Expert-witness

Eye – witness	Expert – witness
1. Eye-witness gives evidence on only what has been seen or heard actually (perceived facts)	1. Gives expert view on the facts in their area of their expertise. 2. Interprets the facts, in terms of the cause and effect relation-ship. 3. Comments on the view of the opposite side. 4. Reports on the professional standards especially on the precautions when the product is made or the service is provided.

2. ***Money Bias:*** Consultants may be influenced or prejudiced for monitory considerations, gain reputation and make a fortune.
3. ***Ego Bias:*** The assumption that the own side is innocent and the other side is guilty, is responsible for this behavior. An inordinate desire to serve one's client and get name and fame is another reason for this bias.
4. ***Sympathy Bias:*** Sympathy for the victim on the opposite side may upset the testimony. The integrity of the consultants will keep these biases away from the justice.

The court also must obtain the balanced view of both sides, by examining the expert witnesses of lawyers on both sides, to remove a probable bias.

5.8.1 Duties

1. The expert-witness is required to exhibit the responsibility of confidentiality just as they do in the consulting roles. They can not divulge the findings of the investigation to the opposite side, unless it is required by the court of law.
2. More important is that as witness they must answer questions truthfully, need not elaborate, and remain neutral until the details are asked for further.
3. They should be objective to discover the truth and communicate them honestly.
4. The experts should earnestly be impartial in identifying and interpreting the observed data, recorded data, and the industrial standards. They should not distort the truth, even under pressure.
   Although they are hired by the lawyers, they do not serve the lawyers or their clients. They serve the justice. Many a time, their objective judgments will help the lawyer to put up the best defense for their clients.

5.9 ENGINEERS AS ADVISORS IN PLANNING AND POLICY MAKING:

Advisors - The engineers are required to give their view on the future such as in planning, policy-making, which involves the technology.

For example, should India expand nuclear power options or support traditional energy sources such as fossil fuels or alternative forms like solar and wind energy?

Various issues and requirements for engineers who act as advisors are:

1. ***Objectivity:*** The engineers should study the cost and benefits of all possible alternative means in objective manner, within the specified conditions and assumptions.
2. ***Study All Aspects:*** They have to study the economic viability (effectiveness), technical feasibility (efficiency), operational feasibility (skills) and social acceptability, which include environmental and ethical aspects, before formulating the policy.
3. ***Values:*** Engineers have to posses the qualities, such as
   (a) honesty,
   (b) competence (skills and expertise),
   (c) diligence (careful and alert)
   (d) loyalty in serving the interests of the clients and maintaining confidentiality, and
   (e) public trust, and respect for the common good, rather than serving only the interests of the clients or the political interests.
4. ***Technical Complexity:*** The arbitrary, unrealistic, and controversial assumptions made during the future planning that are overlooked or not verified, will lead to moral complexity.
5. ***National Security:*** The proposed options should be aimed to strengthen the economy and security of the nation, besides safeguarding the natural resources and the environment from exploitation and degradation.

For the advisors on policy making or planning, a shared understanding on balancing the conflicting responsibilities, both to the clients and to the public, can be affected by the following roles or models:

1. ***Hired Gun:*** The prime obligation is shown to the clients. The data and facts favorable to the clients are highlighted, and unfavorable aspects are hidden or treated as insignificant. The minimal level of interest is shown for public welfare.
2. ***Value-neutral Analysts:*** This assumes an impartial engineer. They exhibit conscientious decisions, impartiality i.e., without bias, fear or favor, and absence of advocacy.
3. ***Value-guided Advocates:*** The consulting engineers remain honest (frank in stating all the relevant facts and truthful in interpretation of the facts) and autonomous (independent) in judgment and show paramount importance to the public (as different from the hired guns).

5.10 MORAL LEADERSHIP

Moral leadership is not merely the dominance by a group. It means adopting reasonable means to motivate the groups to achieve morally desirable goals. This leadership presents the engineers with many challenges to their moral principles.

Moral leadership is essentially required for the engineers, for the reasons listed as follows:

1. It is leading a group of people towards the achievement of global and objectives. The goals as well as the means are to be moral.

   For example, Hitler and Stalin were leaders, but only in an instrumental sense and certainly not on moral sense.

2. The leadership shall direct and motivate the group to move through morally desirable ways.

3. They lead by thinking ahead in time, and morally creative towards new applications, extension and putting values into practice. 'Morally creative' means the identification of the most important values as applicable to the situation, bringing clarity within the groups through proper communication, and putting those values into practice.

4. They sustain professional interest, among social diversity and cross-disciplinary complexity.

   They contribute to the professional societies, their professions, and to their communities. The moral leadership in engineering is manifested in leadership within the professional societies. The professional societies provide a forum for communication, and canvassing for change within and by groups.

5. ***Voluntarism:*** The professional societies can also promote such activities among the engineers. This type of voluntarism (or philanthropy) has been in practice in the fields of medicine, law and education.

6. ***Community service:*** The engineers can help in guiding, organizing, and stimulating the community towards morally- and environmentally-desirable goals.

The Codes of Ethics promote and sustain the ethical environment and assist in achieving the ethical goals in the following manner:

1. It creates an environment in a profession, where ethical behavior is the basic criterion.

2. It guides and reminds the person as to how to act, in any given situation.

3. It provides support to the individual, who is being pressurized or tortured by a superior or employer, to behave unethically.

4. Apart from professional societies, companies and universities have framed their own codes of ethics, based on the individual circumstances and specific mission of the organizations.

These codes of conduct help in employees' awareness of ethical issues, establish, and nurture a strong corporate ethical culture.

5.11 SAMPLE CODE OF CONDUCT

The following are some ethical codes of conduct defined for engineers, which they should follow in their profession. The various societies, organizations, and forums for different disciplines of engineering, has formulated these codes of ethical conducts for engineers, to act in an ethical way.

5.11.1 National Society of Professional Engineers

Engineers in the fulfillment of their professional duties shall

1. Hold paramount the safety, health, and welfare of the public.
2. Perform services only in areas of their competence.
3. Issue public statements only in objective and truthful manner.
4. Act for each employer or client as faithful agents or trustees.
5. Avoid deceptive acts.
6. Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.

Many codes of conduct formulated by NSPE are discussed in chapter 3.

5.11.2 The Institute of Electrical & Electronics Engineers

Code of Ethics

1. To accept responsibility in making engineering decisions consistent with the safety, health and welfare of the public, and to disclose prompt factors that might endanger the public or the environment.
2. To avoid real or perceived conflicts of interest whenever possible, and to disclose them to affected parties when they do exist
3. To be honest and realistic in stating claims or estimates based on available data.
4. To reject bribery in all its forms.
5. To improve the understanding of technology, its appropriate application, and potential consequences.
6. To maintain and improve our technical competence and to undertake technological tasks for others only if qualified by training or experience, or after full disclosure of pertinent limitations.
7. To seek, accept, and offer honest criticism of technical work, to acknowledge and correct errors, and to credit properly the contributions of others.
8. To treat fairly all persons regardless of such factors as race, religion, gender, disability, age, or national origin.

9. To avoid injuring others, their property, reputation, or employment by false or malicious action.
10. To assist colleagues and co-workers in their professional development and to support them in following code of ethics.

5.11.3 Institution of Engineers (India)

Code of Ethics (Effective From March 2004):

The corporate members if the IEI are committed to promote and practice the profession of engineering for the common good of the community bearing in mind the following concerns:

1. The ethical standard
2. Social justice, social order, and human rights
3. Protection of the environment
4. Sustainable development
5. Public safety and tranquility

A corporate member

1. Shall utilize his/her knowledge and expertise for the welfare, health, and safety of the community without any discrimination for sectional or private interests.
2. Shall maintain the honor, integrity and dignity in all his professional actions to be worthy of the trust of the community and the profession.
3. Shall act only in the domains of his competence and with diligence, care, sincerity and honesty.
4. Shall apply his knowledge and expertise in the interest of his employer or the clients for whom he shall work without compromising with other obligations to these tenets.
5. Shall not falsify or misrepresent his own or his associates qualification, experience etc.
6. Wherever necessary and relevant, shall take all reasonable steps to inform, himself, his employer or clients, of the environmental, economic, social and other possible consequences, which may arise out of his actions.
7. Shall maintain utmost honesty and fairness in making a statement or giving witness and shall do so on the basis of adequate knowledge.
8. Shall not directly or indirectly injure the professional reputation of another member.
9. Shall reject any kind of offer that may involve unfair practice or may cause avoidable damage to the eco-system.

10. Shall be concerned about and shall act in the best of his abilities for maintenance of sustainability of the process of development.
11. Shall not act in any manner which may injure the reputation of the institution or which may cause any damage to the institution financially or otherwise.

5.11.4 Indian Institute of Material Management

Code of Ethics

1. To consider first the total interest of one's organization in all transactions without impairing the dignity and responsibility to one's office.
2. To buy without prejudice seeking to obtain the maximum ultimate value for each rupee of expenditure.
3. To subscribe and work for honesty and truth in buying and selling.
4. To denounce all forms and manifestations of commercial bribery and to eschew anti-social practices.
5. To respect one's obligations and those of one's organization consistent with good business practice.

5.11.5 Institution of Electronics And Telecommunication Engineers

The Codes

1. A corporate member will, at all times, endeavor to protect the engineering profession from misrepresentation and misunderstanding.
2. A corporate member will interact with others in his profession by free exchange of information and experience. He will contribute to the growth of the institution to maximum effectiveness to the best of his ability.
3. A corporate member will not offer his professional services by advertisement or through any commercial advertising media, or solicit engineering work, trading, teaching either directly or indirectly or through agencies/organizations in any manner derogatory to the dignity of the profession and the institution.
4. A corporate member will not directly or indirectly injure the professional reputation, work, or practice of another corporate member.
5. A corporate member will not divulge confidential findings or actions of the council or committee of which he is a member, without obtaining official clearance.
6. A corporate member will not take credit for an activity, professional work, engineering proposal when engaged in a team and give due recognition to those where due.
7. A corporate member will express an opinion only when it is founded on facts and honest conviction before a forum, court, commission or at an inquiry.

8. A corporate member will exercise due restraint in criticizing the work or professional conduct of another corporate member which would impinge or hurt his character and reputation.
9. A corporate member will not try to supplant another corporate member in a particular employment, office or contract.
10. A corporate member will be upright in all his dealings with person(s), organizations, in business, contractors, agencies. He should not take actions that lead to groupism, political connotation or unethical conduct in the discharge if his official powers.
11. A corporate member will not misrepresent his qualification to gain undue advantage in his profession.
12. A corporate member will act with fairness and justice in any office, employment or contract.
13. A corporate member will not associate in engineering work which does not conform to ethical practices.
14. A corporate member will not compete unfairly with another corporate member by means, which in the opinion of others, are based on garnering support for personal gain, enlisting uncalled for sympathy, espousing unjust cases or amounts to use of unconstitutional methods.
15. A corporate member will act in professional matters as a faithful agent or trustee.
16. A corporate member will not receive remuneration, commission, discount or any indirect profit from any work with which he is entrusted, unless specifically so permitted.
17. A corporate member will not accept financial or other compensation from more than one source for the same service or work connected thereto, unless so authorized.
18. A corporate member will immediately inform his organization / institution of any financial interest in a business, and engineering work which may compete with, adversely affect or hamper the growth of parent body.
19. A corporate member will engage or enlist the services of specialist/experts when in his judgment; such services are in the best interest of his employer or to the profession.
20. A corporate member will endeavor to develop a team among his colleagues and staff and provide equal opportunity to them for professional development and advancement.
21. A corporate member will subscribe to the principle of appropriate norms, appreciation and adequate compensation for those engaged in office, technical and professional employment including those in subordinate positions.
22. A corporate member, if he considers that another corporate member is guilty of unethical, illegal, unfair practice, defalcation, will not present such information to the Council of the Institution for necessary action, unless armed with substantial proof.

5.11.6 Engineering Council of India

Engineering Council of India was formed in 2002 with one of its objectives as "to establish a common code of ethics for professional and consulting engineers for adoption by Associations/Professional Societies and to evolve the strategy for its enforcement."

The IEI, IETE, and Consulting Engineers Association of India (CEAI), AICTE, and NBA are the members of this council. The Engineers Bill, drafted in 2004, and aimed to introduce the common codes of ethics, is yet to enter the statute books.

5.11.7 Codes of Ethics for Tata Group

- Several Indian companies have risen to the challenge and have established a reputation for fair play and ethics. Among leaders of IT companies, there are models of good governance.
- The 15 million $ TATA Group upholds the leadership with trust as its key asset and holds up the TATA codes of Conduct to its 2.2 million plus employees.
- Founded on the five core values, namely Integrity, Understanding, Excellence, Unity, and Responsibility, the code is enunciated in 24 canons embracing ethical conduct, conflict of interest, corporate governance, whistle blowing, and national interest, health, safety, and welfare of the public including environmental concern.
- An elaborate mechanism to monitor the management of business in each of the 91 member companies is provided.
- All the IT professionals in the group numbering 50 000 plus worldwide, sign allegiance to the code and in particular to mandates on equal opportunity, prevention of gender inequality, concurrent employment, quality of services, and integrity of data furnished.

5.11.8 The ASME Codes Of Ethics

The fundamental principles:

Engineers uphold and advance the integrity, honor, and dignity of the Engineering profession by:

- using their knowledge and skill for the enhancement of human welfare;
- being honest and impartial, and serving with fidelity the public, their employers and clients, and
- striving to increase the competence and prestige of the engineering profession.

The fundamental canons:

1. Engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.
2. Engineers shall perform services only in the areas of their competence.

3. Engineers shall continue their professional development throughout their careers and shall provide opportunities for the professional development of those engineers under their supervision.
4. Engineers shall act in professional matters for each employer or client as faithful agents or trustees, and shall avoid conflicts of interest.
5. Engineers shall build their professional reputations on the merit of their services and shall not compete unfairly with others.
6. Engineers shall associate only with reputable persons or organizations.
7. Engineers shall issue public statements only in an objective and truthful manner.

5.11.9 Professional Practice

The joint IEEE and ACM Software Engineering Code of Ethics and Professional Practice encourages software engineers to undertake positive actions and resist pressures to act unethically.

The code includes eight basic principles.

1. ***Public*** —Software engineers shall act consistently with the public interest.
2. ***Client and employer*** —Software engineers shall act in a manner that is in the best interest of their client and employer, consistent with the public interest.
3. ***Product*** —Software engineers shall ensure that their products and related modifications meet the highest professional standards possible.
4. ***Judgment*** —Software engineers shall maintain integrity and independence in their professional judgment.
5. ***Management*** —Software engineering managers and leaders shall subscribe to and promote an ethical approach to the management of software development and maintenance.
6. ***Profession*** —Software engineers shall advance the integrity and reputation of the profession consistent with the public interest.
7. ***Colleagues*** —Software engineers shall be fair and supportive of their colleagues.
8. ***Self*** —Software engineers shall participate in lifelong learning regarding the practice of their profession and shall promote an ethical approach to the practice of the profession.

5.12 ETHICS AND CODES OF BUSINESS CONDUCT IN MNC

Sarbans-Oxley Act, 2002 (U.S.A.) and New York Stock Exchange listing standards have made many corporate organizations ethics conscious. The organizations are to disclose codes of business conduct and ethics for the organizations.

For example, Texas Instruments a major MNC has declared that "Ethical reputation is our vital asset. Upon applying values each of the employee can say, TI is a good company, and one reason is that I am part of it".

Three major values such as Integrity, Innovation and Commitment, have been elaborated in the form of 28 ethics statements (as pledges to keep) and 17 codes of business conduct have been presented in their documents.

A quick ethics test suggested by TI for all of its employees, without exception, will sufficiently explain their commitment:

1. Is the action LEGAL?
2. Does it comply with our VALUES?
3. If you do it, will you feel BAD?
4. How will it look in the NEWSPAPER?
5. If you know it is WRONG, don't do it.
6. If you are not sure, ASK
7. Keep asking until you get an answer

5.12.1 Special Responsibilities Facing Computer Professionals and Users:

a) Maintaining relationships with and responsibilities toward customers, clients, co-workers, employees, and employers.

b) Making critical decisions that have significant consequences for many people.

c) Determining how to manage, select, or use computers in a professional setting.

d) "Do the Right Thing"

Behaving Ethically Includes:

- Being honest.
- Keeping promises.
- Doing your job well.
- Not stealing.

Computer Professionals - are experts in their field, they know customers rely on their knowledge, expertise, and honesty, and understand their products (and related risks) affect many people. They should follow good professional standards and practices. They also have to maintain an expected level of competence and are up-to-date on current knowledge and technology, and educate the non-computer professional.

5.12.2 Ethical Guidelines for Computer Professionals:

The following are the ethical guidelines which are to be followed by any computer professional while involving themselves in a product development.

- Understand Success - Understand what success means—developers (especially) and users of computer systems must see beyond simply writing code to complete a task.

- Design for Real Users - To provide useful systems, real users must be included in the design stage.
- Thorough Planning and Scheduling - Pay attention to details—do a thorough and careful job when planning and scheduling a project and when writing bids.
- Test With Real Users - To provide safe systems, real users must be included in the testing stage.
- Evaluate Re-use of Software - Don't assume existing software is safe and re-usable.
- Candidness - Be open and honest about capabilities, safety, and limitations of software.
- Protect - Require a convincing case for safety.

5.12.3 Analyzing a Professional Ethical Scenario:

When a professional analyze an ethical scenario and make a decision, generally many alternative solutions will be available. The decision making process involves a phase "selecting the best alternative", with the help of which one best alternative can be chosen for analysis and practicing. The following are the two phases of analyzing an ethical scenario and determining the solution.

1. Brainstorming phase
2. Analysis phase

Brainstorming phase involves the following actions;

- List risks, issues, problems, consequences.
- List all the stakeholders.
- List possible actions.

The important stakeholders in the situation are employees and employer organizations. The interests at stake are ethics in the workplace and professional responsibilities companies face. This section deals with how to analyze specific scenarios dealing with the interests at stake and the controversial sides of social ethical issues.

There is a main invasion of privacy issue at stake in copying employee's files. The employee who for example is out sick can have their privacy invaded as another employee needs to copy the files that need to be worked on. Secondly there is insufficient privacy protection, risky systems and going public. Lastly there are cases of release of personal information, conflict of interest, a test plan, copyright violation, and hiring foreign programmers

Analysis phase involves the following activities;

- Identify the responsibilities of the decision-maker.
- Identify the rights of stakeholders.
- Consider the impact of the action options on the stakeholders.
- Find sections in codes of ethics that apply. Categorize each potential action or response as ethically obligatory, ethically prohibited, or ethically acceptable.
- Consider the ethical merits of each option and select one.

TWO MARK QUESTIONS & ANSWERS

1. **Give some of the Environmental issues of concern to engineers?**
   - Releasing harmful substance into air and water.
   - Using toxic substance in food processing.
   - Disturbing land and water balances.
2. **What are the issues in Computer ethics?**
   - Power Relationship
   - Property
   - Privacy
   - Professional Issues
3. **What are the problems of Defense industry?**
   - Problem of waste and huge cost in implementing and maintaining a weapons system.
   - Problem of Technology creep.
   - Problems in maintaining secrecy.
   - Every country allocates large amount of its resources to defense sector [India spent ¼ of its resource for defense]
4. **What are ways to promote an Ethical climate?**
   a. Ethical values in their full complexity are widely acknowledged and appreciated by managers and employees alike.
   b. The sincere use of ethical language has to be recognized as a legitimate part of corporate dialogue.
   c. The top level management must establish a moral tone in words, in policies, by personal example etc.
   d. The management has to establish some procedures for resolving conflicts.
5. **What are the characteristics of an engineer as expert advisers in public planning and policy making?**
   - Honesty
   - Competence
   - Diligence
   - Loyalty

6. How can Deceptive advertising be done?

a. By outright lies.

b. By half-truths.

c. Through exaggeration.

d. By making false innuendos, suggestions or implications.

e. Through obfuscation created by ambiguity, vagueness or incoherence.

f. Through subliminal manipulation of the unconscious.

7. Give the usage of the code of conduct?

The code of conduct will help the engineers to have a set of standards of behavior. They act as guidelines for their behavior. It helps to create workplaces where employees are encouraged to make ethical implications.

8. Give the IEEE Code of Ethics?

The members of the IEEE, in recognition of the importance of their technologies affecting the quality of life throughout the world, and in accepting a personal obligation to their profession, its members and the communities they serve, do hereby commit themselves to the highest ethical and professional conduct and agree…

i. To accept responsibility in making engineering decisions consistent with the safety, health and welfare of the public, and to disclose promptly factors that might endanger the public or the environment.

ii. To avoid real or perceived conflicts of interest whenever possible and to disclose them to the affected parties when they do exist.

iii. To be honest and realistic in stating claims or estimates based on available data.

iv. To reject bribery in all its forms.

v. To improve the understanding of technology, its appropriate application, and potential consequences.

vi. To maintain and improve their technical competence and to undertake technological tasks for others only if qualified by training or experience, or after full disclosure of pertinent limitations.

vii. To seek, accept and offer honest criticism of technical work, to acknowledge and correct errors, and to credit properly the contributions of others.

viii. To treat fairly all persons regardless of such factors such as religion, gender, disability, age or national origin.

ix. To avoid injuring others, their property, reputation or employment by false or malicious action.

x. To assist colleagues and co-workers in their professional development and to support them in following this code of ethics.

9. Enumerate the code of ethics of engineers?

- Engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.
- Engineers shall perform services only in the areas of their competence.
- Engineers shall issue public statements only in an objective and truthful manner.
- Engineers shall act in professional matters for each employer or client as faithful agents or trustees, and shall avoid conflicts of interest.
- Engineers shall build their professional reputation on the merit of their services and shall not compete unfairly with others.

10. What is globalization?

Globalization - means integration of countries through commerce, transfer of technology, and exchange of information and culture. In a way, it includes acting together and interacting economies through trade, investment, loan, development schemes and capital across countries.

11. What are the ten international rights to be considered?

1. Right of freedom of physical movement of people
2. Right of ownership of properties
3. Freedom from torture
4. Right to fair trial on the products
5. Freedom from discrimination on the basis of race or sex.
6. Physical security.
7. Freedom of speech and forming association
8. Right to have a minimum education
9. Right to political participation
10. Right to live and exist (i.e., coexistence).

12. Define appropriate technology (Aptech).

Identification, transfer, and implementation of most suitable technology for a set of new situations, is called appropriate technology.

13. What is technology transfer?

It is a process of moving technology to a new setting and implementing it there. Technology includes hardware (machines and installations) and the techniques (technical, organizational, and managerial skills and procedures).

14. What is environmental ethics?

Environmental ethics is the study of

(a) moral issues concerning the environment, and

(b) moral perspectives, beliefs, or attitudes concerning those issues.

15. What is acid rain? How it is caused?

Large emissions of sulphur oxides and nitrous oxides are being released in to the air from the thermal power stations using the fossil fuels, and several processing industries. These gases form compounds with water in the air and precipitates as rain or snow on to the earth.

16. Define Computer ethics.

Computer ethics is defined as

(a) study and analysis of nature and social impact of computer technology,

(b) formulation and justification of policies, for ethical use of computers. This subject has become relevant to the professionals such as designers of computers, programmers, system analysts, system managers, and operators.

17. What are the different types of issues related with computer?

1. Computer as the Instrument of Unethical Acts
2. Computer as the Object of Unethical Act :
   - Hacking,
   - Spreading virus,
   - Health hazard ,
3. Problems Related to the Autonomous Nature of Computer :
   - Security risk :
   - Loss of human lives:
   - In flexible manufacturing systems.

18. Define Physical and logical security related to computer.

1. Physical Security :

The computers are to be protected against theft, fire, and physical damage. This can be achieved by proper insurance on the assets.

2. Logical security:

The aspects related to logical security are ...

(a) The privacy of the individuals or organizations,

(b) Confidentiality,

(c) Integrity

(d) Uninterrupted service.

(e) Protection against hacking that causes dislocation or distortion

(f) Passwords and data encryption

19. What is competitive bidding?

Competitive bidding - means offering a price, and get something in return for the service offered. The organizations have a pool of engineers. The expertise can be shared and the bidding is made more realistic.

But the individual consultants have to develop creative designs and build their reputation steadily and carefully, over a period of time.

20. What are the various issues and requirements for engineers who act as advisors?

1. Objectivity
2. Study All Aspects
3. Values: Engineers have to posses the qualities, such as

   (a) honesty,

   (b) competence (skills and expertise),

   (c) diligence (careful and alert)

   (d) loyalty in serving the interests of the clients and maintaining confidentiality, and

   (e) public trust
4. Technical Complexity
5. National Security

21. What are the codes formulated for engineers by NSPE?

- Hold paramount the safety, health, and welfare of the public.
- Perform services only in areas of their competence.
- Issue public statements only in objective and truthful manner.
- Act for each employer or client as faithful agents or trustees.
- Avoid deceptive acts.
- Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.

22. What are the codes formulated for engineers by IEI?

- The ethical standard
- Social justice, social order, and human rights
- Protection of the environment
- Sustainable development
- Public safety and tranquility

23. Explain Hacking.

Hacking: The software is stolen or information is accessed from other computers. This may cause financial loss to the business or violation of privacy rights of the individuals or business. In case of defense information being hacked, this may endanger the security of the nation.

24. How viruses are spreaded over computers?

Spreading virus: Through mail or otherwise, other computers are accessed and the files are erased or contents changed altogether. 'Trojan horses' are implanted to distort the messages and files beyond recovery.

This again causes financial loss or mental torture to the individuals. Some hackers feel that they have justified their right of free information or they do it for fun. However, these acts are certainly unethical.

25. What are the property issues concerned with the computers?

1. Computers have been used to extort money through anonymous telephone calls.
2. Computers are used to cheat and steal by current as well as previous employees.
3. Cheating of and stealing from the customers and clients.
4. Violation of contracts on computer sales and services.
5. Conspiracy as a group, especially with the internet, to defraud the gullible, stealing the identity and to forge documents.

26. List some issues concerned with the privacy.

1. Records of Evidence
2. Hacking
3. Legal Response

27. What is Trojan horse attack?

- The computer hackers, plant virus or "Trojan horses" that may fill the disc space, falsify information, erase files, and even harm the hardware.
- They breakdown the functioning of computers and can be treated as violation of property rights.
- The proprietary information and data of the organizations are to be protected so that they can pursue the goals without hindrance.

28. What are the rights, "The Right to Information ACT" includes?

- Inspect works, documents, records,
- Take notes, extracts or certified copies of documents or records,
- Take certified samples of material, and
- Obtain information in the form of printouts, diskettes, floppies, tapes, video cassettes or in any other electronic mode.

APPENDIX-A

CASE STUDIES

CASE 1: THE SPACE SHUTTLE CHALLENGER DISASTER

INTRODUCTION TO THE CASE

On January 28, 1986, seven astronauts were killed when the space shuttle they were piloting, the Challenger, exploded at just over a minute into the flight. The failure of the solid rocket booster O-rings to seal properly allowed hot combustion gases to leak from the side of the booster and burn through the external fuel tank. The failure of the O-ring was attributed to several factors, including faulty design of the solid rocket boosters, insufficient low-temperature testing of the O-ring material and of the joints that the O-ring sealed, and lack of proper communication between different levels of NASA management.

ORGANIZATIONS / PEOPLE INVOLVED

- **Marshall Space Flight Center** - in charge of booster rocket development.
- **Larry Mulloy** - challenged the engineers' decision not to launch.
- **Morton Thiokol** - Contracted by NASA to build the solid rocket booster.
- **Alan McDonald** - Director of the Solid Rocket Motors project.
- **Bob Lund** - Engineering Vice President.
- **Robert Ebeling** - Engineer who worked under McDonald.
- **Roger Boisjoly** - Engineer who worked under McDonald.
- **Joe Kilminster** - Engineer in a management position.
- **Jerald Mason** - Senior executive who encouraged Lund to reassess his decision not to launch.

KEY DATES

- 1974 - Morton-Thiokol awarded contract to build solid rocket boosters.
- 1976 - NASA accepts Morton-Thiokol's booster design.
- 1977 - Morton-Thiokol discovers joint rotation problem.
- November 1981 - O-ring erosion discovered after second shuttle flight.

- January 24, 1985 - shuttle flight that exhibited the worst O-ring blow by.
- July 1985 - Thiokol orders new steel billets for new field joint design.
- August 19, 1985 - NASA Level I management briefed on booster problem.
- January 27, 1986 - night teleconference to discuss effects of cold temperature on booster performance.
- January 28, 1986 - Challenger explodes 72 seconds after liftoff.

KEY ISSUES

1. How does the implied social contract of professionals apply to this case?
2. What professional responsibilities were neglected, if any?
3. Should NASA have done anything differently in their launch decision procedure?

BACKGROUND OF THE DISASTER

a) Pressure to launch

NASA managers were anxious to launch the Challenger for several reasons, including economic considerations, political pressures, and scheduling backlogs.

Unforeseen competition from the European Space Agency put NASA in a position in which it would have to fly the shuttle dependably on a very ambitious schedule to prove the Space Transportation System's cost effectiveness and potential for commercialization. This prompted NASA to schedule a record number of missions in 1986 to make a case for its budget requests.

The shuttle mission just prior to the Challenger had been delayed a record number of times due to inclement weather and mechanical factors. NASA wanted to launch the Challenger without any delays so the launch pad could be refurbished in time for the next mission, which would be carrying a probe that would examine Halley's Comet. If launched on time, this probe would have collected data a few days before a similar Russian probe would be launched.

There was probably also pressure to launch Challenger so that it could be in space when President Reagan gave his State of the Union address. Reagan's main topic was to be education, and he was expected to mention the shuttle and the first teacher in space, Christa McAuliffe.

b) Solid rocket booster

The shuttle solid rocket boosters (or SRBs), are key elements in the operation of the shuttle. Without the boosters, the shuttle cannot produce enough thrust to overcome the earth's gravitational pull and achieve orbit.

An SRB is attached to each side of the external fuel tank. Each booster is 149 feet long and 12 feet in diameter. Before ignition, each booster weighs 2 million pounds.

Solid rockets, in general, produce much more thrust per pound than their liquid fuel counterparts. The drawback is that, once the solid rocket fuel has been ignited, it cannot be turned off or even controlled. So it was extremely important that the shuttle SRBs be properly designed.

Morton Thiokol was awarded the contract to design and build the SRBs in 1974. Thiokol's design is a scaled-up version of a Titan missile, which had been used successfully for years. NASA accepted the design in 1976.

c) O-rings

Each SRB joint is sealed by two O-rings: the bottom ring known as the primary O-ring, and the top known as the secondary O-ring. (The Titan booster had only one O-ring. The second ring was added as a measure of redundancy since the boosters would be lifting humans into orbit. Except for the increased scale of the rocket's diameter, this was the only major difference between the shuttle booster and the Titan booster.)

The purpose of the O-rings is to prevent hot combustion gasses from escaping from the inside of the motor.

- To provide a barrier between the rubber O-rings and the combustion gasses, heat-resistant putty is applied to the inner section of the joint prior to assembly. The gap between the tang and the clevis determines the amount of compression on the O-ring.
- To minimize the gap and increase the squeeze on the O-ring, shims are inserted between the tang and the outside leg of the clevis.
- Temperatures for the next launch date were predicted to be in the low 20°s. This prompted Alan McDonald to ask his engineers at Thiokol to prepare a presentation on the effects of cold temperature on booster performance.
- A teleconference was held between engineers and management from Kennedy Space Center, Marshall Space Flight Center in Alabama, and Morton-Thiokol in Utah. Boisjoly and another engineer, Arnie Thompson, knew this would be another opportunity to express their concerns about the boosters.
- But they had only a short time to prepare their data for the presentation.
- Thiokol's engineers gave an hour-long presentation, presenting a convincing argument that the cold weather would exaggerate the problems of joint rotation and delayed O-ring seating.
- The lowest temperature experienced by the O-rings in any previous mission was 53°F, on the January 24, 1985 flight. With a predicted ambient temperature of 26°F at launch, the O-rings were estimated to be at 29°F.
- After the technical presentation, Thiokol's Engineering Vice President Bob Lund presented the conclusions and recommendations. His main conclusion was that 53°F was the only low-temperature data Thiokol had for the effects of cold on the operational boosters.

- The boosters had experienced O-ring erosion at this temperature. Since his engineers had no low-temperature data below 53°F, they could not prove that it was unsafe to launch at lower temperatures.
- He read his recommendations and commented that the predicted temperatures for the morning's launch was outside the database and NASA should delay the launch, so the ambient temperature could rise until the O-ring temperature was at least 53°F.
- This confused NASA managers because the booster design specifications called for booster operation as low as 31°F. (It later came out in the investigation that Thiokol understood that the 31°F limit temperature was for storage of the booster, and that the launch temperature limit was 40°F. Because of this, dynamic tests of the boosters had never been performed below 40°F.)
- Marshall's Solid Rocket Booster Project Manager, Larry Mulloy, commented that the data was inconclusive and challenged the engineers' logic. A heated debate went on for several minutes before Mulloy bypassed Lund and asked Joe Kilminster for his opinion. Kilminster was in management, although he had an extensive engineering background.
- By bypassing the engineers, Mulloy was calling for a middle-management decision, but Kilminster stood by his engineers. Several other managers at Marshall expressed their doubts about the recommendations, and finally Kilminster asked for a meeting off of the net, so Thiokol could review its data. Boisjoly and Thompson tried to convince their senior managers to stay with their original decision not to launch.
- A senior executive at Thiokol, Jerald Mason, commented that a management decision was required. The managers seemed to believe the O-rings could be eroded up to one-third of their diameter and still seal properly, regardless of the temperature.
- The data presented to them showed no correlation between temperature and the blow by gasses which eroded the O-rings in previous missions. According to testimony by Kilminster and Boisjoly, Mason finally turned to Bob Lund and said, "Take off your engineering hat and put on your management hat."
- Joe Kilminster wrote out the new recommendation and went back online with the teleconference. The new recommendation stated that the cold was still a safety concern, but their people had found that the original data was indeed inconclusive and their "engineering assessment" was that launch was recommended, even though the engineers had no part in writing the new recommendation and refused to sign it.
- Alan McDonald, who was present with NASA management in Florida, was surprised to see the recommendation to launch and appealed to NASA management not to launch. NASA managers decided to approve the boosters for launch despite the fact that the predicted launch temperature was outside of their operational specifications.

d) Launch Delays

- The first delay of the Challenger mission was due to a weather front expected to move into the area, bringing rain and cold temperatures. Usually a mission wasn't postponed until inclement weather actually entered the area, but the Vice President was expected to be present for the launch and NASA officials wanted to avoid the necessity of the Vice President's having to make an unnecessary trip to Florida, so they postponed the launch early.
- The Vice President was a key spokesperson for the President on the space program, and NASA coveted his good will. The weather front stalled, and the launch window had perfect weather conditions; but the launch had already been postponed.
- The second launch delay was caused by a defective micro-switch in the hatch locking mechanism and by problems in removing the hatch handle. By the time these problems had been sorted out, winds had become too high. The weather front had started moving again, and appeared to be bringing record-setting low temperatures to the Florida area.
- NASA wanted to check with all of its contractors to determine if there would be any problems with launching in the cold temperatures. Alan McDonald, director of the Solid Rocket Motor Project at Morton-Thiokol, was convinced that there were cold-weather problems with the solid rocket motors and contacted two of the engineers working on the project, Robert Ebeling and Roger Boisjoly.
- Thiokol knew there was a problem with the boosters as early as 1977, and had initiated a redesign effort in 1985. NASA Level I management had been briefed on the problem on August 19, 1985.
- Almost half of the shuttle flights had experienced O-ring erosion in the booster field joints. Ebeling and Boisjoly had complained to Thiokol that management was not supporting the redesign task force.

e) The Night Before the Launch

Temperatures for the next launch date were predicted to be in the low 20°s. This prompted Alan McDonald to ask his engineers at Thiokol to prepare a presentation on the effects of cold temperature on booster performance.

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f) The Launch

- During the night, temperatures dropped to as low as 8°F, much lower than had been anticipated. To keep the water pipes in the launch platform from freezing, safety showers and fire hoses had been turned on. Some of this water had accumulated, and ice had formed all over the platform.
- There was some concern that the ice would fall off of the platform during launch and might damage the heat-resistant tiles on the shuttle.
- The ice inspection team thought the situation was of great concern, but the launch director decided to go ahead with the countdown. (Note that safety limitations on low temperature launching had to be waived and authorized by key personnel several times during the final countdown. These key personnel were not aware of the teleconference about the solid rocket boosters that had taken place the night before.)
- At launch, the impact of ignition broke loose a shower of ice from the launch platform. Some of the ice struck the left-hand booster, and some ice was actually sucked into the booster nozzle itself by an aspiration effect.
- Although there was no evidence of any ice damage to the Orbiter itself, NASA analysis of the ice problem was wrong.
- The booster ignition transient started six hundredths of a second after the igniter fired. The aft field joint on the right-hand booster was the coldest spot on the booster: about 28°F. The booster's segmented steel casing ballooned and the joint rotated, expanding inward as it had on all other shuttle flights.
- The primary O-ring was too cold to seal properly, the cold-stiffened heat resistant putty that protected the rubber O-rings from the fuel collapsed, and gases at over 5000°F burned past both O-rings across 70 degrees of arc.
- Eight hundredths of a second after ignition, the shuttle lifted off. Engineering cameras focused on the right-hand booster showed about nine smoke puffs coming from the booster aft field joint. Before the shuttle cleared the tower, oxides from the burnt propellant temporarily sealed the field joint before flames could escape.
- Fifty-nine seconds into the flight, Challenger experienced the most violent wind shear ever encountered on a shuttle mission. The glassy oxides that sealed the field joint were shattered by the stresses of the wind shear, and within seconds flames from the field joint burned through the external fuel tank. Hundreds of tons of propellant ignited, tearing apart the shuttle.
- One hundred seconds into the flight, the last bit of telemetry data was transmitted from the Challenger.

ISSUES FOR DISCUSSION

1. What could NASA management have done differently?
2. What, if anything, could their subordinates have done differently?
3. What should Roger Boisjoly have done differently (if anything)? In answering this question, keep in mind that, at his age, the prospect of finding a new job if he was fired was slim. He also had a family to support.
4. What do you (the students) see as your future engineering professional responsibilities in relation to both being loyal to management and protecting the public welfare?

The Challenger disaster presents several issues that are relevant to engineers. These issues raise many questions that may not have any definite answers, but can serve to heighten the awareness of engineers when faced with a similar situation.

One of the most important is **engineers who are placed in management positions.** It is important that these managers not ignore their own engineering experience, or the expertise of their subordinate engineers.

Often a manager, even if she has engineering experience, is not as up-to-date on current engineering practices as are the actual practicing engineers. She should keep this in mind when making any sort of decision that involves an understanding of technical matters.

Another issue is the fact that managers encouraged launching due to the fact that there was insufficient low-temperature data. Since there was not enough data available to make an informed decision, this was not, in their opinion, grounds for stopping a launch.

This was a reversal in the thinking that went on in the early years of the space program, which discouraged launching until all the facts were known about a particular problem.

This same reasoning can be traced back to an earlier phase in the shuttle program, when upper-level NASA management was alerted to problems in the booster design, yet did not halt the program until the problem was solved.

As engineers test designs for ever-increasing speeds, loads, capacities and the like, they must always be aware of their obligation to society to protect the public welfare. After all, the public has provided engineers, through the tax base, with the means for obtaining an education and, through legislation, the means to license and regulate themselves.

In return, engineers have a responsibility to protect the safety and well-being of the public in all of their professional efforts. This is part of the implicit social contract all engineers have agreed to when they accepted admission to an engineering college.

The first canon in the ASME Code of Ethics urges engineers to ***"hold paramount the safety, health, and welfare of the public in the performance of their professional duties."*** Every major engineering code of ethics reminds engineers of the importance of their responsibility to keep the safety and well being of the public at the top of their list of priorities.

Although company loyalty is important, it must not be allowed to override the engineer's obligation to the public. Marcia Baron, in an excellent monograph on loyalty, states: "It is a sad fact about loyalty that it invites...single-mindedness.

Single-minded pursuit of a goal is sometimes delightfully romantic, even a real inspiration. But it is hardly something to advocate to engineers, whose impact on the safety of the public is so very significant. Irresponsibility, whether caused by selfishness or by magnificently unselfish loyalty, can have most unfortunate consequences."

NUCLEAR POWER PLANT DISASTERS

CASE 2: THREE MILE ISLAND (MARCH 28, 1979, 4 A.M.)

The TMI nuclear power plant unit 2 is located in a river basin in Pennysylvania, USA.

- The nuclear power plant had a pressurized water reactor system (PWR). The main reactor core (1) release heat which is transferred to water in the primary circuit (1-2-3-4).
- The heat from the steam generator (3) is transferred to water in the secondary circuit (7) at low pressure.
- The water in the secondary circuit gets converted into steam in the boiler (3). This steam flow drives the turbine (8), and the exhaust stem is converted into water in the condenser (10) and circulated back into the boiler (3) by means of pumps (11,13,14).

The demineraliser (12) contains resin beads to clean condensate. A problem in demineraliser arose and it led to the closure of the outlet valve of (12) to the steam generator (3). This resulted in shutdown of main feed water pump (13) and the auxiliary feed water pump (14) failed.The reactor pressure increased to very high level, opened a pressure relief valve(6) and gave a signal, which helped to lower the control rods in the reactor core, in order to stop the main fission process. This valve (6) remained open for long.

The system components of TMI plant unit 2 is shown in the following fig C2.1

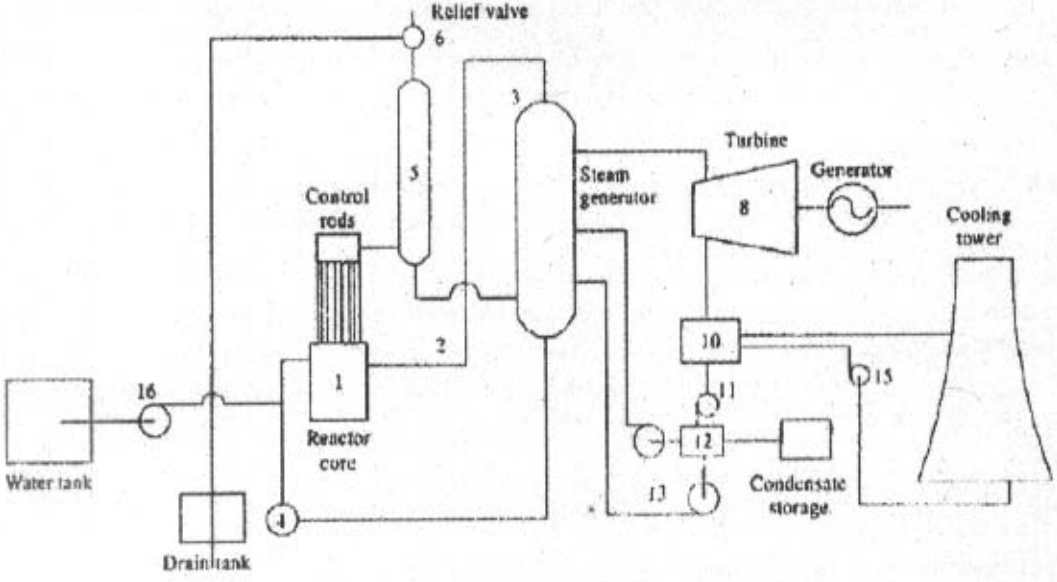


Fig C2.1 System Components of TMI plant unit 2

When pump (14) failed, the steam generator (3) went dry. So, heat was not removed from the reactor. Water was pouring out at 220 gallons/min but reactor has not cooled down. Pumps (16) were started to refill water reactor core. There was too much of water in the reactor now.

The reactor fuel rods began to break to pieces. Then the chemical reaction between steam and the Zinc alloy fuel elements produced Hydrogen and the Hydrogen accumulated caused the explosion of the structure.

The radiation levels in the building increased and the sound alarm blew. Immediately people contacted Nuclear Regulatory Commission and B and W, who constructed the reactor. Nobody was there to answer the call at B and W. But somehow people escaped without any loss of human lives. After 13 hours and a half, the reactor was put under control.

CASE 3: CHERNOBYL NUCLEAR PLANT DISASTER:

On 26 April 1986, at 01:23 (UTC+3), reactor four suffered a catastrophic power increase, leading to explosions in its core. This dispersed large quantities of radioactive fuel and core materials into the atmosphere and ignited the combustible graphite moderator. The burning graphite moderator increased the emission of radioactive particles, carried by the smoke, as the reactor had not been encased by any kind of hard containment vessel. The accident occurred during an experiment scheduled to test a potential safety emergency core cooling feature, which took place during the normal shutdown procedure.

CONSEQUENCES OF THE DISASTER (HEALTH IMPACTS):

- The accident destroyed the Chernobyl 4 reactor, killing 30 operators and firemen within three months and several further deaths later.
- One person was killed immediately and a second died in hospital soon after as a result of injuries received.
- Another person is reported to have died at the time from a coronary thrombosis.
- Acute radiation syndrome (ARS) was originally diagnosed in 237 people on-site and involved with the clean-up and it was later confirmed in 134 cases. Of these, 28 people died as a result of ARS within a few weeks of the accident.
- Nineteen more subsequently died between 1987 and 2004 but their deaths cannot necessarily be attributed to radiation exposure.
- Nobody off-site suffered from acute radiation effects although a large proportion of childhood thyroid cancers diagnosed since the accident is likely to be due to intake of radioactive iodine fallout.

The Chernobyl disaster was a unique event and the only accident in the history of commercial nuclear power where radiation-related fatalities occurred. However, the design of the reactor is unique and the accident is thus of little relevance to the rest of the nuclear industry outside the then Eastern Bloc.

The RBMK-1000 is a Soviet-designed and built graphite moderated pressure tube type reactor, using slightly enriched (2% U-235) uranium dioxide fuel. It is a boiling light water reactor, with two loops feeding steam directly to the turbines, without an intervening heat exchanger. Water pumped to the bottom of the fuel channels boils as it progresses up the pressure tubes, producing steam which feeds two 500 MWe turbines. The water acts as a coolant and also provides the steam used to drive the turbines.

The vertical pressure tubes contain the zirconium alloy clad uranium dioxide fuel around which the cooling water flows. The extensions of the fuel channels penetrate the lower plate and the cover plate of the core and are welded to each. A specially designed refueling machine allows fuel bundles to be changed without shutting down the reactor.The moderator, whose function is to slow down neutrons to make them more efficient in producing fission in the fuel, is graphite, surrounding the pressure tubes. A mixture of nitrogen and helium is circulated between the graphite blocks to prevent oxidation of the graphite and to improve the transmission of the heat produced by neutron interactions in the graphite to the fuel channel.

The following figure C3.1 shows the components of nuclear reactor unit 4.

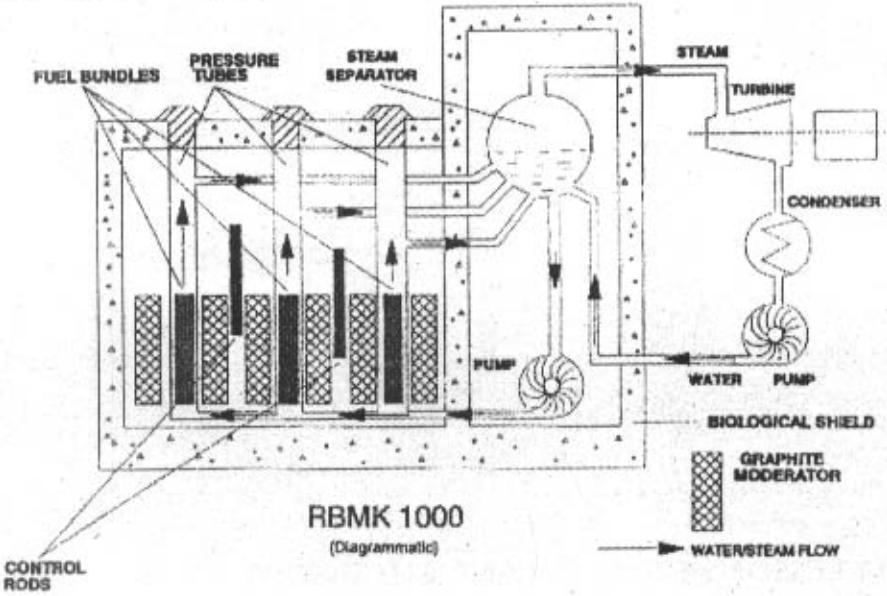


Fig C3.1 Components of nuclear reactor unit 4

The core itself is about 7 m high and about 12 m in diameter. In each of the two loops, there are four main coolant circulating pumps, one of which is always on standby. The reactivity or power of the reactor is controlled by raising or lowering 211 control rods, which, when lowered into the moderator, absorb neutrons and reduce the fission rate.

The power output of this reactor is 3200 MW thermal, or 1000 MWe. Various safety systems, such as an emergency core cooling system, were incorporated into the reactor design.

One of the most important characteristics of the RBMK reactor is that it can possess a 'positive void coefficient', where an increase in steam bubbles ('voids') is accompanied by an increase in core reactivity (see information page on RBMK Reactors). As steam production in the fuel channels increases, the neutrons that would have been absorbed by the denser water now produce increased fission in the fuel.

There are other components that contribute to the overall power coefficient of reactivity, but the void coefficient is the dominant one in RBMK reactors. The void coefficient depends on the composition of the core – a new RBMK core will have a negative void coefficient.

However, at the time of the accident at Chernobyl 4, the reactor's fuel burn-up, control rod configuration and power level led to a positive void coefficient large enough to overwhelm all other influences on the power coefficient.

The following figure C3.2 shows the damaged building of nuclear reactor unit 4

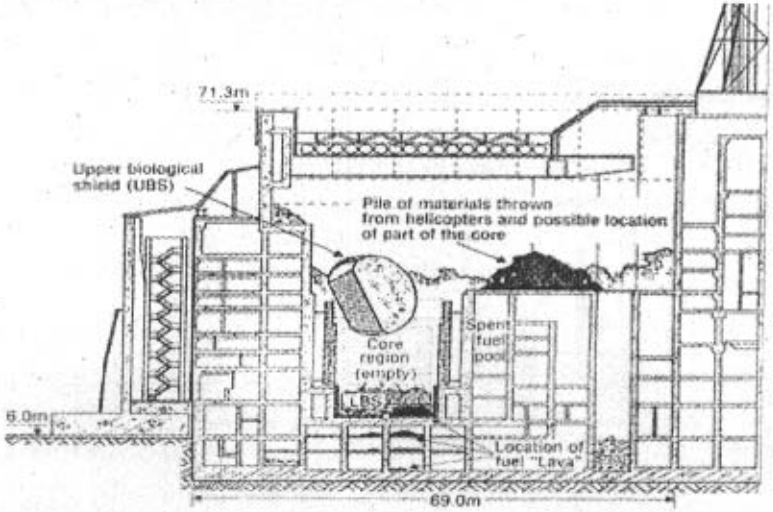


Fig C3.2 The damaged Chernobyl unit 4 reactor building

SAFETY LESSONS FROM TMI AND CHERNOBYL

1. The thickness of the containment should be more, to withstand the possible explosion and further damage due to radiation and leakage over the surroundings (Chernobyl).
2. When the test began at low loads, the demand for increased out power should have been declined.
3. The tests should have been abandoned and all controls switched on. Then the output should have been raised in case of Chernobyl.
4. The decision making on test increase the load with one person, the decision makers should have coordinated among themselves. (Chernobyl)
5. In hydraulic systems valves are the reliable components, so malfunction of a valve must be reported properly.
6. In case of TMI, continuous monitoring of components such as demineraliser, pressure valves must have been made.
7. Emergency Procedures which should be adopted in case of critical situations should have been planned.
8. Safe exit should have arranged for the operators working inside nuclear reactors. Periodical mock drill (practice about how to act in emergency situations, rescuing life) should have been conducted.
9. Radio activity monitoring instruments should have been kept in proper condition.

CASE 4: FIRE BY SODIUM COOLANT LEAK AT PROTOTYPE FAST BREEDER REACTOR, MONJU

DISASTER OVERVIEW:

1. On December 8, 1995, a prototype fast breeder reactor, Monju, located in Tsuruga City, 350km west of Tokyo, was operating at 40% power.
2. The Power Reactor and Nuclear Fuel Development Corp (PNC), a government controlled organization, operated this reactor.
3. At 19:47 high temperature liquid sodium coolant at one of the three secondary heat exchangers started leaking through a broken thermometer sheath (designed by IH Company, OD: 10mm, ID: 4mm, Length: 150mm) on the piping and it ignited on contact with air.
4. The primary heat exchangers are designed to take heat out of the core of the reactor to the secondary heat exchangers, which then transfer the heat to steam generators for power.
5. Because of this design, it was a simple fire caused by the leakage of chemically reactive but non-radioactive sodium coolant.
6. But due to the delay in shutting down of the reactor, 640kg of the sodium leaked in 3 hours and caused some unexpected damage by the fire and chemical reactions to the surrounding structure.

The sheath was found to have been broken by following design errors such as,

1. The sharp cut edge design of the sheath which caused stress concentration and breakage,
2. Neglect of newly established mechanical design analysis of vibration of the sheath parallel to the sodium flow and
3. The IH company's failure to consider the fact that liquid sodium is 120 times more heat conductive than water and to use the another contractor's (the H company's) better and simpler design for those of the primary heat exchangers.

The PNC had been always asked by neighbors as well as anti-nuclear organizations whether their nuclear reactors are absolutely safe. They felt constrained to reply "yes" under the circumstances.

Under these conditions, the initial cover up of hiding the videotapes taken at the site and of showing them after editing and the PNC's delay (of about one hour) in informing the neighboring community agencies of the accident ignited a fierce protest by the public.

This example teaches the students following lessons:

a) Influence of quality of engineering works:

The small design errors in the cheap component which may come from lack of competence and care of designers in the IH Company and JNC as the user, caused the accident

b) The cover up of the video tapes and delay in informing others of the accident:

The cover up decision was made by managers including ex-engineers. When it has been asked to the students in a class if they do the same under the situations, one-third of them said they might although they think it is a very stupid act.

The delay of informing the accidents is mainly due to lack of the system oversight and to the bureaucracy within the JNC organization.

These caused loss of public trust in general and have delayed the several tens of billion dollar project at least 6 years, although the government wants to resume the project as soon as possible.

c) Importance of professional work in accidents:

The manuals to handle this kind of the accident were not made although they had some for other types of sodium coolant leakage. Manuals are necessary and useful especially in simple operation.

But in accidents like this, which no one had expected and which are generally much more complex than those anticipated in manuals, professional judgments are much more important and necessary.

In this case, the air conditioners, which had not been shut down, continued to supply fresh air to the fire.

d) Learning from past experience:

The earlier experimental fast breeder reactor, Joyo, which was designed based on practical experiences by the engineers of previous generation, had not had any serious sodium leak accident for 18 years since its start of the operation in1977.

Most of these engineers, however, were retired or moved to other job as time passed. New generation of engineers might have thought it easy to handle. This is the problem of transferring and learning engineering experience and skills between generations.

e) Responsibility of managers (ex-engineers) to the public:

Engineers know "nothing is absolutely safe". But sometimes political pressure forces managers to say yes to the public on the absolute safety question. But the more realistic question form the public is that the engineers make a maximum professional effort to eliminate the safety hazard.

Engineers should have realized the responsibility of clarifying the situation. After a long discussion on the safety including the following two accidents, the Committee of the Nuclear Safety Commission in Japan formally declared in "The White Paper 2000 on Safety of Nuclear Energy (in Japanese)" approved on March 27, 2001 that "none can say nuclear energy is absolutely safe".

CASE 5: FIRE AND EXPLOSION AT BITUMINIZATION DEMONSTRATION FACILITY IN 1997

DISASTER OVERVIEW:

The second accident occurred 14months after the first one at Tokai Works of PNC, located in Tokaimura, 140km north of Tokyo.

The facility mixes a low radioactive nuclear wastewater with molten bitumen and evaporates water in a steam-heated extruder at 180_ and pours the molten mixture into steel drums (180 liters) to cool down.

Since the waste contains a high percentage of sodium nitrate, a strong oxidation reagent, and bitumen and other organic chemicals, the mixture is likely to initiate oxidation reaction by itself at high temperature.

Because of the risk, reagents to retard the oxidation reaction were investigated before the process started operation in 1982.

Engineers planned an experiment to reduce a flow rate by 10% then 20%.

Operators from subcontractors observed lowering viscosity of the final mixture, an indication of higher temperature but the thermometer at the exit of the extruder was not working well for years.

When they saw pillars of flame on the drums being cooled down, they splashed water from sprinklers for one minute just enough to extinguish the fire. They reported to the engineers.

No engineer responsible to the operation came to the place before an explosion occurred 10 hours later and a small amount of radioactive materials went out of the building.

Several tens of workers had been scheduled to enter the building 40minutes after the explosion. It was very fortunate that there were no casualties.

This case can be used to caution the students against the following mistakes

a) Incompetent and inexperienced behavior by the engineers (stationed at dirty, difficult, unimportant, and unhealthy working environment),
b) Careless experimental design,
   Negligence in watching and examining the experiment,
c) Dereliction of the engineers' responsibility of checking and controlling workers' safety and the floor after the fire,
d) Some engineers become a kind of managers who do not want to know and do not know what is going on the operating floor.
e) No accident for 15 years made them smug and think the operation is completely safe, although there was a similar accident in Belgium
f) Delay in informing community agencies about the accident.
g) Learning from past experience &
h) Responsibility of managers (ex-engineers) to the public are common to the first and second accidents.

PNC in charge of both operations was reorganized into JNC (Japan Nuclear Cycle Development Corp) because of the two accidents and their poor handling of the situations despite their thirty years of substantial technical achievements.

CASE 6: CRITICALITY ACCIDENT AT JCO IN 1999:

OVERVIEW:

In 1999, a criticality accident at JCO, a subsidiary of Sumitomo Metal Mining Co., astonished the Japanese people and the world at large.

Three workers were refining an enriched (the uranium235 concentration was 18.8%) uranyl nitrate solution for a research fast breeder reactor in Tokaimura, the same village of the second accident.

They were pouring uranyl nitrate solution from a five-liter stainless beaker through a funnel into the sedimentation tank that was installed there (but used for other purpose).

When they poured the fourteenth dose, they saw a blue flash. The total amount of uranium poured was 16.8 kg, seven times larger than the maximum allowable quantity for the tank.

In order to save time, they had changed the process on their own and violated a legal requirement in the operation manuals, which the company had established a few years before.

Three were immediately hospitalized and two later died because of excessive neutron and gamma ray exposure.

The plant equipment had been designed with a critically safe slim geometry such as 117mm in diameter and 3500 mm high (80 liters in volume), which also prohibited efficient operation.

But the roughly spherical sedimentation tank (450mm in diameter, 600mm high and 100 liters in volume) was an exception. This was an "irradiation" accident, not a "contamination" accident.

One hundred and fifty other persons received a radiation exposure, but it was less than a maximum allowable annual dose. This was a special operation for them and, therefore, required some special care.

But no qualified engineers were in charge of the operation and workers were not educated well for the operation and accompanying risks partly because the company was in a difficult financial position, which could not be a reason of the excuse.

This is simply a problem of poor management and management ethics.

This accident teaches students following lessons:

- Poor management. Managements illegally changed the operation manuals and they neither allocated qualified engineers nor educated workers for the operation.
- The management of the operation was so badly controlled that the workers tried to improve efficiency without knowledge and approval of qualified engineers. Trust and good communication between engineers and workers are essential for safety of any operation.
- Even under such a situation, engineers who were not in charge of the operation could have pointed out the danger to the management, when they found them.

Several managers (ex-engineers) including the plant manager were put on trial and JCO closed all the operation due to this accident.

CASE 7: THE NEEMIX CASE STUDY:

Before discussing this case related to rights over property let we have a brief recall about IPR (Intellectual Property Rights).

What Is Intellectual Property?

- In the narrow legal sense, intellectual property is a patented invention, a trade secret, or copyrighted material.
- A patent grants an inventor exclusive rights to an invention for 17 years in exchange for disclosing it to the public. One cannot patent (or copyright) a pure idea, such as a mathematical theorem.
- The invention must be some product or process that embodies an idea. United States law defines it to be a method, product, apparatus, composition of matter, design for articles of commerce, or in certain cases a plant.
- The disclosure must be specific enough to allow a person skilled in the art to recreate and use the invention.

To be patented, the invention must be useful, novel, and unobvious. It is "novel" if

(a) it was not known or used in the United States prior to the patent application,

(b) it was not patented or described in a publication anywhere in the world more than a year prior to the patent application.

The invention is "unobvious" if the idea was not obvious to a person skilled in the art at the time of the invention. One cannot patent a "way of doing business" or anything that occurs in nature.

OVERVIEW:

This interesting case study introduces some of the ethical issues surrounding the patenting of life. The story began when W. R. Grace received a U.S. patent on an insecticide, neemix, derived from the seeds of the neem tree, which occurs naturally in India. Some Indians challenged the patent on the grounds that

(a) neem seeds are natural and belong to everyone, and

(b) neem extracts and their effects are traditional knowledge in Indian culture.

Some of the issues might be untangled as follows.

a) Can one patent a substance that occurs naturally in neem seeds?

No. In fact, Grace did not seek a patent on the seeds themselves or any component of them. They patented a more stable form of the traditional extract. One might argue that their modification was too trivial, and the result too similar to the traditional extracts, to be novel. But this is an issue of fact and law, not ethics. The related ethical issues are stated in the next two paragraphs.

b) Should U.S. patent law award Grace a patent for a neem-based product even if it is not novel?

Current law would in fact award Grace the patent in this case, provided neem extract was unknown in the United States, because the idea had not been patented or published in India.

One might defend this policy on the ground that it grants the two countries symmetrical rights. Companies in each country can (and do) profit from intellectual property that originates in the 9 other. (Grace did not seek and in any event would not be granted a patent in India.) Indian companies, for example, regularly sell unlicensed copies of video tapes from the United States.

Current patent law therefore recognizes international boundaries. An alternative would be to regard the entire world as a single jurisdiction with uniform patent protection everywhere.

A difficulty with this arrangement, however, is that Indians would be unable to patent their traditional knowledge anywhere (because it is not novel), but Americans would be able to copyright the content of their video tapes everywhere (because it is new).

The developed countries gain an unfair advantage because of the nature of their products. This issue must be addressed in any multilateral agreement on intellectual property.

c) What if the product is novel?

New products based on natural substances have traditionally been granted patents without controversy. But one may still raise the next question.

d) Should indigenous people receive royalties from companies that profit, directly or indirectly, from their traditional knowledge?

Note first that this issue is different from the issue of whether Indian folk knowledge should be patented in the United States. If Indians deserve payment for their knowledge, this is the case whether a single company or many companies exploit it in another country.

As for the issue of royalties, one can observe that a subculture within the United States has no rights to royalties from domestic companies that use its traditional knowledge, either directly without modification or indirectly in the form of a patented product.

This is precisely because the knowledge is traditional rather than new. If one accepts this situation, then it is hard to argue that people abroad should have rights to royalties from U.S. companies that use their traditional knowledge.

As a practical matter, it is hard to say exactly to whom royalties would be paid, particularly in view of the fact that past generations should get most of the credit.

There is a deeper argument, however, that goes to the heart of the intellectual property dispute. It asks what sorts of goods should be regarded as property in the first place.

NATURAL DISASTERS

CASE 8: 2004 INDIAN OCEAN EARTHQUAKE AND TSUNAMI

OVERVIEW:

- The 2004 Indian Ocean earthquake was an undersea megathrust earthquake that occurred at 00:58:53 UTC on Sunday, December 26, 2004, with an epicenter off the west coast of Sumatra, Indonesia.
- The quake itself is known by the scientific community as the Sumatra-Andaman earthquake. The resulting tsunami is given various names, including the 2004 Indian Ocean tsunami, South Asian Tsunami, Indonesian Tsunami, and Boxing Day Tsunami.
- The earthquake was caused by subduction and triggered a series of devastating tsunamis along the coasts of most landmasses bordering the Indian Ocean, killing over 230,000 people in fourteen countries, and inundating coastal communities with waves up to 30 meters (98 ft) high.
- It was one of the deadliest natural disasters in recorded history. Indonesia was the hardest hit, followed by Sri Lanka, India, and Thailand.
- With a magnitude of Mw 9.1–9.3, it is the third largest earthquake ever recorded on a seismograph. This earthquake had the longest duration of faulting ever observed, between 8.3 and 10 minutes.
- It caused the entire planet to vibrate as much as 1 centimeter (0.4 inches) and triggered other earthquakes as far away as Alaska. Its epicenter was between Simeulue and mainland Indonesia.
- The plight of the affected people and countries prompted a worldwide humanitarian response. In all, the worldwide community donated more than $14 billion (2004 U.S. dollars) in humanitarian aid.

TECTONIC PLATES

The megathrust earthquake was unusually large in geographical and geological extent. An estimated 1,600 kilometres (1,000 mi) of fault surface slipped (or ruptured) about 15 metres (50 ft) along the subduction zone where the India Plate slides (or subducts) under the overriding Burma Plate.

The slip did not happen instantaneously but took place in two phases over a period of several minutes:

- Seismographic and acoustic data indicate that the first phase involved a rupture about 400 kilometer (250 mi) long and 100 kilometer (60 mi) wide, located 30 kilometers (19 mi) beneath the sea bed—the largest rupture ever known to have been caused by an earthquake. The rupture proceeded at a speed of about 2.8 kilometer per second (1.7 miles per second) (10,000 km/h or 6,200 mph), beginning off the coast of Aceh and proceeding north-westerly over a period of about 100 seconds.

- A pause of about another 100 seconds took place before the rupture continued northwards towards the Andaman and Nicobar Islands. However, the northern rupture occurred more slowly than in the south, at about 2.1 km/s (1.3 mi/s) (7,500 km/h or 4,700 mph), continuing north for another five minutes to a plate boundary where the fault type changes from subduction to strike-slip (the two plates slide past one another in opposite directions).

The India Plate is part of the great Indo-Australian Plate, which underlies the Indian Ocean and Bay of Bengal, and is drifting north-east at an average of 6 centimeter per year (2.4 inches per year).

The India Plate meets the Burma Plate (which is considered a portion of the great Eurasian Plate) at the Sunda Trench. At this point the India Plate subducts beneath the Burma Plate, which carries the Nicobar Islands, the Andaman Islands, and northern Sumatra.

The India Plate sinks deeper and deeper beneath the Burma Plate until the increasing temperature and pressure drive volatiles out of the subducting plate.

These volatiles rise into the overlying plate causing partial melting and the formation of magma.

The rising magma intrudes into the crust above and exits the Earth's crust through volcanoes in the form of a volcanic arc.

The volcanic activity that results as the Indo-Australian Plate subducts the Eurasian Plate has created the Sunda Arc.

As well as the sideways movement between the plates, the sea floor is estimated to have risen by several meter, displacing an estimated 30 cubic kilometer (7.2 cu mi) of water and triggering devastating tsunami waves.

The waves did not originate from a point source, as was inaccurately depicted in some illustrations of their paths of travel, but rather radiated outwards along the entire 1,600-kilometre (1,000 mi) length of the rupture (acting as a line source).

This greatly increased the geographical area over which the waves were observed, reaching as far as Mexico, Chile, and the Arctic.

The raising of the sea floor significantly reduced the capacity of the Indian Ocean, producing a permanent rise in the global sea level by an estimated 0.1 millimeter (0.004 in).

LACK OF WARNING SYSTEMS:

There were no tsunami warning systems in the Indian Ocean to detect tsunamis or to warn the general populace living around the ocean.

Tsunami detection is not easy because while a tsunami is in deep water it has little height and a network of sensors is needed to detect it. Setting up the communications infrastructure to issue timely warnings is an even bigger problem, particularly in a relatively poor part of the world.

Tsunamis are much more frequent in the Pacific Ocean because of earthquakes in the "Ring of Fire", and an effective tsunami warning system has long been in place there.

Although the extreme western edge of the Ring of Fire extends into the Indian Ocean (the point where this earthquake struck), no warning system exists in that ocean.

Tsunamis there are relatively rare despite earthquakes being relatively frequent in Indonesia. The last major tsunami was caused by the Krakatoa eruption of 1883.

It should be noted that not every earthquake produces large tsunamis; on March 28, 2005, a magnitude 8.7 earthquake hit roughly the same area of the Indian Ocean but did not result in a major tsunami.

In the aftermath of the disaster, there is now an awareness of the need for a tsunami warning system for the Indian Ocean.

The United Nations started working on an Indian Ocean Tsunami Warning System and by 2005 had the initial steps in place. Some have even proposed creating a unified global tsunami warning system, to include the Atlantic Ocean and Caribbean.

The first warning sign of a possible tsunami is the earthquake itself. However, tsunami can strike thousands of kilometer away where the earthquake is only felt weakly or not at all.

Also, in the minutes preceding a tsunami strike, the sea often recedes temporarily from the coast.

Around the Indian Ocean, this rare sight reportedly induced people, especially children, to visit the coast to investigate and collect stranded fish on as much as 2.5 km (1.6 mi) of exposed beach, with fatal results.

However, not all tsunami causes this "disappearing sea" effect. In some cases, there are no warning signs at all: the sea will suddenly swell without retreating, surprising many people and giving them little time to flee.

One of the few coastal areas to evacuate ahead of the tsunami was on the Indonesian island of Simeulue, very close to the epicenter.

RECOGNITION OF TSUNAMI WAVES BY PEOPLE:

- On Maikhao beach in northern Phuket, Thailand, a 10-year-old British tourist named Tilly Smith had studied tsunami in geography at school and recognized the warning signs of the receding ocean and frothing bubbles. She and her parents warned others on the beach, which was evacuated safely.
- John Chroston, a biology teacher from Scotland, also recognized the signs at Kamala Bay north of Phuket, taking a busload of vacationers and locals to safety on higher ground.

HUMAN CAUSES FOR DISASTER:

1. The human destruction of coral reefs may have played a role in exacerbating the destruction caused by the tsunami.
2. Many countries across Asia, including Indonesia, Sri Lanka and Bangladesh, have put forth efforts to destroy the coral surrounding their beaches, and instead make way for shrimp farms and other economic choices.
3. Many reefs areas around the Indian Ocean have been destroyed using dynamite because they are considered impediments to shipping, an important part of the South Asian economy.
4. The removal of coastal mangrove trees may have intensified the effect of the tsunami in some locations
5. Another factor, is the removal of coastal sand dunes

The tsunami attack over India on Dec 26, 2005 has many economic, and environmental impacts, including several thousands of lives lost.

SAFETY MEASURES:

- To safeguard, lives and properties from such massive natural disasters, every people, should be aware of the proper use of natural resources.
- Especially, the coastal areas should be well planted with mangrove trees, which act as a barrier against high potential waves.
- The coral reefs, are to be conserved, since they are much valuable to save our most valuable lives.
- Efficient alarming system must be designed to get prior information about the earthquakes occurring at the center of oceans.

CASE 9: TSUNAMI ATTACK ON JAPAN – FUKUSHIMA NUCLEAR REACTOR ACCIDENT:

SOME DATA ABOUT FUKUSHIMA NUCLEAR POWER PLANT:

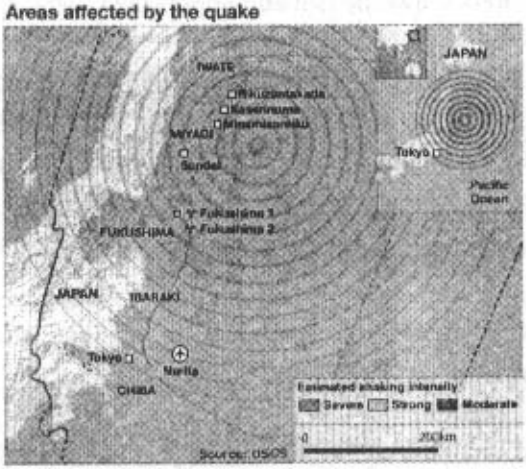
Last month The World Bank estimated the cost of the nuclear crisis at $235bn (£144bn) - making it one of the world's most expensive disasters.

The operators of the plant, Tokyo Electric Power (Tepco), announced record losses of 1.25 trillion yen (£9.5bn) as they struggle with the nuclear crisis still present.

Tepco also announced last month that there is data that would indicate that during the immediate aftermath of the earthquake and tsunami, the fuel rods in three of the reactors had melted.

Although it may be some time after the radiation levels at the Fukushima Daiichi nuclear power plant rose: the severity level changed from five to seven - the same level as Chernobyl in 1986, the Fukushima plant is still being focused on as more information and images appear.

Areas affected by the quake



Fukushima nuclear power plant has been closely scrutinized as reports flow in on the progress of the situation - Japan's nuclear board previously raised the nuclear alert level from four to five in the weeks following the disaster and the JAIF warned of products such as dairy and spinach being restricted for shipping.

Explosions and reports of nuclear fuel rods melting at the power plant have meant progress on the situation has been closely followed as has the environmental effects with concerns for marine life and spreading radiation through seawater.

There were also concerns over radioactive dirt found in a school playground in Fukushima.

"The amount of radiation released by the Fukushima Daiichi nuclear power plant in the days after the 11 March tsunami could have been more than double that originally estimated by its operator, Japan's nuclear safety agency has said.

The revelation has raised fears that the situation at the plant, where fuel in three reactors suffered meltdown, was more serious than government officials have acknowledged.

'IGNORED TSUNAMI WARNING'

Tokyo Electric Power rejected report warning the nuclear plant could be at risk from 10-metre high tsunami.

The Fukushima Daiichi plant as the tsunami approached. Seawater flooded power lines, causing a meltdown in three of the six reactors.

The operator of the Fukushima Daiichi nuclear power plant ignored warnings that the complex was at risk of damage from a tsunami of the size that hit north-east Japan in March, and dismissed the need for better protection against seawater flooding, according to reports.

Tokyo Electric Power (Tepco) officials rejected "unrealistic" estimates made in a 2008 internal report that the plant could be threatened by a tsunami of up to 10.2 meters.

The tsunami that crippled backup power supplies at the plant on the afternoon of 11 March, leading to the meltdown of three reactors, was more than 14 meters high.

Evidence that the utility was unprepared for the tsunami, despite previous warnings, came as the firm announced that the manager of the Fukushima plant, Masao Yoshida, was being treated for an unspecified illness and would leave his post on Thursday.

The accident was triggered when seawater flooded power supply lines, disabling cooling systems and triggering a meltdown in three of Fukushima Daiichi's six reactors.

The 40-year-old plant was built on the assumption that the biggest tsunami that could be expected on the Fukushima coast would be 5.7 meters high. Even at that height, the 2008 report said, water levels onsite could exceed 15 meters.

Kyodo quoted Tepco sources as saying the plant might have been better prepared for the disaster had it taken the report seriously.

Greenpeace, meanwhile, called on Japan not to restart nuclear reactors taken offline for stress tests and maintenance checks until it improves its disaster-response plans. It said simulation maps of potential accidents being used to devise emergency response efforts did not take into account accidents of the severity of the Fukushima disaster.

Greenpeace said Japanese government officials had conceded that the Speedi simulations were inadequate, as they are confined to low-level releases of radiation over a six-mile radius. Contamination from the Fukushima accident has spread over a much wider area.

There is a strong risk of reactor restarts being pushed through without a proper, science-based assessment on the real risks being conducted, and without proper precautions being taken to protect the communities around the plants.

More than 80% of Japan's nuclear reactors will lie idle once Kansai Electric Power suspends operation of a reactor for inspection at a plant in western Japan on Friday. The move will leave all but 10 of the country's 54 reactors out of service.

The danger contamination poses to food supplies was underlined this week when officials in Fukushima confirmed that 9kg of a batch of contaminated rice had been sold to consumers this month. The discovery came soon after they banned shipments of another batch of rice containing excessive levels of radioactive caesium.

The rice, grown at three farms in the town of Date, contained up to 1,050 becquerels of caesium per kg, compared with the government-set upper limit of 500 becquerels.

In response, the government imposed a ban on Tuesday on rice shipments from the area, while local officials said they were trying to trace the consumers.

JAPAN EARTHQUAKE: EXPLOSION AT FUKUSHIMA NUCLEAR PLANT:

A powerful explosion has hit a nuclear power station in north-eastern Japan which was badly damaged in Friday's devastating earthquake and tsunami.

1. A building housing a reactor was destroyed, but authorities said the reactor itself was intact.
2. The government sought to play down fears of a meltdown at the Fukushima 1 plant.
3. But officials later announced the cooling system of a second reactor at the plant had failed.
4. The news sparked fears of a the risk of a further explosion or leak of radioactive material.
5. A huge rescue and relief operation is under way in the region after the earthquake and subsequent tsunami, which are thought to have killed more than 1,000 people.
6. Tokyo Electric Power said four of its workers had been injured in Saturday's blast at Fukushima, 250km (155 miles) north of Tokyo, but that their injuries were not life-threatening.
7. An evacuation zone around the damaged nuclear plant has been extended to 20km (12.4 miles) from 10km, and a state of emergency declared.
8. An estimated 200,000 people have been evacuated from the area, the International Atomic Energy Agency says.

DISCUSSION POINTS:

From the detailed analysis of the case, the following issues exist:

- The nuclear reactor's severity level has been raised from five to seven, like Chernobyl accident.
- The nuclear reactor board has raised the warning level from four to five, after the tsunami hit on Japan at March 2011. but the warning has been discarded by the operator.
- The risk taken while constructing the plant, without analyzing the future risk factors is another issue.
- The nuclear rods, which have been melted when flooded, creates an important issue about, the safety precautions of the nuclear reactor and its components' withstanding capacity.
- The contamination caused by the release of nuclear wastes during the accident.
- Likewise several factors lead to the Fukushima Daiichi nuclear reactor failure, which causes no loss of lives.

APPENDIX-B

SOLVED ANNA UNIVERSITY QUESTION PAPERS

B.E./B.TECH. DEGREE EXAMINATION, MAY/JUNE 2009.

Seventh Semester

Aeronautical Engineering

GE 035 – Professional Ethics

(common to all branches of B.E./B.Tech.)

Time:3hrs Max Marks: 100

PART - A (10 × 2 = 20 Marks)

1. **What are the senses of engineering ethics?**

   There are two different senses (meanings) of engineering ethics:

   - The normative senses
   - The descriptive senses

2. **What are the uses of ethical theories?**

   Ethical theories are useful..

   - In understanding moral dilemmas
   - Justifying professional obligations and ideals
   - Relating ordinary and professional morality

3. **Give a brief account of learning from the past with an example.**

   Engineers normally learn from their own previous designs and infer from the analysis of operation and results, and sometimes from the reports of other engineers. But this does not happen frequently. But many failures have been caused due to the following reasons:

   - The absence of interest,
   - Channels of communication,
   - Ego in not seeking information,
   - Guilty upon the failure,
   - Fear of legal actions, and
   - Mere negligence

e.g.,

(i) The Titanic ship lacked sufficient number of lifeboats—it had only 825 boats for the actual passengers of 2227, the capacity of the ship being3547! In the emergent situation, all the existing life boats could not be launched.

(ii) Forty years back, another steamship Arctic met with same tragedy due to the same problem in the same region. But the lesson was learned at that time.

4. What do you understand by experiment control?

In standard experiments, members for study are selected into two groups namely A and B at random.

Group A are given special treatment. The group B is given no treatment and is called the ***'controlled group'***. But they are placed in the same environment as the other group A. This process is called the experimental control. This practice is adopted in the field of medicine.

5. Distinguish between the attitudes of different types of consumers with regard to safety.

QUANTITATIVE ATTITUDE	QUALITY ATTITUDE	TANGIBLE CHARACTERISTICS	IN - TANGIBLE CHARACTERISTICS
The quantitative attitude of a customer focus on the measure of how much amount of a particular product is safe.	The qualitative refers to the safety of a product which is acceptable only if it has maximum quality, instead of number of items.	It refers to some characteristics which can be seen or felt by the user of the product. It can be measured.	It refers to the characteristics which cannot be seen and have no metrics.

6. What do you understand by acceptable risks?

An Acceptable Risk is one that is freely assumed with informed consent equitably distributed & properly compensated. The risk which is known and judged as acceptable is referred as safety.

7. What is meant by loyalty and collegiality?

Loyalty is the quality of being firm in your decision, support for someone / something. Lovalty is exhibited in two senses as given below:

a) Agency Loyalty

b) Attitude Loyalty

Collegiality is a kind of connectedness grounded in respect for professional expertise and in a commitment to the goals and values of the profession and collegiality includes a disposition to support and cooperate with one's colleagues.

8. What is meant by "Discrimination"?

Discrimination means morally unjustified treatment of people on arbitrary or irrelevant grounds. It involves the actual behaviors towards groups such as excluding or restricting members of one group from opportunities that are available to another group.

"Discriminatory behaviors take many forms, but they all involve some form of exclusion or rejection."

9. What is meant by "Globalization"?

Globalization - means integration of countries through commerce, transfer of technology, and exchange of information and culture. In a way, it includes acting together and interacting economies through trade, investment, loan, development schemes and capital across countries.

10. What is contextualism?

Moral relationalism or moral contextualism: According to this phenomenon, the moral judgments must be made in relation to certain factors, which may vary from case to case.

The morally important factors for making judgments include the customs and laws. The virtue ethicists hold that the practical wisdom should prevail upon assessing the facts and in the judgment.

PART - B (5 × 16 = 80 Marks)

11. (a) (i) What is moral autonomy and relate it to the work in the psychological theory by Lawrence Kohlberg? (8)

Refer Page no: 2.6 -2.8

(ii) What are the models of professional roles and how engineers contribute to it? (8)

Refer Page no: 2.10 – 2.12

Or

(b) (i) Do engineers who work for tobacco companies (for example, in designing cigarette – making machineries) betray their moral integrity, or can they provide adequate moral accounting for their work? (8)

Refer Page no: 1.3 & 3.9-3.10

(ii) Discuss the self interest and ethical egoism. (8)

(Topic Excluded from Syllabus)

12. (a) (i) Compare the contrast Engineering Experiments with standard experiments. (8)

Refer Page no: 3.2 -3.7

(ii) Discuss the problems with law in engineering (8)

Refer Page no: 3.14 -3.15

Or

(b) (i) What are the general features of morally responsible engineers? Explain each with appropriate example. (8)

Refer Page no: 3.7 – 3.10

(ii) Enumerate the conditions that would define valid consent. (8)

Refer Page no: 3.5 - 3.6 & two marks Q.No: 01

13. (a) (i) Explain in detail the effect of information on risk assessments. (8)

Refer Page no: 4.3 - 4.4

(ii) Discuss in detail testing strategies for safety (8)

(Topic Excluded from Syllabus)

Or

(b) (i) Discuss in detail 'Risk – Benefit Analysis' and reducing risk. (8)

Refer Page no: 4.4 - 4.6

(ii) What are the safety lessons we can learn from three mile island and Chernobyl safe exists? (8)

Refer Page no: 15- 16 in CASE STUDY 3

14. (a) (i) How are conflicts of interest solved. (8)

Refer Page no: 4.16 - 4.17

(ii) What are the procedures to be followed for 'whistle blowing'? How can this be avoided? (8)

(Topic Excluded from Syllabus)

Or

(b) (i) Discuss faithful agent and public service arguments. (8)

(Topic Excluded from Syllabus)

(ii) Differentiate copyright from patent. (8)

Refer Page no: 4.23 to 4.24

15. (a) (i) **Explain the role of engineers as managers.** **(8)**

Refer Page no: 5.17 to 5.18

(ii) **Explain environmental ethics.** **(8)**

Refer Page no: 5.6 to 5.10

Or

(b) (i) **Discuss an engineer's involvement in weapons work.** **(8)**

Refer Page no: 5.16 – 5.17

(ii) **Discuss 'morally creative leaders' and participation in professional societies.** **(8)**

Refer Page no: 5.23 to 5.24

B.E., / B.TECH., DEGREE EXAMINATION

NOVEMBER / DECEMBER 2009

Fifth semester - Civil Engineering

GE 1301 – Professional Ethics and Human Values

Time:3hrs Max Marks: 100

PART - A (10 × 2 = 20 Marks)

1. Distinguish sympathy and empathy.

Sympathy and empathy are separate terms with some very important distinctions.

SYMPATHY: The ability to understand and to support the emotional situation or experience of another being with compassion and sensitivity

EMPATHY: The ability to co-experience and relate to the thoughts, emotions, or experience of another without them being communicated directly by the individual

Sympathy and empathy are both acts of feeling, but the difference is as follows:

SYMPATHY	EMPATHY
1. With sympathy you feel for the person; you're sorry for them or pity them,	Empathy can best be described as feeling with the person
2. Sometimes we're left with little choice but to feel sympathetic because we really can't understand the plight or predicament of someone else.	To an extent you are placing yourself in that person's place, have a good sense of what they feel, and understand their feelings to a degree.
3. It takes imagination, work, or possibly a similar experience to get to empathy.	Yet the idea of empathy implies a much more active process.

2. What do you understand by civic virtue?

Civic virtue is the cultivation of habits of personal living that are claimed to be important for the success of the community. The identification of the character traits that constitute civic virtue have been a major concern of political philosophy.

3. Mention the various types of enquiries.

- Normative inquiry,
- Conceptual inquiry, and
- Factual or descriptive inquiry.

4. What are the situations in engineering that lead to moral dilemma?

The three complex situations leading to moral dilemmas are:

1. The problem of vagueness
2. The problem of conflicting reasons
3. The problem of disagreement

5. What do you mean by valid consent?

A valid consent, is the one which fulfills the following four conditions:

- The Consent must be voluntary.
- All relevant information shall be presented / stated in a clearly understandable form.
- Consenter (person who involved in the experiment) shall be capable of processing the information and make rational decisions.
- The subject's consent may be offered in proxy by a group that represents many subjects of like-interests.

6. How minimal compliance influences engineer's liability?

The minimal compliance in terms of agreement about what the engineers are expected to do on their profession, will affect their liability as follows:

- It will reduce the amount of money owed by the company or the organization.
- The engineers are liable, i.e., may cause lot of problems to the company's development.

7. Distinguish between personal risk and public risk

PERSONAL RISK	PUBLIC RISK
The involuntary personal risk is described using the following example "a group residing near the cement plant is exposed to a lot of risk". If suppose a cement plant or refinery was to come up in the area where this group already reside, they will object the proposal.	Assessing the public risk is relatively easy, as in society the cost of disability can be calculated as an average value. To assess the public risk, the loss of assets and the correction costs are estimated.
There are persons who dared to serve people in dire straits (means an urgent or serious, difficult situation), in spite of the risky situations where their lives were in stakes. **For example:** ***Mahatma Gandhi*** served people during **NAVAKALI YATRA,** when dangers were present all over. For such saviors, there was no personal risk.	**For example:** ➢ Loss of reduction in future income or earning capacity due to loss of their capability / physical disability. ➢ Cost associated with an accident, includes the transportation / reinforcement of body parts and medical treatment, etc.,

8. Define Collegiality.

Collegiality is the tendency to support and cooperate with the colleagues. It is a virtue essential for team work to be effective. It consists of various aspects such as:

- Respect to the ideas and work of others.
- Commitment to moral principles.
- Connectedness.

9. State any four international rights.

1. Right of freedom of physical movement of people
2. Right of ownership of properties
3. Freedom from torture
4. Freedom from discrimination on the basis of race or sex.

10. Mention the virtues of expertise.

1. Self-direction (Self-governance) virtues,
2. Public-spirited virtues,
3. Team-work virtues,
4. Proficiency virtues,
5. Cardinal (chief) virtues.

PART - B (5 × 16 = 80 Marks)

11. (a) (i) Describe honesty as a fundamental virtue between engineers employers and clients. **(8)**

Refer Page no: 1.19 – 1.21

(ii) Engineers who work for tobacco betray their moral integrity or can they provide an adequate moral accounting for their work? Justify your answer. **(8)**

Write your own ideas – refer accountability pg no: 3.9 – 3.10

Or

(b) (i) Explain how character influences one's personal and professional life. **(8)**

Refer page no: 1.31 to 1.32

(ii) Write a brief note on service learning. **(8)**

Refer page no: 1.10 to 1.14

12. (a) **Explain the uses of ethical theories and its limitations.**

Refer page no: 2.22 & 2.17

Or

(b) (i) **Describe the various theories of Right actions with examples.** **(8)**

Refer page no: 2.12 – 2.18

(ii) **What do you understand by moral autonomy? Discuss the skills to be acquired by the engineers to become morally autonomous.** **(8)**

Refer page no: 2.6 to 2.7

13. (a) **"On being one's own rabbit" is an essay by J.B. Haldin who conducted many risky medical experiments on his own body. Discuss as a responsible experimenter to what extent such a practice is desirable or not.** **(16)**

Refer Voluntary risk and informed consent (discuss with your own points).

Pg no: 3.5 & 3.5

Or

(b) **Explain the ethical issues involved in the Challenger case study.** **(16)**

Refer page no: 3.23 to 3.27

14. (a) (i) **Discuss the effect of information on assessment of safety and risk.** **(8)**

Refer page no: 4.3 to 4.4.

(ii) **Collegiality is an important virtue of team work – Justify.** **(8)**

(Topic Excluded from Syllabus)

Or

(b) (i) **Describe the various occupational crimes among the professionals.** **(8)**

Refer page no: 4.17- 4.18

(ii) **Write a brief note on Intellectual property rights.** **(8)**

Refer page no: 4.22 - 4.25

15. (a) **Explain the various ethical issues involved in computer science and technology field.** **(16)**

Refer page no: 5.11 to 5.16

Or

(b) **Discuss how the sample code of ethics serves as a model guide for professional conduct.** **(16)**

Refer page no: 5.24 to 5.29

B.E./B.TECH. DEGREE EXAMINATION, APRIL/MAY 2011.

Seventh Semester

Civil Engineering

GE 035 – Professional Ethics

(common to all branches) (Regulation 2001)

Time:3hrs Max Marks: 100

PART - A (10 × 2 = 20 Marks)

1. **Is there a nexus between safety and risk? (Nexus – connection)**
   - Yes. Safety and Risk are closely related to each other.
   - Acceptable level of risk is defined as safety.
   - Safety level when exceeds the threshold value, it becomes risk.
2. **State the differences between labour intensive and capital intensive technologies?**

   Labour intensive technologies concentrate / focus on the employees working in the organization. Its primary focus will be on the safety of the employees, rather increasing the profit.

   Capital intensive technologies focus on the annual turnover of the company / organization itself. Safety is of secondary concern only.
3. **What is meant by appropriate technology?**

   Identification, transfer, and implementation of most suitable technology for a set of new situations, is called appropriate technology.

   Technology includes both hardware (machines and installations) and software (technical, organizational and managerial skills and procedures).

   Factors such as economic, social, and engineering constraints are the causes for the modification of technology.
4. **Mention any 4 international rights listed by Donaldson.**
   - Right of freedom of physical movement of people
   - Right of ownership of properties
   - Freedom from torture
   - Right to fair trial on the products

5. **Give the three features of moral problems which make them complex.**

   - Moral integrity
   - Moral Autonomy
   - Authority

6. **Define moral autonomy.**

   Moral autonomy is defined as, decisions and actions exercised on the basis of moral concern for other people and recognition of good moral reasons. Alternatively, moral autonomy means 'self determinant or independent'.

7. **Define confidentiality**

   Confidentiality means keeping the information on the employer and clients, as secrets. It is one of the important aspects of team work.

8. **What do you mean by external whistle – blowing?**

   External Whistle – Blowing: This happens when the information is transmitted outside the organization. The recipient may be a municipal chairman or member of legislature or minister. It becomes severe if the information reaches the press and through them the public. The damage is maximum and sometimes poses difficulty in remedying the situation.

9. **List the functions of code of ethics.**

   - The code of conduct will help the engineers to have a set of standards of behavior.
   - They act as guidelines for their behavior.
   - It helps to create workplaces where employees are encouraged to make ethical implications.

10. **List out the responsibilities of engineers to society.**

    - Maintaining the ethical standard
    - Social justice, social order, and human rights
    - Protection of the environment
    - Sustainable development
    - Public safety and tranquility

PART - B (5 × 16 = 80 Marks)

11. (a) **Discuss on the different roles played by the codes of ethics set by professional societies.** **(16)**

    Refer page no: 2.10 to 2.12

    Or

    (b) **Give the code of ethics promulgated by Institute of Electrical and Electronics Engineers and discuss.**

    Refer page no: 5.24 – 5.25 (discuss with your own example)

12. (a) (i) **Explain the skills needed to handle problems about moral issues in engineering ethics.** (8)

Refer page no: 2.2 to 2.6

(ii) **Discuss the different models of professional roles.** (8)

Refer page no: 2.10 to 2.12

Or

(b) **What are the main elements included in "Informed consent"? Give the conditions defining valid consent.** (16)

Refer page no: 2.5 to 3.6 & two marks Q.No: 01

13. (a) **Is there any relationship among engineering, Ecology and economics? Discuss.** (16)

Justify with your own points.

Or

(b) **Explain the issues related to computer ethics and Internet with your personal experience.** (16)

Refer page no: 5.11 to 5.16

14. (a) **Explain the concept of collegiality and loyalty.** (16)

(Topic Excluded from Syllabus)

Or

(b) **Write short notes on:**

(i) **Professional rights** (8)

Refer page no: 4.18 to 4.19

(ii) **Employee rights for privacy and choice of outside activities.** (8)

Refer page no: 4.19 -4.21

15. (a) **Explain the role of engineers as responsible experimenters pertaining to Chernobyl nuclear disaster and also discuss the ethical dimensions.** (16)

Refer page no: 13 – 16 in CASE STUDY 3

Or

(b) **Examine the case study pertaining to Bhopal Gas strategy and examine the various ethical perspectives.** (16)

Refer page no: 4.31 to 4.36

B.E./B.TECH. DEGREE EXAMINATION, NOV/DEC 2011.

Seventh Semester

Electronics and Communicaiton Engineering

GE 2025 – Professional Ethics in Engineering

Time:3hrs Max Marks: 100

PART - A (10 × 2 = 20 Marks)

1. State the various approaches to engineering ethics.

There are conventionally two approaches in the study of ethics:

1. Micro-ethics - which deals with decisions and problems of individuals, professional, and companies.
2. Macro-ethics - which deals with the societal problems on a regional/national level.

2. What are conceptual enquiries? Give examples.

Conceptual Inquiries are directed to clarify the meaning of concepts or ideas or principles that are expressed by words or by questions and statements.

Examples:

- What is meant by safety?
- How is it related to risk?
- What is a bribe?
- What is a profession?

3. Briefly explain the two elements of informed consent.

Informed consent is said to have two basic elements:

1. Knowledge
2. Voluntariness

Knowledge: The subject (person who involves in the experiment) should be given all relevant information to make the decision whether to participate in the experiment or not

Voluntariness: Subject should take part in the experiment without force, fraud. Respect for rights of minorities to dissent and compensation for harmful effect are assumed here.

4. What are the limitations of codes of ethics?

- General and vague wordings. Many statements are general in nature and hence unable to solve all problems.

- Not applicable to all situations.
- Often have internal conflicts.
- They cannot be treated as final moral authority for professional conduct. Codes have flaws by commission and omission..
- Only a few enroll as members in professional society and non-members can not be compelled.
- Even as members of the professional society, many are unaware of the codes.
- Different societies have different codes.
- Codes are said to be coercive. They are sometimes claimed to be threatening and forceful.

5. Define safety. What does relative safety express?

Safety has different definitions...

a) A product or project is said to be safe, with respect to a person or a group of individuals, at a given time, if its risks are fully known, and if they are acceptable.

b) Awareness and maintenance of a particular situation is called safety.

Relative safety expresses the phenomena of being safe by reducing the risk factor to a minimum level, when compared to unsafe conditions with maximum level of risk factor.

6. What is meant by risk? State the causes of risk.

- In engineering experimentation every product or project has its own safety limit and risk factor.
- Each product has its risk factor defined within it.
- Risk is objective in some factors and as well as subjective in some perspectives.
- Risk is a potential that something unwanted and harmful may occur. It is the result of an unsafe situation, sometimes unanticipated, during its use.

Causes of risk:

1. Potentially unsafe working condition.
2. Uncontrolled Testing
3. Extent of risk factors.
4. Perception of an individual.

7. Distinguish Authority and power.

AUTHORITY	POWER
In an organization, the authority plays a great role in transferring decisions into actions, efficiently.	In an organization, if someone has power, means, he have a lot of control over people and activities, he has the ability to do a thing.
The authority fixes the personal responsibility and accountability uniquely on each person.	Power literally means the legal right to do something, or to order others to do a thing.

8. What do you meant by conflicts of interest? Give examples.

Conflict of interests is a situation in which two or more interests are not simultaneously realizable. It is the disagreement between public obligation and self-interest of an official.

Examples:

- Insider Trading in an organization
- Collecting Bribe and Gifts to do a work.

9. Write a note on ethical pluralism

The ethical pluralism is a concept which views more than one justifiable moral solution is also adaptable. Since Moral judgments are made in relation to the factors prevailing locally, without framing rigid rules. The judgments should be contextual and in line with the customs of other cultures.

10. Briefly explain the categories of computer ethic problems.

1. Computer may be used as the Instrument of Unethical Acts
2. Computer may be used as the Object of Unethical Act.
   - Hacking,
   - Spreading virus,
   - Health hazard.
3. Problems Related to the Autonomous Nature of Computer.
   - Security risk ,
   - Loss of human lives,
   - In flexible manufacturing systems.

PART - B (5 × 16 = 80 Marks)

11. (a) Explain with examples different types of inquiry.

Refer page no: 2.3 to 2.5

Or

(b) What is meant by Moral autonomy? Discuss the various levels of Kohlberg's theory.

Refer page no: 2.6 to 2.8

12. (a) What are codes of ethics? State and explain the functions of codes of ethics. In what way the engineering societies can promote ethics?

Refer page no: 3.10 – 3.14

Or

(b) What is meant by standardization? Why do industries welcome the concept of standards? Narrate the types, purpose, benefits and the negative aspects of standards.

(Topic Excluded from Syllabus)

13. (a) Define Risk-Benefit Analysis. Discuss the conceptual difficulties, ethical implications of Risk-Benefit Analysis. What are the elements of a risk management programme?

Refer page no: 4.4 to 4.6

Or

(b) What are the safety lessons you have learnt from Bhopal and Chernobyl case studies?

Refer page no: 4.35 – 4.36 & 15-16 in CASE STUDY 3

14. (a) Define Collegiality. State and explain the elements of collegiality. Why is collegiality a virtue? What are the negative aspects of Collegiality?

(Topic Excluded from Syllabus)

Or

(b) What is meant by Loyalty? Explain the sense of loyalty. Is loyalty obligatory? What are the relationship between professional responsibility and loyalty to employees?

(Topic Excluded from Syllabus)

15. (a) Discuss on Engineer's involvement in weapon's development and analyze the problem faced by the Defense industry.

Refer page no: 5.16 – 5.17

Or

(b) What is meant by computer ethics? What is the nature of ethical problem that computers create?

Refer page no: 5.11 to 5.16

B.E./B.Tech DEGREE EXAMINATION, MAY/JUNE 2012.

Seventh Semester

Electronics and Communication Engineering

GE 2025 / GE 606 / 10177 GE 005 – PROFESSIONAL ETHICS IN ENGINEERING

(Common to Fifth Semester – Textile TechnologyTextile Technology (Fashion Technology and Biotechnology))

(Regulation 2008)

Time:3hrs Max Marks: 100

PART - A (10 × 2 = 20 Marks)

1. **Define 'Moral dilemma'.**

   Definition:

   Dilemmas are situations in which moral reasons come into conflict, or in which the application of moral values are problems, and one is not clear of the immediate choice or solution of the problems.

   Moral reasons could be rights, duties, goods or obligations. These situations do not mean that things had gone wrong, but they only indicate the presence of moral complexity. This makes the decision making complex.

2. **What are the chief characteristics of a 'profession'?**

   The characteristics of profession are:

   - Advanced expertise
   - Self regulation
   - Public good.

3. **What are the pros and cons of Industrial Standradization?**

   The Advantages of Standardization

   a. Cost Reduction
      - Scale economies (input and process)
      - Scope economies (synergy, brand equity)

   b. Improved Quality (reliability)
      - Better equipment, more experience

c. Enhanced Customer Preference (no surprises)

d. Global Customers (mobility)

e. Global Segments (convergence)

f. Time to Market

- Centralized R & D

The Drawbacks of Standardization

- Lack of Uniqueness - Is uniqueness an important attribute?
- Vulnerability to Trade Barriers - More barriers, less standardization
- Strong Local Competitors - Can we afford the handicap of standardization?

4. Mention the fudamental underlying principle for each of the ethical theories.

- The theory must be clear and (coherent) formulated with concepts that are logically connected.
- It must be internally consistent, i.e., none of its principles conflicts with any other
- The theory and its defense must depend, only upon facts.
- It must organize basic moral values in systematic and comprehensive manner. It is to fix priority of values and provide guidance in all situations
- It must provide guidance compatible with our moral convictions (judgments) about concrete situations.

5. How are consumers classified on the basis of product usage?

a) Seasonal consumers

b) Personal consumers

c) Organizational consumer

d) Impulse consumers

e) Need based consumers

f) Discount driven consumers

g) Habitual consumers

(a) Seasonal consumers - These are types of consumers who purchase and consume products on seasonal basis.

Examples

- Purchasing umbrellas during the rainy season
- Purchasing cold drinks during the hot seasons
- Going out for holyday during the Christmas season

b) Personal consumers - These types of consumers are individual consumers who purchase goods for the sole purpose of personal, family or household use

Examples

- Going to the supermarket and shopping for goods which are to be used in the house
- Purchasing a car that you intend to use personally

c) Organizational consumer - E.g. an organization may buy raw materials that are aimed at producing other goods which will later be offered for sale to other consumers.

d) Impulse consumers - impulse consumers or buyers are those who make unplanned buying decisions.

e) Need based consumers - Need based consumers are those types of consumers who buy goods and services when they need them and not any other time.

f) Discount driven consumers - Discount driven consumers are types of consumers who are purchase goods and services primarily for the discounts on offer.

g) Habitual consumer - Habitual consumers are those who find it a must or compelling to use certain type of goods whenever they are presented with the opportunity.]

6. **Identify the contarst between 'public risk' and 'personal risk'.**

PUBLIC RISK	PERSONAL RISK
Assessing the public risk is relatively easy, as in society the cost of disability can be calculated as an average value. To assess the public risk, the loss of assets and the correction costs are estimated.	The involuntary personal risk is described using the following example "a group residing near the cement plant is exposed to a lot of risk". If suppose a cement plant or refinery was to come up in the area where this group already reside, they will object the proposal.
For example: ➢ Loss of reduction in future income or earning capacity due to loss of their capability / physical disability. ➢ Cost associated with an accident, includes the transportation / reinforcement of body parts and medical treatment, etc.	There are persons who dared to serve people in dire straits (means an urgent or serious, difficult situation), in spite of the risky situations where their lives were in stakes. **For example:** ***Mahatma Gandhi*** served people during ***NAVAKALI YATRA,*** when dangers were present all over. For such saviors, there was no personal risk.

7. What are 'conflicting interests'?. Give example.

Conflict of interests is a situation in which two or more interests are not simultaneously realizable. It is the disagreement between public obligation and self-interest of an official.

Examples:

- Insider Trading in an organization
- Collecting Bribe and Gifts to do a work.

8. What is reverse discrimination?

When a majority group (white, male, heterosexual, rich etc.) is discriminated against because they are a member of this group this is usually called reverse discrimination.

Some attempts at antidiscrimination have been criticized as reverse discrimination. In particular, minority quotas (for example, affirmative action) discriminate against members of a dominant or majority group.

9. What do you think are the major responsibilities of MNC's towards the host country?

A few principles are enlisted here:

1. MNC should respect the basic human rights of the people of the host countries.
2. The activities of the MNC should give economic and transfer technical benefits, and implement welfare measures of the workers of the host countries.
3. The business practices of the multinational organizations should improve and promote morally justified institutions in the host countries.
4. The multinationals must respect the laws and political set up, besides cultures and promote the cultures of the host countries.
5. The multinational organizations should provide a fair remuneration to the employees of the host countries. If the remuneration is high as that of home country, this may create tensions and if it is too low it will lead to exploitation.
6. Multinational institutions should provide necessary safety for the workers when they are engaged in hazardous activities and 'informed consent' should be obtained from them. Adequate compensation should be paid to them for the additional risks undertaken.

10. Comment on the NSPE code, "Engineers shall perform services only in the areas of their competence".

The NSPE Code III 6 (a) says that the engineers shall not propose or accept a commission on a contingent basis where their judgment may be compromised.

The fee may be either as an agreed amount or a fixed percentage of the savings realized. But in the contingency fee-agreements, the judgment of the consultant may be biased. The consultant may be tempted to specify inferior materials or design methods to cut the construction cost.

This fee may motivate the consultants to effect saving in the costs to the clients, through reasonably moral and technological means.

PART B – (5 × 16 = 80 marks)

11. (a) (i) What are the stages of 'moral development' according to Gilligan? Discuss. (8)

Refer Page no: 2.8 in Section: 2.6 (2)

(ii) Apply bothe Kholberg's theory and Gilligan's theory on Heinz's dilemma and justify your arguments. (8)

Refer Page no: 2.9 – Use Your own example.

Or

(b) (i) Write in brief about Kant's theory. How this was later modified be Rawl? (8)

Refer Page no: 2.13 – 2.21, In Section: 2.9.1 (2) Duty Ethics

(b)(ii) What are the uses of ethical theories? Discuss. (8)

Refer Page no: 2.22, In Section: 2.13

12. (a) Whom do you think should take 'public accountability' for unsafe machines? From the designer to final promoter, identify the roles and responsibilities towards 'safety' and justify your vies through a detailed case study. (16)

Refer Page no: 3.9 -3.10, In Section: 3.2.4 &

Refer Page no: 3.15 -3.27, In Section: 3.5 Challeger Space Shuttle Case Study

Or

(b) What are the roles of codes of ethics? What are its limitations? Give examples. (16)

Refer Page no: 3.12-3.14, In Section: 3.3.6 & 3.3.7

13. (a) (i) **How is fault-tree analysis conducted? Explain with an exapmle.** **(8)**

(Topic Excluded from Syllabus)

(ii) **Depict and analyze Risk-Benefit value function.** **(8)**

Refer Page no: 4.4 – 4.5, In Section: 4.4

Or

(b) **What do you mean by 'transfer of appropriate technology'?. In this context, what lessons were learnt after the tragedy of Bhopal?** **(16)**

Refer Page no:5.3 -5.5

14. (a) (i) **What are the ethical issues associated with 'confidentiality' obligation?** **(8)**

Refer Page no: 4.9 – 4.10, In Section: 4.8

(ii) **How does an engineer acquire authority by expertise? How does it differ from institutional authority?** **(8)**

Refer Page no: 4.7, In Section: 4.6

Or

(b) (i) **Suggest guidelines for ethical whistle blowing.** **(8)**

(Topic Excluded from Syllabus)

(ii) **Write about types of IPRs.** **(8)**

Refer Page no: 4.23 – 4.25, In Section: 4.13.3

15. (a) (i) **What do you think about the notion of 'Human-Centered environmental ethics'? Justify your vies with supporft of ethical theories.** **(8)**

Refer Page no: 5.10, In Section: 5.3.3

(Justify with your own ideas by referring Page no:2.15- Section:2.9.1(3) Rights Theory)

(ii) **What kind of ethical issues arise with usage of computers? Discuss.** **(8)**

Refer Page no: 5.11 – 5.16, In Section: 5.4

Or

(b) (i) **What are the defining features of an ethical corporate climate?** **(8)**

Refer Page no: 5.25 – 5.27, In Section: 5.11.3, 5.11.4, 5.11.5

(ii) **How critical do you think is the role of engineers as 'advisors'?** **(8)**

Refer Page no: 5.22 In Section: 5.9

B.E./B.Tech DEGREE EXAMINATION, NOVEMBER / DECEMBER 2012.

Seventh Semester

Electronics and Communication Engineering

GE 2025 / GE 606 / 10177 GE 005 – PROFESSIONAL ETHICS IN ENGINEERING

(Common to Fifth Semester – Textile TechnologyTextile Technology (Fashion Technology and Biotechnology))

(Also common to Eighth Semester Electronics and Instrumentation Engineering, Instrumentation and Control Engineering, Marine Engineering, Mechanical Engineering and Informational Technology and Computer Science and Engineering)

(Regulation 2008)

(Common to PTGE 2025 – Professional Ethics in Engineering for B.E. (Part-Time)

Seventh Semester – ECE – Regulation 2009)

Time:3hrs Max Marks: 100

PART - A (10 × 2 = 20 Marks)

1. **Mention the situations that will lead to Moral Dilemma**

   The three complex situations leading to moral dilemmas are:

   1. The problem of vagueness
   2. The problem of conflicting reasons
   3. The problem of disagreement

2. **Distinguish 'Self respect' and 'Self esteem'.**

Self-respect	Self-esteem
1. A moral concept	1. A psychological concept
2. Valuing oneself in morally – suitable ways.	2. Having a positive attitude towards oneself. It may be excessive or unwarranted or normal.
3. It includes virtues or recognition and appraisal. It promotes virtues of sense of honor, self – control and courage.	

3. Give any two examples in field of engineering for learning from the past.

- Bhopal Disaster – Methyl Isocyanite Gas Leakage
- Challenger Space Shuttle Failure

4. What are the moral problems in engineering due to minimal compliance?

- Software piracy
- Expense account padding
- Copying of Videos or CD's
- Plagiarism
- Using the copy machine at work

5. Define 'Risk benefit analysis'.

Risk-Benefit analysis is defined as the process to know risks and benefits and weigh them each and decide on designs, advisability of product/project also it suggests and modifies the design so that the risks are eliminated or reduced.

6. Give any two examples of improved safety.

1. An application with inherent safety while designing, e.g., LPG cylinder is provided with a protective frame, the valve handle that avoid the gas leakage.
2. Periodical monitoring (inspection) and testing of safety system to ensure reliability, e.g., Fire extinguishers, 'earth' system in electric circuits are checked periodically.

7. Distinguish 'Institutional authority' and 'Expert authority'.

Institutional Authority	Expert Authority
It is the authority exercised within the organization. It is the right given to the employees... (a) to exercise power, (b) to complete the task and (c) force them to achieve their goals.	On the other hand, the Expert Authority is... (a) the possession of special knowledge, skills and competence to perform a job thoroughly (expertise), (b) the advice on jobs, and (c) is a staff function.
Duties such as resource allocation, policy dissemination, recommendation, supervision, issue orders (empower) or directions on sub-ordinates are vested to institutional authority	It is also known as 'authority of leadership'. These experts direct others in effective manner.
E.g., Line Managers and Project Managers have the institutional duty to make sure that the products/projects are completed successfully.	E.g., advisers, experts, and consultants are engaged in an organization for a specific term.

8. What do you understand by the term 'Kick backs'?

Prearranged payments made by contractors to companies or their representatives in exchange for contracts actually granted are called kickbacks.

9. Define the term 'Appropriate technology'.

Identification, transfer, and implementation of most suitable technology for a set of new situations, is called appropriate technology.

Depending on the availability of resources, physical conditions (such as temperature, humidity, salinity, geographical location, isolated land area, and availability of water), capital opportunity costs, and the human value system (social acceptability) which includes their traditions, beliefs, and religion, the appropriateness is to be determined.

For example, small farmers in our country prefer to own and use the power tillers, rather than the high-powered tractors or sophisticated harvesting machines.

10. Are consultant engineers have greater responsibility in the matters of safety? Why?

Yes. They have greater responsibility in the matters of safety because of the following reasons.

- The greater freedom for the consulting engineers in decision making on safety aspects, and difficulties concerning truthfulness are the matters to be given attention.
- For example, in design-only projects, the consulting engineers may design something and have no role in the construction.
- Sometimes, difficulties may crop-up during construction due to non-availability of suitable materials, some shortcuts in construction, and lack of necessary and adequate supervision and inspection.
- Properly-trained supervision is needed, but may not happen, unless it is provided. Further, the contractor may not understand and / or be willing to modify the original design to serve the clients best.
- A few on-site inspections by the consulting engineers will expose the deficiency in execution and save the workers, the public, and the environment that may be exposed to risk upon completion of the project.

PART B – (5 × 16 =80 marks)

11. (a) (i) What do you understand by moral autonomy? Mention the skills to be possessed by morally autonomous engineer. **(6)**

Refer Page no: 2.6 – 2.7, Section 1.5

(ii) Compare the theories of moral autonomy. **(10)**

Refer Page no: 2.7 - 2.9.

Or

(b) (i) **Discuss in detail the various theories on right action.** **(12)**

Refer Page no: 2.12 -2.18, Section 2.9

(b)(ii) **What are the criteria to be met by an occupation to call it as a profession?** **(4)**

Refer Page no: 2.10 -2.12, Section 2.8

12. (a) **Describe the general features of a morally responsible engineer from the perspective of engineering as social experimentation.**

Refer Page no: 3.7 -3.10, Section 3.2

Or

(b) (i) **Comment on the following "A code only sets the limits beyond which behavior will be condemned and moral level is not high when all or most of those who live under it always act within a hairline of those limits".** **(6)**

Discuss with your own points.

(ii) **How do the functions of standards, regulations and laws differ from one another in their effects on engineering products and practice?** **(10)**

Refer Page no: 3.2 – 3.7, Section 3.1.1

13. (a) **Compare 'Fault tree analysis' and 'Event tree analysis'. Illustrate with suitable example, how safety analysis of a system can be done with fault tree.**

(Topic Excluded from Syllabus)

Or

(b) (i) **Discuss the notion of safety exit, using evacuation plans for communities near nuclear power plant.** **(8)**

Discuss with your own points.

14. (a) **Write a brief note on**

(i) **Occupational crime.** **(8)**

Refer Page no:4.17 - 4.18, Section 4.10

(ii) **Intellectual property rights.** **(8)**

Refer Page no: 4.22- 4.25, Section 4.13

Or

(b) **Discuss the features, guidelines and procedures of whistle blowing?**

(Topic Excluded from Syllabus)

15. (a) **Explain in detail about the ethical conflicts in the field on computer science technology.**

Refer Page no: 5.11- 5.16, Section 5.4

Or

(b) **Discuss in detail, how the sample code would be the moral guide for the professional conduct of engineers.**

Refer Page no: 5.24 - 5.29, Section 5.11

B.E., / B.Tech., DEGREE EXAMINATION, MAY / JUNE 2013

Seventh Semester

Electronics and Communication Engineering

GE 2025 / GE 606 / 10177 Professional Ethics in Engineering

(Reg. 2008)

Time:3hrs Max Marks: 100

PART - A (10 × 2 = 20 Marks)

1. **Define Moral autonomy**

   Moral autonomy is defined as, decisions and actions exercised on the basis of moral concern for other people and recognition of good moral reasons. Alternatively, moral autonomy means 'self determinant or independent'.

2. **List the type of inquiry.**

   The three types of inquiries, in solving ethical problems are:

   - Normative inquiry,
   - Conceptual inquiry, and
   - Factual or descriptive inquiry.

3. **Define Engineering Ethics.**

   Engineering ethics is defined as

   - The Study of the moral issues and decisions confronting individuals and organizations engaged in engineering / profession.
   - The Study of related questions about the moral ideals, character, policies and relationships of people and corporations involved in technological activity.
   - The Moral standards / values and system of morals.

4. **What do you understand by 'a balanced outlook on law'?**

   The 'balanced outlook on law' in engineering practice stresses the necessity of laws and regulations and also their limitations in directing and controlling the engineering practice.

5. **Define safety.**

   In the definition stated by William W. Lawrence safety is defined, as a thing is safe if its risks are acceptable.

   A thing is safe with respect to a given person or group, at a given time, if its risk is fully known, if those risks would be judged acceptable, in light of settled value principles. In the view of objective, safety is a matter of how people would find risks acceptable or unacceptable.

6. What shall be the approach of Government Regulator towards Risk Mitigation?

- Regulators should use comprehensive risk assessment.
- They should identify the degree of risk, i.e., the degree to which issues of public risk are taken into account.
- They should find the accuracy of the cost and risk-benefit analysis.

7. Define the term Collective Bargaining.

It is the bargain by the trade union for improving the economic interests of the worker members. The process includes negotiation, threatening verbally, and declaration of 'strike'.

8. What is 'Intellectual Property Rights'?

IPR is the information and the original expression that derives its original value from creative ideas, and is with a commercial value. IP permits people to have fully independent ownership for their inventions and creativity, like that of own physical property.

9. What is 'Environment Ethics'? Give examples.

Environmental ethics is the study of moral issues concerning the environment, and moral perspectives, beliefs, or attitudes concerning those issues. Engineers in the past are known for their negligence of environment, in their activities.

Examples: e-Waste Disposal, Reducing Global Warming, etc.,

10. How to manage a business process model?

Business process management is a field of management focused on aligning organizations with the wants and needs of clients. It is a "process optimization" process and includes the following steps:

- Process discovery and project scoping
- Process modeling and design
- Business rules engine
- Workflow engine
- Simulation and testing

PART B – (5 × 16 =80 marks)

11. (a) (i) Discuss the Kholberg's theory on moral development. (10)

Refer Page no: 2.7 Section 2.6 (1)

Or

(b) (i) Discuss Gilligan Theory. **(6)**

Refer Page no: 2.8 Section 2.6 (1)

(b)(ii) **What are the uses of Ethical theories.** **(6)**

Refer Page no:2.22, Section 2.13

(b)(iii) **Write on 'Professional Ideals and Virtues'.** **(4)**

Refer Page no:2.19, Section 2.10.1

12. (a) **Explain the importance of Industrial Standards. (16)**

(Topic Excluded from this syllabus)

Or

(b) **What are the Codes of ethics? Discuss its advantages and disadvantages.** **(16)**

Refer Page no: 3.10 and 3.13, Section: 3.3, 3.3.1 and 3.3.7

13. (a) (i) **Discuss the concept of Risk benefit analysis in detail.** **(8)**

Refer Page no: 4.4 – 4.5 .Section :4.4

14. (a)(ii) **Illustrate risk and disaster with suitable example.** **(8)**

Refer Page no: 4.34 – 4.36 .

Or

(b) (i) **Discuss the various measures of assessing and reducing risks. (8)**

Refer Page no: 4.3 – 4.4 .Section :4.3

(b)(ii) **What are the safety measures to be taken in establishing an engineering unit.** **(8)**

(Topic Excluded from this syllabus)

14. (a) (i) **Discuss the significance of Loyalty and Collegiality in team work.** **(8)**

(Topic Excluded from this syllabus)

(a)(ii) **discuss the concept of confidentiality in professional ethics. (8)**

Refer Page no: 4.9 – 4.12 .Section :4.9

Or

(b) **Write short notes on the following:**

(i)Employee Rights (6) Refer Page no: 4.19 – 4.21 .Section :4.12

(ii)Professional Rights (6) Refer Page no: 4.18- 4.19 .Section :4.11

(iii)Occupational Crime (4) Refer Page no: 4.17- 4.18 .Section :4.10

15. (a) (i) Illustrate technology transfer with suitable examples. **(8)**

Refer Page no: 5.3 .Section 5.2.2, 5.2.3, & 5.2.4

(a)(ii) Discuss the issues relevant to computer ethics. **(8)**

Refer Page no: 5.11 .Section 5.4 & 5.4.1

Or

(b) Discuss the following concepts. **(16)**

(i) Business Ethics Refer Page no: 5.1 – 5.4 , Section : 5.2

(ii) Ethical climate Refer Page no:

(iii) Mode of conduct Refer Page no: 5.24 , Describe any one of the Company codes

(iv) Moral Leadership Refer Page no: 5.23 – 5.24, Section :5.10

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2013.

Seventh Semester

Electronics and Communication Engineering

GE 2025 / GE 606 10177 /GE 005 — PROFESSIONAL ETHICS IN ENGINEERING/ PROFESSIONAL ETHICS AND HUMAN VALUES

(Common to Fifth Semester — Textile Technology / Textile Technology (Fashion Technology) and Biotechnology)

(Regulation 2008 / 2010)

(Common to PTGE 2025 — Professional Ethics in Engineering, for B.E. (Part-Time)

Seventh Semester — ECE — Regulation 2009)

Time:3hrs Max Marks: 100

PART - A (10 × 2 = 20 Marks)

1. **Define ethics. Mention some universally accepted standards.**

Ethics is defined as the set of moral principles that govern a person's behavior or the conducting of an activity. It is the branch of knowledge that deals with moral principles. It also refers to rules provided by an external source, e.g., codes of conduct in workplaces or principles in religions.

Some universally accepted standards:

For Mass the standard is Kilogram

For time the standard is Seconds

Standard room temperature is 27degree celcius

2. **Define moral values with suitable examples.**

Moral values are relative values that protect life and are respectful of the dual life value of self and others. The great moral values, such as truth, freedom, charity, etc., have one thing in common. When they are functioning correctly, they are life protecting or life enhancing for all.

3. Define engineering ethics.

Engineering Ethics is the activity and discipline aimed at

(a) understanding the moral values that ought to guide engineering profession or practice,

(b) resolving moral issues in engineering, and

(c) justifying the moral judgments in engineering.

4. What are the senses of engineering ethics?

There are two different senses (meanings) of engineering ethics, namely the Normative and the Descriptive senses.

- The normative sense
- The descriptive sense

5. Define 'Disaster'.

(Man-made) Disaster is defined as a seriously disruptive event causes due to a state of unpreparedness.

A Disaster = A seriously disruptive event + A state of unpreparedness.

6. What is the use-of risk-analysis?

The major uses of the risk-analysis process are:

1) To know risks and benefits and weigh them each
2) To decide on designs, advisability of product/project
3) To suggest and modify the design so that the risks are eliminated or reduced.

7. Define collegiality? What are its elements?

Collegiality is defined as the tendency to support and cooperate with the colleagues. It is a virtue essential for team work to be effective.

It consists of various elements such as:

- Respect to the ideas and work of others.
- Commitment to moral principles.
- Connectedness.

8. List the factors that shape the self confidence in a person.

- Psychological Health,
- Mattering To Others,
- Body Image
- Physical Health.

9. Mention the different types of intellectual property rights.

i) Patents

ii) Copyrights

iii) Trademarks

iv) Trade secrets

10. What is meant by moral leadership?

Moral leadership is not merely the dominance by a group. It means adopting reasonable means to motivate the groups to achieve morally desirable goals. This leadership presents the engineers with many challenges to their moral principles.

PART – B (5 × 16 = 80 marks)

11. (a) (i) Bring out the differences between the Kholberg's theory and Gilligan's theory.

Refer Page no: 2.8 -2.9

(ii) Write short notes on moral autonomy.

Refer Page no: 2.6 -2.7

OR

(b) (i) Explain the types of inquiry in detail.

Refer Page no: 2.3 -2.4

(ii) Mention the different types of ethical theories. What are its uses?

Refer Page no: 2.13, 2.15, 2.16 for theory definitions and

Refer Page no: 2.11 for its uses

12. (a) (i) Why engineering projects are viewed as experiments?

Refer Page no: 3.1 -3.7

(ii) Enumerate the codes of ethics of engineers.

Refer Page no: 3.10 -3.14

OR

(b) (i) Explain the ethical issues involved in the Challenger mission – Case study.

Refer Page no: 3.23 -3.26

(ii) Explain Work ethics in detail.

Refer Page no: 1.5 -1.10

13. (a) (i) Define the terms 'risk' and 'safety'. How will an engineer assess the safety?

Refer Page no: 4.1, 4.2 for definitions and 4.3 -4.4

(ii) What are factors that affect risk acceptability? What is the use of knowledge at risk acceptance of engineers?

Refer Page no: 4.2 (Briefly explain each points)

OR

(b) Define risk benefit analysis. Why is it conducted? What are the limitations of risk benefit analysis?

Refer Page no: 4.4 -4.5

14. (a) (i) Write short notes on Occupational crime.

Refer Page no: 4.17 -4.18

(ii) Distinguish between Employee rights and Professional rights.

Refer Page no: 4.18 -4.21

OR

(b) Discuss the significance of Intellectual Property Rights. Also explain the legislations covering IPR in India.

Refer Page no: 4.22 -4.25

15. (a) What is environmental ethics? Why is it important to study? Discuss any environmental issues in ethical point of view to engineers.

Refer Page no: 5.6 -5.10

OR

(b) Define Computer Ethics. What are the issues in Computer ethics?

Refer Page no: 5.11-5.16

B.E./B.Tech. DEGREE EXAMINATION, APRIL 2014

Seventh Semester

Electronics and Communication Engineering

GE 2025 / GE 606 /10177—

PROFESSIONAL ETHICS AND HUMAN VALUES

(Regulation 2008)

Time:3hrs Max Marks: 100

PART - A (10 × 2 = 20 Marks)

1. **Define work ethic**

   Work ethic is a value based on hard work and diligence. It is also a belief in the moral benefit of work and its ability to enhance character.

2. **How character and values are related?**

   Character deals with how people think and behave related to issues such as right and wrong, justice and equity, and other areas of human conduct.

   Values describe individual or personal standards (character) of what is valuable or important.

3. **When Dilemma occupies a center stage in an individual's society?**

   When an individual meets situations in which moral reasons come into conflict, or in which the application of moral values are problems, and one is not clear of the immediate choice or solution of the problems Dilemma plays a center stage role.

4. **Give two examples of customs followed in your area.**

   - Worshipping cow – in the name of "Co-Pooja"
   - Providing food for the poor people in temples in the name of "Annadhanam".

5. **Write any two reasons that prevented safe exit of passengers and crew of the titanic ship.**

   Reason 1: The Titanic ship lacked sufficient number of lifeboats.

   It had only 8anic25 boats for the actual passengers of 2227, the capacity of the ship being3547! In the emergent situation, all the existing life boats could not be launched.

   Reason 2: Bad adverse cold weather condition of the ocean.

6. **What is 'learning from the past'?**

   Engineers normally learn from their own previous designs and infer from the analysis of operation and results, and sometimes from the reports of other engineers. But this does not happen frequently. But many failures have been caused due to the following reasons:

- The absence of interest,
- Channels of communication,
- Ego in not seeking information,
- Guilty upon the failure,
- Fear of legal actions, and
- Mere negligence

7. What is agency loyalty?

Agency Loyalty: It is an obligation to fulfill his/ her duties to the employer. The duties are specific actions assigned to an individual, and in general it refers to the act of cooperating with others, in the organization. It consists of several obligations to the employers. But for the engineers, the paramount obligation is still " the safety, health and welfare of the public".

8. What is the prime objective of Intellectual Property Rights legislation?

IPR plays an essential role to stabilize and develop the economy of a nation. This protection actually stimulates creativity, research, and innovation by ensuring freedom to individuals and organizations to benefit from their creative intellectual investments.

9. Name any two mean by global issues.

a) Weapons development

b) Cyber ethics.

10. Name any two weapons of mass destruction.

- A rocket having a propellant charge of more than four ounces,
- A missile having an explosive
- Land mine.

PART B — (5 × 16 =80 marks)

11. (a) Explain with suitable examples the need of courage in maintaining honesty and character.

Refer Page no: 1.20, 1.23 & 1.31(Write own Examples)

OR

(b) Explain with suitable examples 'how respect for other religious beliefs' enhances the peaceful living.

Refer page no: 1.14 – 1.18

12. (a) **Why 'Integrity' should be maintained in private and professional responsibilities? Explain with suitable examples.**

Refer page no: 1.3 – 1.5 (Write own Examples)

OR

(b) **Explain the need of tolerance for different customs and ethical pluralism in a diverse society with suitable examples.**

Refer Page no: 2.10 -2.21

13. (a) **Explain briefly four cases where, plain neglect to learn from the past mistakes lead to repetition of accidents / mistakes.**

Refer CASE STUDY 1,2,3 & 4

OR

(b) **Explain the responsibilities of engineers to society.**

Refer Page no: 3.7 – 3.10

14. (a) **Explain the concept of safety. How the same differs with standard of living of countries.**

Refer Page no: 4.1 – 4.2

OR

(b) **Explain with case studies, where the employers expose their employees to safety hazards.**

Refer Page no:1-10 in CASE STUDY 1

15. (a) **Explain the basic concepts of environmental ethics through case studies.**

Refer Page no: 5.6 – 5.8 (Choose any nuclear plant disaster case study)

OR

(b) **Explain the moral obligations of an engineer as per the code of ethics.**

Refer Page no: 5.26 – 5.29

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER / DECEMBER 2014

Seventh Semester

Electronics and Communication Engineering

GE 2025 / GE 606 /10177 GE 005 / 10144 CSE 59— PROFESSIONAL ETHICS IN ENGINEERING / PROFESSIONAL ETHICS AND HUMAN VALUES

(Regulation 2008 / 2010)

Time:3hrs Max Marks: 100

PART - A (10 × 2 = 20 Marks)

1. **Define moral autonomy.**

   Moral autonomy is defined as, decisions and actions exercised on the basis of moral concern for other people and recognition of good moral reasons. Alternatively, moral autonomy means 'self determinant or independent'.

2. **What are the models of professional roles?**

   - Savior
   - Guardian
   - Bureaucratic Servant
   - Social Servant
   - Social Enabler and Catalyst
   - Game Player

3. **What are the limitations of code of ethics?**

   - Codes are restricted to general and vague wording.
   - Codes can't give a solution or method for solving the internal conflicts.
   - Codes cannot serve as the final moral authority for professional conduct.
   - Codes can be reproduced in a very rapid manner.

4. **What are the features of engineering experimentation?**

   a. Conscientiousness

   b. Comprehensive Perspective

   c. Moral Autonomy

   d. Accountability

5. Define the term Risk.

A risk is the potential that something unwanted and harmful may occur. Risk is the possibility of suffering harm or loss. It is also defined as the probability of a specified level of hazardous consequences, being realized. Hence Risk (R) is the product of Probability (P) and consequence(C)

(i.e) $R = P * C$

6. List the methods that can be applied when testing is inappropriate.

When testing is inappropriate, 'Safe Exit' is to be adopted. The conditions referred to as safe exit are:

a) The product when it fails, should fail safely.

b) The product when it fails, can be abandoned safely.

c) The user can safely escape the product.

7. What is the difference between bribe and gift?

BRIBE	GIFT
A Bribe is a substantial amount of money or goods offered beyond a stated business contract with the aim of winning an advantage in gaining or keeping the contract.	Gifts are not bribes as long as they are small gratuities offered in the normal conduct of business.

8. What does whistle blowing mean?

Whistle blowing is defined as conveying information by an employee, on an important problem to somebody in a position to take action on the problem. Further this id done outside the approved organizational channels.

9. What are the International rights listed by Donaldson?

- Freedom of physical movement
- Ownership of property
- Freedom from torture
- Fair trial
- Non-discrimination
- Physical security
- Freedom of speech and association
- Minimal education
- Political participation
- Subsistence

10. Explain the meaning of 'Moral Leadership'.

Moral leadership is not merely the dominance by a group. It means adopting reasonable means to motivate the groups to achieve morally desirable goals. This leadership presents the engineers with many challenges to their moral principles.

PART B — (5 × 16 =80 marks)

11. (a) (i) How did Gilligan view the three levels of moral development initiated by Kholberg? (12)

Refer Page no: 2.8 – 2.9

(ii) Discuss three types of inquiry. (4)

Refer Page no: 2.3 – 2.4

OR

(b) (i) Discuss the different models of professional roles. (8)

Refer Page no: 2.10

(ii) Explain the skills needed to handle problems about moral issues in engineering ethics. (8)

Refer Page no: 2.2 – 2.4

12. (a) (i) Discuss on the roles played by the codes of ethics set by professional societies. (10)

Refer Page no: 3.12 – 3.13

(ii) Compare and contrast engineering experiments with standard experiments. (6)

Refer Page no: 3.2 – 3.7

OR

(b) (i) Explain in detail the Challenger accident. What are the ethical problems involved in this? (12)

Refer Page no: 3.15 – 3.17 & 3.23 – 3.26

(ii) Discuss Research Ethics. (4)

RESEARCH ETHICS

Research ethics involves the application of fundamental ethical principles to a variety of topics involving scientific research.

These include,

- The design and implementation of research involving human experimentation,

- Animal experimentation,
- Various aspects of academic scandal,
- Including scientific misconduct (such as fraud, fabrication of data),
- Whistle blowing; regulation of research, etc.

Research ethics is most developed as a concept in medical research. The Nuremberg Code is a former agreement, but with many still important notes. Research in the social sciences presents a different set of issues than those in medical research.

There are many ethical issues to be taken into serious consideration for research. Sociologists need to be aware of having the responsibility to secure the actual permission and interests of all those involved in the study. They should not misuse any of the information discovered, and there should be a certain moral responsibility maintained towards the participants. There is a duty to protect the rights of people in the study as well as their privacy and sensitivity. The confidentiality of those involved in the observation must be carried out, keeping their anonymity and privacy secure. As pointed out in the BSA for Sociology, all of these ethics must be honored unless there are other overriding reasons to do so - for example, any illegal or terrorist activity.

Ethical Standards

The researchers should, do the following as per the standard of research ethics,

1. Avoid any risk of considerably harming people, the environment, or property unnecessarily. The Tuskegee Syphilis Study is an example of a study which seriously violated these standards.
2. Obtain informed consent from all involved in the study.
3. Preserve privacy and confidentiality whenever possible.
4. Take special precautions when involving populations or animals which may not be considered to understand fully the purpose of the study.
5. Not offer big rewards or enforce binding contracts for the study. This is especially important when people are somehow reliant on the reward.
6. Not skew their conclusions based on funding.
7. Not commit science fraud, falsify research or otherwise conduct scientific misconduct. A con-study, which devastated the public view of the subject for decades, was the study of selling more coke and popcorn by unconscious ads.
8. The researcher said that he had found great effects from subliminal messages, whilst he had, in fact, never conducted the experiment.
9. Not use the position as a peer reviewer to give sham peer reviews to punish or damage fellow scientists.

Basically, research must follow all regulations given, and also anticipate possible ethical problems in their research. Competition is an important factor in research, and may be both a good thing and a bad thing. Whistle blowing is one mechanism to help discover misconduct in research.

What Is Ethics In Research & Why Is It Important?

Most people learn ethical norms at home, at school, in church, or in other social settings. Although most people acquire their sense of right and wrong during childhood, moral development occurs throughout life and human beings pass through different stages of growth as they mature. Ethical norms are so ubiquitous that one might be tempted to regard them as simple commonsense. On the other hand, if morality were nothing more than commonsense, then why are there so many ethical disputes and issues in our society?

Most societies also have legal rules that govern behavior, but ethical norms tend to be broader and more informal than laws. Although most societies use laws to enforce widely accepted moral standards and ethical and legal rules use similar concepts, it is important to remember that ethics and law are not the same. An action may be legal but unethical or illegal but ethical. We can also use ethical concepts and principles to criticize, evaluate, propose, or interpret laws. Indeed, in the last century.

Many social reformers urged citizens to disobey laws in order to protest what they regarded as immoral or unjust laws. Peaceful civil disobedience is an ethical way of expressing political viewpoints. Another way of defining 'ethics' focuses on the disciplines that study standards of conduct, such as philosophy, theology, law, psychology, or sociology.

For example, a "medical ethicist" is someone who studies ethical standards in medicine. One may also define ethics as a method, procedure, or perspective for deciding how to act and for analyzing complex problems and issues.

For instance, in considering a complex issue like global warming, one may take an economic, ecological, political, or ethical perspective on the problem

13. (a) (i) Discuss the concept in risk-benefit analysis. **(8)**

Refer Page no: 4.4 – 4.5

(ii) Explain in detail the effect of information on risk assessment with an example. **(8)**

Refer Page no: 4.3 – 4.4

OR

(b) Discuss the concept of safety exits in Chernobyl Case studies. **(16)**

Refer Page no: 13- 16 in CASE STUDY 3

14. (a) (i) **What is Intellectual Property Rights? Explain various elements of IPR in detail.** **(10)**

Refer Page no: 4.22 – 4.25

(ii) Discuss human rights and professional rights in an engineering field. (6)

HUMAN RIGHTS

Human rights are defined as moral entitlements that place obligations on other people to treat one with dignity and respect. Organizations and engineers are to be familiar with the minimum provisions under the human rights, so that the engineers and organizations for a firm base for understanding and productivity. Provisions under 'human rights' are as follows:

- Right to pursue legitimate personal interest
- Right to make a living
- Right to privacy
- Right to property
- Right to non-discrimination
- No sexual harassment

PROFESSIONAL RIGHTS - Refer Page no: 4.18 – 4.19

OR

(b) (i) **Define Collective Bargaining. Explain the role of collective bargaining in workplace rights and responsibilities.** **(12)**

COLLECTIVE BARGAINING

It is the bargain by the trade union for improving the economic interests of the worker members. The process includes negotiation, threatening verbally, and declaration of 'strike'.

It is impossible to endorse fully the collective bargaining of unions or to condemn. There exist always conflicting views between the professionalism and unionism.

a. Faithful Agent or Trustee?

Professional societies such as NSPE and IEI refuse to accept the 'collective coercive action' of unionism, holding the principles of professional integrity as right.

E.g., as per NSPE code III, i.e., engineers shall not promote their own interest at the expense of the dignity and integrity of the profession.

The engineers are said to exhibit a higher standard than self – interest, and they are expected to perform an ethical duty to their employer as faithful agent or trustee.

It is concluded, that:

- The duty of the employee to his employer means not sacrificing their self – interest.
- Trustee or faithful agents mean completing the assigned tasks properly, and maintaining safety.
- On the other hand, the employee has the right to negotiate for safe and hygienic work conditions.

An employee has also the right to disobey, illegal or unethical activities.

b. Service To The Public

- Servicing the public is the most important thing, but most of the unions doesn't consider the public welfare.
- Eg., if the doctors, teachers, go on strike means, then the entire society will get affected by this.
- Collective bargaining by engineers through unions or associations, should act with public concerns. Professional societies play an important role in the promotion and establishment of principles and practices towards, public welfare.
- The collective bargaining cannot be judged as an unethical activity, it is acceptable, but the reasons should be constructive, based on mutual understanding between the people and the organization.
- It should not be a destructive and harming one to the people lives and property.

c. Assessment On Unionism

The moral assessment on unions is a complex process. All relevant moral facts are to be considered, inquired, and judged. Unionism has different views, hence it cannot be generalized. The supporting and anti view of unionism are summarized in the following table.

Pro- and anti-views on unionism

For Unionism	Against Unionism
1. Unions have been useful in improving the standard of living and economic benefits of the workers. Even non – union members leading to inflationary condition are able to get those benefits.	2. Unions have lead to disturb the economy of state of salaries, and increases salaries and expenses, leading to inflationary conditions.

2. Unions have obtained greater participation in organization by participative management. Union members are appointed as Directors in the Board and credited to act as bridge between the employers and employees.	2. Instead of being cooperative they act in negative and destructive ways, causing loss of man-days. Opinions of the individual workers is suppressed and used as pawns.
3. Unions have contributed to the job security, and protection against arbitrary treatment to the employees.	3. Unions encourage mediocrity and act in favor of seniority based promotion. Merit-based promotion and awards for personal achievement are disregarded.
4. They are able to put resistance to unethical orders and supports to ethical actions.	4. Union thrive on prolonged unrest, dissatisfied, and tense relations between workers and management.
5. They have provided for effective grievance redressal mechanism for employees.	5. They cause pigeon-holding of employee in narrow job classification to which the salary scales are attached.

(ii) Discuss on collegiality and loyalty. (4)

COLLEGIALITY

Collegiality is the tendency to support and cooperate with the colleagues. It is a virtue essential for team work to be effective. It consists of various aspects such as:

- Respect to the ideas and work of others.
- Commitment to moral principles.
- Connectedness.

Respect to the ideas and work of others: This results in support and cooperation with one's colleagues. It is mutually beneficial, so that he can get support and cooperation from others also.

Commitment to moral principles: Commitment is towards moral decisions, actions, goals of the organization and values of the profession.

Connectedness: It means the shared commitment and mutual understanding. It ensures the absence of egoism and paves way for progress for both.

LOYALTY

Loyalty is exhibited in two senses as given below:

- Agency Loyalty
- Attitude Loyalty

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