1. Briefly explain the three main levels of Moral developments, developed by Laurence-Kohlberg.

Moral Autonomy is based on the psychology of moral developments. The first psychological theory was developed by Jean Piaget. On the basis of Piaget’s theory, Laurence-Kohlberg developed three main levels of moral development. which is based on the kinds of reasoning and motivation adopted by individuals with regard to moral questions.

1. The preconventional level

It is nothing but self-centered attitude. In this level, right conduct is very essential for an individual which directly benefits him.

According to this level, individuals are motivated by their willingness to avoid punishment, or by their desire to safety their own needs or by the influence of the power exerted by them. This level is related to the moral development of children and some adults who never want to grow beyond a certain limit.

2. The conventional level.

The level deals with the respect for conventional rules and authority. As per this level the rules and norms of one’s family or group or society has been accepted as the final standard of morality. These conventions are regarded as correct, because they represent with authority.

When individuals are under this level, they always want to please/satisfy others and also to meet the expectations of the society and not their self-interest. Loyalty and close identification with others have been given much importance, No adult tries to go beyond this level.
3. The post conventional level.

This level is said to be attained when an individual recognizes the right and the wrong on the basis of a set of principles which are not based on self-interest or social conventions. These individuals are called ‘autonomous’, because they only think by themselves and also they do not agree that customs are always correct.

They want to live by general principles which are universally applied to all people. They always want to maintain their moral integrity, self-respect and the respect for other autonomous people.

Kohlberg’s theory of moral development is very much related to the goals of studying ethics at college level. Moral responsibility comes out of the foundation of early moral training given by an individual’s parents and culture. This early training helps to complete the above said three levels of moral development by an individual.

2. How did Gilligun recast Kohlberg levels of moral developments? (OR) How did Gilligan view the three levels of moral developments initiated by Kohlberg?

1. GILLIGAN’S ARGUMENT.

Carol Gilligan was one of the students of Kohlberg. She criticizes Kohlberg’s theory on the basis of approached made by both male and female towards morality. On the basis of her studies and researches, she criticizes Kohlberg’s theory which is only based on bale bias and his studies are typically male preoccupation with general rules and rights.

She also suggests that men are always more interested in resolving moral problem by applying some most important moral rules. But women always want to keep up the personal relationship with all those involved in a situation and they always give attention only on the circumstances responsible for that critical situation and not on general moral rules.

She also states the Kohlberg theory is only an ethics of rules and rights. But her theory is known as ethics of care.i.e. context oriented emphasis required to maintain the personal relationship.
2. LEVELS OF MORAL DEVELOPMENT

Gilligan recasts Kohlberg’s three levels of moral developments on the basis of her own studies of women, as follows:

i) The pre-conventional level:

This is more or less the same as Kohlberg’s first level i.e. Right conduct is a selfish thing as only what is good for oneself.

ii) The conventional level:

This level differs from Kohlberg’s second level. According to her, women don’t want to hurt others and want to help others i.e., women always want to give up their interests in order to help the others to fulfill their needs.

iii) The post conventional level:

This level is also differed from Kohlberg’s level. In this level, individuals (particularly women) want to balance between caring about other people and their own interests.

The main aim here is to balance an individual’s needs with those of others on the basis of mutual caring. This can be achieved only through context-oriented reasoning and not by abstract rules.

3. HEINZ’S DILEMMA:

Gilligan’s criticism on the Kohlberg’s theory can be made very clear with the help of a famous example used by Kohlberg in his questionnaires and interview. This is called Heinz’s dilemma

- This example was about a woman and Heinz, her husband, living in Europe.
- The woman was affected by cancer. The doctors told her to use an expensive drug to save her life.
- The pharmacist who also invented that medicine charged ten times the cost of making the drug.
In spite of his poverty, Heinz took a lot of effort to borrow money, but he could get only half of the amount needed.

He approached to the pharmacist and begged him to sell the medicine at a cheaper price or allow him to pay or it later.

But the pharmacist refused to do so. Finally without any hope, Heinz forcibly entered into the pharmacy and stole the drug.

The question here is “Was the theft morally right or wrong?

By asking this question among the males, Kohlberg has received two sets of answers:

One is based on the conventional level i.e. Heinz did a wrong thing. Another one is based on the post conventional level i.e. Heinz was correct as the life of the wife is more important than the property right of the pharmacist.

But when the same question was asked among the women, they gave (all women) same answer. They replied that Heinz was wrong. They told that instead of theft the medicine, Heinz could have tried alternative solutions. They also told that Heinz should have convinced the pharmacist to give the medicine.

From the above, Kohlberg concluded that women’s decisions are always based on the conventional rule and also they have different opinions in applying the general moral rules and principles about the right to live.

On the basis of the Kohlberg’s comment on the women, Gilligan came to a different conclusion. She tells that is shows greater sensitivity to people and personal relationships. She concluded that the decision taken by women by women is context-oriented and not on the basis of general rules ranked in order of priority.
3. What are the general types of Inquiries involved in engineering inspection? Give details.

Inquiry means an investigation. Like general ethics, engineering ethics also involves investigation into values, meaning and facts.

These inquiries in the field of engineering ethics are of three types, they are

1. Normative inquiries
2. Conceptual inquiries
3. Factual or Descriptive inquiries

1. NORMATIVE INQUIRIES:

These inquiries are mostly helpful to identify the values which guide the individuals and groups in taking a decision. These are meant for identifying and justifying some norms and standards of morally desirable nature for guiding individuals as well as groups.

In most of the cases, the normative questions are: what should be? And what is good?

Some types of questions are given below:

1. How do the obligations of engineers protect the public safety in given situations?
2. When should an engineer have to alarm their employers on dangerous practices?
3. What are the laws and organizational procedures that affect engineering practice on moral issues?
4. What are the moral rights essential for engineers to fulfill their professional obligations?

From the above questions, the normative inquiries also have the theoretical goal of justifying moral judgments.

2. Conceptual inquiries:
These are meant for describing the meaning of concepts, principles and issues related to Engineering Ethics. These inquiries also explain whether the concepts and ideas are expressed by single word or by phrases.

The following are some of the questions of conceptual inquiries.

1. What is safety and how is it related to risk?
2. What does it mean when codes of ethics say engineers should protect the safety, health and welfare of the public?
3. What is a ‘bribe’?
4. What is ‘Profession’ and ‘Professional’?

3. FACTUAL/DESCRIPTIVE INQUIRIES:

These help to provide facts for understanding and finding solutions to value based issues. The engineer has to conduct factual inquiries by using scientific techniques. These help to provide information regarding the business realities such as engineering practice, history of engineering profession, the effectiveness of professional societies in imposing moral conduct, the procedures to be adopted when assessing risks and psychological profiles of engineers.

The information about these facts provides understanding and background conditions which create moral problems. These facts are also helpful in solving moral problems by using alternative ways of solutions.

These types of inquiries are said to be complementary and interrelated. Suppose an engineer wants to tell a wrong thing in an engineering practice to his superiors, he has to make all these inquiries and prepare an analysis about the problem on the basis of moral values and issues attached to that wrong thing. The only he can convince his superior. Otherwise his judgment may be neglected or rejected by his superior.
4. Enumerate the steps to resolve problems of disagreement in solving moral problems in engineering companies.

i) Why study engineering ethics?

Engineering ethics is not only teaching moral behavior in knowing about immoral and moral in a set of beliefs, but also increasing the ability of engineers and other professional to face boldly the moral problems arising from technological advancements, changes and other related activities. This can be imparted among the engineers, only through college courses, seminars, etc., which involve individual study.

ii) Moral dilemmas:

Dilemmas are certain kind of situations in which a difficult choice has to be made.

Moral dilemmas can also be called moral problems. Moral dilemmas have two or more conflicting moral obligations, duties, rights, goods, or ideals come into disagreement with each other. One moral principle can have two or more conflicting applications for a particular given situation.

Moral dilemmas can occur in so many ways. For example, suppose one gives a promise to his friend that he will meet him on the evening of a particular day, but unfortunately on the same day his brother has met with an accident and he has to take him to hospital.

The dilemma here consists of a conflict, between the duty to keep the promise and the obligations to his brother. In this situation, to solve this moral problem, he can make a phone call to his friend and make apology for his inability to come. So, from the above it is clear that the duty to keep promises always has two different conflicting applications.

The moral dilemmas cannot easily be addressed or resolved always. It requires an elaborate searching which sometimes causing extreme suffering and reflection of a situation. The modern engineering practice compels that all the engineers have to face boldly the moral dilemmas in their careers.

To find a simple and clear solution to the moral problems in the field of engineering there must be some provision to allocate time for learning ethics in engineering course. But at the
same time, it should not be ignored in the following three categories of complex and gloomy moral situations:

i) The problem of Vagueness:

The problem of Vagueness is related to individuals. The individuals may not know how to use moral considerations or principles in resolving a moral problem at a particular situation.

For example, an engineer in a higher position of a company, is responsible and having sole right to make purchase on his own on behalf of the company. There may be many suppliers for supplying materials.

In this situation, a sales representative from one of the suppliers approaches him with a gift. In this case, the engineer may have some doubts like i) whether this is an acceptance of a bribe? ii) Does it create a conflict of interest? The solution is only with that engineer.

He can also discuss with his colleagues about the problem. The colleague may find the solution on the basis of previous experiences; it may not be a kind of a bribe, but at the same time it should not be encouraged in future because there is the possibility of supplying substandard materials. It is difficult to arrive at the conclusion whether the gift is an innocent amenity or an unacceptable bribe.

ii) The problem of conflicting reasons:

These occur more frequently. In a difficult situation of a moral problem, an individual may clearly know about what moral principles has to be applied to resolve the problem. When it arises, there are two or more moral principles with clear solutions in conflict with one another or one particular moral principle.

Simultaneously, there can be of two different directions. In this case, that individual has to choose a better one among them on the basis of the importance and the applicability.

For example, an engineer has given a promise to his employer and another one to a colleague. If it is difficult to fulfill both the promises, he can drop off one promise which is of the least importance. If he explains the situation to his colleagues, it can be understood.
iii) The problem of disagreement:

The individuals and groups in engineering companies may disagree with resolving moral problems in difficult situations. The disagreement will be normally about how to interpret, apply and balance the moral problems. In this situation they have to use the following steps to resolve the problems.

**STEPS IN FACING MORAL DILEMMAS:**

All the above said three problems pave the way for the need of several steps in resolving the moral dilemmas. All the steps are interrelated and they can also be used jointly.

1) Identifying the relevant moral factors and reasons: i.e., Finding solutions for i) the conflicting responsibilities ii) the competing rights and iii) the clashing ideals involved.

2) Collecting and gathering all the available facts which are relevant to the moral factors while resolving.

3) Ranking the moral considerations or principles on the basis of importance as applicable to the situation.

4) Considering alternative courses of action for resolving the problems and tracing the full implications of each i.e., conducting factual inquiries.

5) Having talked with the colleagues, friends about that problem getting their suggestions and alternative ideas on resolving that dilemma

6) Arriving at a careful and reasonable judgment or solution by taking into consideration all important moral factors and reasons on the basis of the facts or truths. But it seems to be difficult.

**Conclusion:**

Only the study of engineering ethics can help in developing the skills and attitudes to follow the above steps in resolving moral problems among the engineers and other professionals by means of case studies, class room discussions and debating.
5. What is the need for moral Autonomy in the field of engineering ethics?

Definition:

Autonomy means self-governing or self-determining i.e., acting independently. Moral autonomy means the right or the wrong conduct which is independent on ethical issues.

It deals with the improvement of an individual’s moral thoughts which make him to adapt good habits. Moral autonomy is concerned with the independent attitude of a person related to ethical issues. It helps to improve the self-determination among the individuals.

Need for moral autonomy in the field of engineering ethics:

The objectives of engineering ethics are not related to implanting particular moral beliefs on engineers. In other way they help the engineers and other professionals to strengthen their professional values such as honesty, respect for the colleagues and thinking for the welfare of the general public.

Though the above said values have been already in the mind of engineers, engineering ethics helps to improve these qualities in a better manner among the engineers, and not inculcating them newly.

The objective of engineering ethics is to enable the individuals to understand the moral responsibilities in a clear and careful manner. The main aim of studying engineering ethics is to increase the moral autonomy within them.

Moral autonomy is a skill and habit of thinking ethical problems in rational manners. These ethical issues are to be found out on the basis of moral problems. The general responsiveness of moral values are derived only form the training that we have received as a child with response to the right of others and ourselves.

Suppose the training is not given in the child hood itself, those children may be ill-treated or neglected by the society. These children in future may grow up with lack of sense on moral issues and they become sociopaths. They are never morally autonomous. They won’t feel sorry their mistakes and wrong doings.
These moral concerns can be initiated or imparted among the engineers, mainly by engineers of various subjects and also by the way of their friends, or by social events occurring around them or by books and movies.

So the main aim of all the courses of applied ethics is only to improve their abilities in order to face the moral issues critically. This can be achieved by improving the practical skills which are helping in producing effective independent or self-determination thoughts among the individuals about the moral problems.

**SKILLS FOR IMPROVING MORAL AUTONOMY:**

1. The engineers must have the Competence (capability) for identifying the moral problems and ethical issues related to the field of engineering- they must have the ability to distinguish and related these moral problems with the problems of law, economics, religions principles etc.

2. They must possess the skills of understanding, clarifying and assessing the arguments which are against the moral issues.

3. They must have the ability to suggest the solutions of moral issues on the basis of facts. These suggestions must be consistent and must include all the aspects of the problem.

4. They must have the imaginative skill to view the problems from all view points and also be able to suggest proper alternative solutions.

5. They must be able to tolerate while giving moral judgments and decisions which may cause trouble. i.e. they have to understand the difficulties in making moral decisions.

6. They must have adequate knowledge and understanding of the use of ethical language so as to defend or support their views with others.

7. They must have some better knowledge in understanding the importance of suggestions and better solutions while resolving moral problems and slo about the importance of tolerance on some critical situations.
8. They must understand the importance of maintaining the moral honesty i.e. the personal convictions and beliefs and individual's professional life must be integrated.

**Conclusion:**

*The moral autonomy helps an engineer to improve his moral outlook in an appreciable manner. It also helps to be morally responsible in his daily activities.*

6. Explain the vital role of Consensus and Controversy while considering the moral autonomy in engineering ethics?

When individuals exercise moral autonomy, there is no assurance that they will arrive at the same verdicts or truths as the other people exercising their moral autonomy. There will be some basic moral differences. This is inevitable in a given situation of complex in nature.

Tolerance is needed among us for disagreement among autonomous reasonable and responsible persons.

The principle of tolerance suggests that aim of teaching engineering ethics is not to produce a unanimous conformity of outlook. Sometimes, consensus would be achieved by restoring to intimidation, coercion or dogmatic teaching.

One major goal with the field of engineering ethics is to promote tolerance, while exercising moral autonomy by the engineers. In the class room as well as in work places, there is need for authority. Teachers have authority over students and employers have authority over engineers. In both situations, the need for some consensus concerning the role of authority of individuals and their own moral views, consensus need not be undermined. Two general points about the relationships between moral autonomy and the authority can be illustrated with particular reference to a class room.

The first point is that moral autonomy and respect for authority are not incompatible. Moral autonomy is exercised on the basis of moral concern for other people and recognition of good moral reasons. In addition, valuing moral autonomy creates faith in most people's capacity
for moral reasonableness. There is a very good reason for accepting authority in the classroom. Authority provides the framework in which learning can take place.

Authority should not compel or intimidate or coerce the professionals. For example, without consensus among the students and teachers, classes could not be conducted in orderly ways. In case of controversy, trust and respect between the teachers and students would be eroded.

The second point is, sometimes a tension arises between individuals’ need for autonomy and the need for consensus about authority. Good faith differences among students and faculty with the rules of a given class need to be discussed openly whenever possible. Cheating is clearly forbidden. Cheating is dishonesty in trying to gain something underserved. Conflicts between autonomy and authority arise when authority is abused. In classes, the students should be allowed to express their own views. The authority is abused when discussion is discouraged by a professor’s intimidating approach.

7. Write short notes on ‘professionals,’ ‘professionalism’ and ‘profession’

**Profession, Professional and Professionalism**

Profession : Profession means a “job” or an “occupation”.

Professional : A Professional is someone who is member of a profession or Someone who is practicing a profession.

Professionalism : Professionalism means employed engineers as professionals Having obligations to both employers and the public.

Professionalism also mean as services to some important aspects of the public good.

Profession can be applied only to certain occupation, which meets special criteria. They are given us under.

**Knowledge**

The works involves sophisticated skills, theoretical knowledge, judgment and discussion to be engaged in the work. It also requires extensive formal education, technical studies in more areas. Generally continuing education and updating knowledge are also required.
Organization

Special societies and organizations, controlled by members of the profession play a major role in setting standards for admission to the profession. Societies also craft “Codes of ethics”, and enforce standards of conduct. Such societies (professional bodies) represent the profession to the public and the Government.

Public good

The occupation serves the public good as mentioned in codes of ethics. For example, medicine is directed towards promoting health. Law is directed towards promoting legal rights of the public. Engineering is directed towards promoting public health, safety and welfare as they are related to technology. There are many options, “which occupations meet these criteria?” The traditional professions like Medicine, Law, Teaching are cited as examples. Professions like Engineering and business Administration can also be cited as examples of professions. Sanitation works, Taxi driving and playing Basketball are not counted as profession, because they lack required advanced education.

Herbert Hoover describes the honours and liabilities of engineering profession as follows:

Honours of Engineering Profession

It is a great profession. An engineer imagines with the help of science to draw a plan on a paper. Then it is realized in stone or metal or energy. Then it brings jobs and homes to men and women. Then it elevated the standards of living and adds comforts of life. That is, the engineers have high privilege.

Liabilities of Engineering Profession

The greatest liability of an engineer compared to other professionals is that he works out in the open area, where all can see them. He works in hard substance. He cannot busy his mistakes in the grave as the doctors. He cannot argue like the lawyers blaming the judges, like
the politicians blaming the opponents and so on. The engineer simply cannot deny that he did not do it. If his works do not work, he is cursed.

**Professional ideals and virtues**

The spirit of professionalism is shown in moral ideals to which a profession is dedicated. Virtues are desirable features of character. Virtues are desirable ways of relating to other individuals, groups and organizations, sometime being ethical, is equated to being soft hearted. To act ethically, what is required is a high degree of courage.

**Theories about virtues**

1. Aristotle Theory  
2. Mac Intyre Theory

**Aristotle Theory**

Aristotle defined the virtues as acquired habits that enable us to engage effectively in rational activities. That is, the activities that define us as human being. He considered wisdom or good judgment as most important virtue. Good judgment is necessary for successful rational activities, in the fields like engineering, medicine, philosophy and so on.

“Moral Virtues” are tendencies acquired through habit conducting emotion, desire and attitude. Virtues are tendencies to find the golden need between the extremes of excess and deficiencies. For example, courage truthfulness, generosity, friendliness are added virtues of one individual.

Aristotle thought that each virtue must govern a particular aspects of our life, thus courage governs confrontations with danger and risk. Truthfulness governs truth telling. Generosity governs giving. Friendliness governs personal relationships.

Moral virtues enable us to do a variety of social virtues within a community. They enable us to attain happiness. By this, Aristotle meant an active life, in accordance without reason rather than life of pleasure and contentment.
Mac Intyre Theory

Mac Intyre is an ethicisist. He was interested in virtue ethics and then he applied it to professional ethics. He started with the idea of “Social Practices”, which means activities towards public good. This is also known as service to the society. These goods are “internal goods”. Money, prestige, luxury are “external goods”.

For example, the internal good of medicine is promotion of health. The internal good of law is social justice. The internal good of teaching is learning and self development. Thus moral aims the good qualities of persons practicing professions and hence professionalism.

8. Explain in detail the specific virtues of professional responsibility?

Professional Responsibility

The most basic and comprehensive professional virtue of an engineer is “professional responsibility”, that is, morally responsible as a professional.

Professional Responsibility is an overall virtue that covers a number of specific virtues. These virtues can be grouped into four categories. They are:

1. Self-direction virtues.
2. Public spirited virtues.
3. Team work virtues.
4. Proficiency virtues.

Self-direction virtues

These virtues are fundamental in exercising moral autonomy and moral responsibility. Self understanding, humility, Good moral judgment, wisdom, courage, self discipline, perseverance, fidelity to commitment, self respect and integrity; fall under this category.

Public spirited virtues

These virtues are focused towards the good of clients and the public who are affected by one’s work. Engineers avoid being harm fuel to others by promoting public health safety and
welfare. Generosity means going beyond the minimum requirement in helping others which is shown by engineers.

Engineers voluntarily give their time, talent and money to their professional society and local communities.

**Team work virtues**

These virtues are important to enable professional to work successfully with other people. They include collegiality, cooperation, ability to communicate effectively and respect for authorities. A sense of loyalty to employers that is, acting faithfully on behalf of the interest of the employers is also important. Leadership qualities, and ability to motivate others play a key role in any organization.

**Proficiency virtues**

Proficiency virtues are virtues of mastery of one’s craft, which means mastery of the technical skills. They may also be viewed as “intellectual virtues”. The most general proficiency virtue is competence, that is, being well prepared to undertake any job assigned. Similarly diligence, alertness to dangers, careful attention in performing the tasks, avoiding laziness and then excess of workaholism are also considered as professional virtues. Another virtue is creativity, which is, specially desirable in our rapidly changing technological society.

In addition to the above virtues that are expected out of any professional, the following are the other virtues needed by any responsible professional. Thery are

1. Integrity
2. Unity
3. Compromise
4. Honesty – Truthfulness, Trustworthiness
   a. Honesty in act
   b. Honesty in speech
   c. Honesty in belief
5. Self-respect
6. Sense of honour
7. Self-control
8. Courage
9. Good judgment
10. Sense of responsibility

**Integrity**

Moral integrity is the character on the basis of moral concern and especially on the basis of honesty.

**Unity**

Unity is the consistency among our attitudes, emotions and conduct related to moral values.

**Compromise**

Compromise means to settle the differences by mutual discussions and consensus.

**Honesty**

Means truthfulness (concerned with telling truth) and worthiness (concerning trust)

Honesty includes, honesty in actions, speech and beliefs, Honesty may be difficult to achieve fully due to the pressure from various quarters.

**Self-respect**

Self-respect means valuing oneself in morally appropriate ways. Properly valuing is to find meaning in one’s life and work.

**Sense of honour**

Sense of honour implies pride, in maintaining high professional standards and feeling shame for failing to meet minimum standards in professionalism, and guilt for wrong doing.
Self-control

Self-control is the virtue of maintaining personal discipline. It means avoiding weakness of will, half-hearted commitments, emotions of fear, hatred and so on.

Courage

Courage is a virtue required to confront dangers and difficult tasks in rational ways with self-control.

Good judgment

Good judgment is the core of all virtues. For example, maintaining self respect requires keeping a balanced view of the goods we pursue in our work. It also includes a balance between work and other aspects of our lives. We should avoid harming relationships with family and friends.

Senses of responsibility

Another important virtue expected from any professional is sense of responsibility. Sense of responsibility includes:

1. The various virtues like integrity, unity, compromise, honestly, loyalty
2. Obligations.
3. General moral standards of people
4. Liabilities and accountabilities for action.
5. Blame worthiness or praise worthiness

9. State the important or uses of ethical theories.

Use of Ethical Theories

Ethical theories have three important uses:

1. Understanding moral dilemma.
2. Justify professional obligations and ideals.
3. Relating ordinary and professional morality.
Understanding and resolving moral dilemmas

Ethical theories are useful in understanding moral dilemmas. Some of the uses of ethical theories we have already studied are as follows:

a. Ethical theories help the professionals in identifying the moral considerations or the reasons that constitute a dilemma.

i) “Virtue ethics” emphasizes loyalty to employer and colleagues and loyalty to the publics including safety of the public.

ii) “Duty ethics” emphasizes that professional has duties to protect the public affected by his work. Also he has to respect his employers’ authority.

iii) Rights ethics” emphasizes the rights of the public that are to be protected, while at the same time, the rights of the management have to be respected.

b..Ethical theories provide relevant information in solving moral dilemmas.

c. Some times ethical theories offer ways to rank the relevant moral considerations in order of importance and thereby provide a rough guidance in solving moral problems.

d. Ethical theories help us to find alternative courses or action in solving moral dilemmas.

e. Ethical theories strengthen our ability to reach balanced judgments.
1. Justifying moral obligations and ideals

In one way or another, safety is involved in most of the issues in engineering ethics. Engineering ethics focuses the safety of public, while bringing useful technological products to the public. Medical ethics emphasizes or insists on the professional roles in promoting health of patients. Under the “act utilitarianism”, one of the obligations of engineers is to act in any situations so as to maximize the good consequences for every one affected by engineering projects and products.

“Rule-utilitarianism” stresses the engineers to act according to the rules, if it would produce the best consequences for everyone affected. “Duty-Ethics” emphasizes the obligations of engineers based on basic principles of duty. “Rights-Ethics” emphasizes the engineers how engineers safety obligations are based on the moral rights of those affected by their work. A rights-theory assumes that every person has an inherent right as a human being to pursue his or her interests, that is, interest of not harming others. No doubt, there is a direct link between basic human rights and the safety obligations of engineers.

2. Relating professional and ordinary morality

The special obligations regarding safety that engineers acquire are well connected with ordinary or everyday morality. The same ethical theories that are useful in expressing everyday moral experience are also useful in justifying the obligations of professionals. There are four views concerning the origin and justification of the safety obligations of engineers.

(a) The first view is that engineers acquire moral obligations concerning safety subject to laws.
(b) The second view is that engineers acquire special obligations by joining a professional society and thereby agrees to live by the code of ethics of the society.
(c) The third view is that engineers acquire safety obligations, through the contractual agreements by which they are hired by their companies or employers.

(d) The fourth view is that engineers acquire safety obligations, upon entering into their careers, to protect and safeguard the public interests while performing their tasks.

Any how each of these four views prove to be inadequate by itself without reference to ethical theory. Engineers have special safety obligations in respect of their work. Special obligations of engineers arise out of special employment agreements or agreements with professional societies.

All engineers do have special safety obligations. Projects are directly related to the rights of persons affected by engineers' work.

10. **Compare general ethics and engineering ethics.**

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<th>S.NO</th>
<th>General Ethics</th>
<th>Engineering Ethics</th>
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<tbody>
<tr>
<td>1.</td>
<td>Ethics is an activity which concerns with <strong>making investigations</strong> and knowing about moral values, finding solutions to moral issues and justifying moral issues and justifying moral judgments.</td>
<td>Like ethics, engineering ethics also aims at knowing moral values related to engineering, finding accurate solutions to the moral problems in engineering and justifying moral judgments of engineering.</td>
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<td>2.</td>
<td>Ethics is a means of contrasting moral questions from non-moral problems.</td>
<td>Engineering ethics gives total view of the moral problems and how to solve those issues specifically related to engineering filed.</td>
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<td>3.</td>
<td>Ethics is also used as a means of describing the beliefs, attitudes and a habit related to an individual’s or group’s morality. <em>Eg: Ethics given in the Bhagavat Gita or the Bible or the Quran.</em></td>
<td>Engineering ethics is also using some currently accepted codes and standards which are to be followed by the group of engineers and engineering societies.</td>
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<td>4.</td>
<td>As per the definition of dictionaries -‘moral principles’ is about the actions and principles of conduct of the people i.e., ethical or unethical</td>
<td>Engineering ethics also concerns with discovering moral principles such as obligation, rights and ideas in engineering and by applying them to take a correct decision.</td>
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UNIT-2 ENGINEERING AS SOCIAL EXPERIMENTATION

1. Engineering is experimentation-discuss.

   Experimentation plays an important role in the design process. Preliminary tests are conducted from the time when it is decided to make a product in the following order.

   1. Engineering concept
   2. Rough design
   3. Detailed design
   4. Production stage tests
   5. Finished product

   Beyond the specific tests and experiments, however, each engineering project may be viewed as an experiment.

Similarities to standard experiment

   Engineering projects are to be viewed as engineering experiments. First, any project is carried out in partial ignorance. There are uncertainties in the model, in the characteristics of materials purchased, in the constancies of materials, about the nature of the stresses the finished products will bear with. Sometimes, laboratory testing may be by passed for the sake of completion of the project well ahead of time.

   Second, the final outcomes of the engineering project like those of experiments are generally uncertain. The outcome of some projects may involve great risks. For example, a reservoir construction (dam) may do damage to the local area and people or to its ecosystem. If the dam leaks or breaks it cannot even serve the purpose.

   A nuclear reactor may exhibit unexpected problems that may endanger surrounding population, leading to it shutdown, at greater cost to the owner and consumers. A hair dryer may expose the user to living damage from the asbestos insulation in its barrel.
Third, effective engineering depends upon knowledge gained about products, both before and after they leave the factory. Knowledge is needed for improving current products and creating better ones. Monitoring is thus essential in engineering as it is for experimentation in general. To monitor is, to make periodic observation and test in order to check for successful performance.

2. Engineers are responsible experiments-what are the four general features of such morally responsible engineers?

   Engineers are the main technical persons. They are not the sole experimenters. Their responsibility is shared with the management, public and others.

   The four general features of morally responsible engineers are:
   1. Conscientiousness
   2. Relevant information
   3. Moral autonomy
   4. Accountability

1. Conscientiousness

   Conscientiousness means “conscience”. Here the intention alone is not sufficient. Open eyes, open mind are required to understand a given situation and its implications. The people who are involved or affected are to be taken care of.

   About 90% of engineers are salaried employees, most of them work under large management and they are under pressure to function smoothly within the organization.

   Engineering as social experimentation, the engineers have to act as guardians of the public interest. Their professional duties are to guard the welfare and safety of the public affected by engineering projects.

   Engineers as social guardians should not force their own views for the social good upon the society. Their views are to be implemented with the consent of the people.
2. Relevant information

“Conscientiousness” is blind without relevant factual information. Hence showing moral concern, involves a commitment to obtain and access all available information pertinent to meeting one’s moral obligations.

It is very difficult to anticipate all dangers because engineering projects are generally experimental in nature. Individual engineers cannot privately conduct environmental and social impact studies.

3. Moral autonomy

Engineers are morally autonomous when their moral conduct and principles of action are of their own. Engineering as social experimentation helps to be of autonomous participation in one’s work. As an experimenter, an engineer exercises the sophisticated training that makes his or her identity as a professional.

In government projects, a dead line is fixed which becomes the ruling factor. Also, there are fears of competition. Tight schedule contributes losses in a project as it happened in the case of space shuttle “Challenger” as we shall see later.

Engineers have to look into their professional societies and other outside organizations for rural support. For example, a steam plant worker who refused to dump oil into a river in an unauthorized manner, was threatened with dismissal, but his union saw to it that the threat was never carried out.

Professional societies are meant for exchange of technical information, but they lack power to protect their members. Most engineers have no other group to depend on for such protection at the time of any problem or risk. Their professional societies will have to act and protect the interest of the engineers.
4. Accountability

Responsible people accept moral responsibility for their actions. “Accountability”, sometimes is understood with a sense of being faulty or blame worthy for misdeeds but the term “accountable” generally means that one is willing to submit to one’s actions. One is to be open and responsive for the assessment by others.

Submissions to an employer’s authority or any authority for that matter creates a narrow sense of accountability for the consequences of their actions. A psychologist says that there is strong psychological tendency among people to abandon personal accountability when they are placed under authority.

3. What are the roles played by codes?

Professional societies or Professional bodies

Codes of ethics are rules and regulations or guidelines drawn by a professional society, which makes the professional to act ethically.

The following are the professional societies or bodies which are responsible for drawing the code of ethics.

In India

1. Institution of Engineers, India (IEI) – for Engineers
2. Medical Council of India (MCI) – for Doctors
3. Bar Council of India (BCI) – for Lawyers

In USA

1. Accreditation Board for Engineering & Technology (ABET)
2. National Society of Professional Engineers (NSPE)
3. Institution of Electrical and Electronics Engineers (IEEE)
2. Role of codes

Code of ethics provides the engineers,

1. Inspiration and guidance
2. Support
3. Discipline
4. Education and mutual understanding
5. Contributing to the profession’s public image
6. Protecting the status quo
7. Promoting business with interests

When an engineer acts unethically, an investigation can be done to find out whether his actions are ethical or unethical. If it is proved beyond doubt that his conduct is unethical, he will be expelled from the professional society. This is a powerful action by which, he loses respect among his own colleagues and society. License as practicing engineers will be cancelled. Such an action will make the professional to be more disciplined and act ethically.

4. Briefly describe the limitation of codes

Most codes are limited in many ways. Codes provide only a very general guidance for engineers to exercise their moral responsibilities, as social experimenters. They cannot expect codes to solve their moral problems in all cases. Hence the limitations of codes are as follows:

1. Codes are general guidelines. They may not be directly applicable to all situations. A ‘sense of responsibility’ is required by any professional for the correct application of code guidelines to a given situation.
2. Different entries in codes come into conflict with each other providing no guidance as to which entry has to be given priority. In such cases, moral dilemmas arise. For example,

**Code section – 1**

Engineers will act in professional manner for each client or an employer as a faithful agent.

**Code section – 2**

The engineer will have the proper regard for the safety, health and welfare of the public in discharging his professional duties.

Suppose a company, in the interest of the company takes a decision such that the decision is threatening to the public safety, under these circumstances, the engineer is in dilemma, whether he has to be faithful to his employer or he has to take care of the safety of the public?

**Code section – 3**

The third limitation on codes is that, they cannot serve as the final moral authority for professional conduct.

The fourth limitation of codes is, “how there can exist different codes for different professional engineering societies?” This gives the members a feeling that ethical conduct is more relative than it is.

The time has come for adoption of uniform codes by all engineering professional society. The current codes are not perfect but they are steps in the right direction.
5. Briefly list down the code of ethic for corporate members as per institution of engineers, India.

A balanced outlook on laws

In 1969, at Santa Barbara Offshore in California, there spilled about 12 lakhs litres of crude oil. This made the spectacular beach, a black one, for a stretch of about 50km. This also damaged wildlife and the tourist trade was affected. This disaster prompted new laws and strict controls to prevent such occurrences in the future.

In drafting safety regulation for offshore drilling experienced petroleum engineers, geologist and well drillers are to be involved. Some safeguards are also required by law. Following the Santa Barbara incident, then Secretary of Petroleum department ordered an inspection of thousands of offshore oil wells. The inspection showed that hundreds of wells lacked mandatory safety chokes. The Secretary ordered prosecutions.

A regulated society

In order to live, work and play together in harmony as a society we have to balance individual needs and desires, against collective needs and desires. Ethical conduct provides such a balance. Engineers should play an active role in establishing rules of engineering as well as in enforcing them.

Industrial Standards

Among many areas, industry is one which welcomes greater accuracy and quality in respect of standards.

Standards decrease production cost. Standards not only help the manufacturers but also benefit the clients and the public. They help the industries to be more competitive but reduces importance on name brands and give the smaller manufacturer a chance to compete. International standards are becoming a necessity in world trade.

The proper roles of law in engineering and sincere attempts on regulations have often failed. It would be wrong to say, rule making and rule following are futile.
Good laws effectively enforced, clearly produce benefits. Good laws establish reasonable minimum standards of professional conduct.

Moreover, standards serve as a powerful support and defense for those who want to act ethically.

Rules that govern the engineering practice should not be viewed as rules of a game but to be viewed as rules of responsible experimentation.

Such a view fixes greater responsibility on the engineer who is connected with his or her experiment. Precise rule and enforceable sanctions are expected to give good result in case of ethical misconduct. Rules must neither attempt to cover all possible outcomes not they must force the engineer to adopt a rigid, specified course of action. Regulations should be broad but it has to make the engineer accountable for his or her actions.

Laws serve as a protector of the ethical engineer, some laws are being slowly modified from the precedence of court verdicts. Sometimes engineer will try to settle cases out of the court, though this helps an engineer. It will not establish a legal precedence.

6. Challenger disaster-discuss.

The space shuttle by name “Challenger” was launched by “National Aeronautical Society of America (NASA) in the year 1986. The main components of the space shuttle ‘challenger’ are:

1. Main rocket
2. Booster rocket
3. Orbiter
4. O-rings in the field joint
5. Satellite
6. Shuttle
Challenger – The Space Shuttle

For launching satellites and other missions, U.S. Air Force was directed to use the NASA (National Aeronautics and Space Administration) shuttle, instead of its own shuttle. In the Space Shuttle, each orbiter has three main engines, fueled by a few million – newtons of liquid hydrogen. The fuel is carried in a very big external divided fuel tank, which is abandoned when becomes empty.

During liftoff, immediately after firing, much of the thrust is supplied by two “booster rockets”. These booster rockets are of the “solid-fuel type”, each burning about a million - newtons load of a mixture of aluminum, potassium chloride and iron oxide.

The casing of each booster rocket is about 50 meters long and 4 meters in diameter. It consists of cylindrical segments that are assembled at the launching site. The four field joints use seals made of pairs of O-rings, manufactured from vulcanized rubber which is less heat-resistant. To make it more heat – resistant, a putty barrier made of zinc chromide is provided.

After unexpected delays, Challenger’s first flight was set for launching on Tuesday morning, January 28th 1986. Mr. Alan J.McDonald, one of the Design Engineer at Cape Kennedy was worried about the freezing temperature predicted for the night. Also another design engineer of the solid booster rocket, knew the difficulties that were experienced with the field joints, on a previous cold-weather launch.

The seal experts explained to the NASA engineers that how of launching, the booster rocket walls will bulge and the combustion gases will blow past both O-rings of the filed joints. The O-rings will fail, as had been observed on many previous flights. In cold weather, the problem is still worse because the O-rings and the putty packing are less pliable.

The NASA engineers agreed that there was a problem with safety. According to specifications, no launching should take place at less than 53˚F, but the temperature predicted at that night was very near to freezing temperature. This made the engineers to postpone the launching.
In order to save the image of the company which fabricated booster rockets, its engineers thought that the seals could not be shown to be unsafe. Considering the other factors the engineers expressed that the launching will be unsafe, but their suggestion was not heeded. Somehow, the NASA engineers decided to go ahead with launching of the space shuttle.

The temperature had risen to 36°F. As the rockets carrying “challenger” rose from the ground, there was puffs of smoke that emanated from one of the filed joints on the right side of booster rocket. Soon these turned into a flame, which hit the external fuel tank. The hydrogen in the tank caught fire, and the challenger’s wing was smashed. Within 75 seconds from liftoff, the challenger and its rockets had reached 16,000 metres high and it was totally engulfed in flames.

The crew cabin separated and fell into the ocean, killing all the crew.

Thus the challenger’s disaster was totally not only a technological disaster but also a financial disaster.

7. Describe the safety issues that were ignored in launching of the space shuttle challenger.

The space shuttle that carried astronauts to the moon had three stage rockets safety point of view. A similar design was suggested in case of Challenger, but it was rejected by the government sincere it was too expensive. The crew had no escape mechanism.

The shuttle programme was an experimental and a research undertaking. Challenger astronauts were not informed about the problems such as the field joints. They were not asked for their consent towards unsafe condition.

Another cause for the failure of the Challenger was the NASA’s scientists were unwilling to wait for proper weather condition. Weather was partially responsible for Challenger’s disaster. Because, a strong wind shear may result in rupturing of the weak O-rings.
The safety concerns were ignored by the management. One engineer said this “A small amount of professional safety effort and the support of the management will cause an enormous quantum safety improvement with little expenses”. The important role of the management is for safety first and the schedules second.

**UNIT-III ENGINEER’S RESPONSIBILITY FOR SAFETY**

1. Discuss the concept of safety.

   Engineering products are designed and manufactured with the aim of serving the public safely and without any risk. In spite of careful design and giving allowance for any unforeseen failures, our machines and control systems malfunction because of unexpected circumstances. Sometimes they fail and cause accidents. As a result “safety” is not there and the “risk” becomes inevitable. Here, we will study what is safety? What is risk? How risk can be assessed? How risks can be reduced?

   Nuclear Power Plant accidents at Three Miles Island and Chernobyl tell us about the complexity in engineering systems and the need for safe exits.

   Engineers are to work as a team in a company. They are paid salary for their work. They are expected to be loyal and honest to their employers. Engineers have moral responsibilities to discharge their duties in the interest of the company. At the same time, they have rights to freely pursue their work. Also they have the right to refuse illegal and unethical activities. Further, we will study- What is loyalty? What are professional rights? What are employee rights? and so on.

**The Concept of Safety**

   We expect engineering projects not to do any harm to the man and to the man and the environment. What may be safe for one person may not be safe for other person. For example, a power saw in the hands of the child is unsafe, but, it is safe in the hands of an adult. A sick adult is more prone to ill effects from air pollution than a healthy adult.

   Absolute safety is neither attainable nor affordable. Yet for our discussion, let us discuss what we mean by “safety”.

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“Safety” means the various risks a person judges to be acceptable. According to William W. Lawrence, “A thing is safe, if its risks are judged to be acceptable”.

Let us consider first, that we “under estimate” the risks of a thing, say “Toaster” by mistake. We judge that it is very safe and buy it. At home when we make toast using the toaster one receives severe electric shock and burn, so that he is hospitalized. Now we conclude that we were wrong in our earlier judgement. The toaster was not safe at all, that is, its risks should not have been acceptable earlier. By Lawrence definition, we are forced to say that prior to the accident, the toaster was full safe, because at that time we judged the risks to be acceptable.

Second, let us take a case where we, “Over estimate”, the risks of a thing. For example, we think fluoride in drinking water will kill a person. According to Lawrence definition, the fluoride water is unsafe since we judge its risks are unacceptable. It is impossible for someone to prove that the water actually safe.

Again according to Mr. Lawrence, the water becomes unsafe the moment we will judge the risks involved are unacceptable for us. The concept of safety allows to say that the water has been safe all along in spite of such irrational judgement.

Third, there is a situation in which people make no judgement at all, about the risks of things that are acceptable or unacceptable. They simply do not think about it. By Lawrence definition, this means that the thing is neither safe nor unsafe with respect to that group. We normally say that some cars are safe and others are unsafe, many people never even think about the safety of cars they drive.

Safety is frequently valued in terms of degrees and comparisons. Hence we speak of something “fairly safe” or “relatively safe”.

For example, airplane travel is safer than automobile travel because for each kilometer travelled, the plane travel leads to a fewer deaths and injuries.

For engineer the term “safety” will mean the safe operation of systems and the prevention of natural or human caused disasters.
2. Discuss the concept of risk.

A risk is a thing if it exposes us to unacceptable danger or hazard. A risk is the potential that something unwanted and harmful may occur. We take a risk when we undertake something or use a product that is unsafe.

Risk, like harm covers many different types of unwanted happenings. In technology, it includes dangers of bodily harm, of economic loss, or of environmental degradation. These are caused by delayed job completion, faulty products or systems or environmentally harmful solutions to technological problems. Natural hazards continued to threaten human population. Floods, storms, heavy snowfall, earthquakes affected our population and cause a greater damage to the technological networks for water, energy and food. Here a word should be said about disasters. A disaster takes place when a serious accident happens with a state of unpreparedness. Titanic collision with an iceberg happened to be a disaster because emergency preparedness were inadequate. There were only a few life boats. The warning about iceberg was not heeded. The severity of the risk is judged by its nature and possible consequences.

3. Explain the briefly about assessment of safety and risk

Assessment of Safety and Risk

Absolute safety is not possible. Any improvement in making a product safe involves an increase in the cost of production. A product involves primary cost (Production) and secondary cost, both are taken into consideration in calculating the total cost. The secondary costs are warranty expenses, loss of customer goodwill and loss of even customers and so on. Therefore, it is very important for the manufacturer and the users to have some understanding to know about the risks connected with any product and know how much it will cost to reduce those risks.
P - Primary cost of products, including cost of safety measures involved.
S - Secondary costs including warranty, loss of customer goodwill
T - Total cost+P+S

Minimum total cost occurs at M.

H - Highest acceptable risk may fall below risk at least cost M.

H - H and its higher costs must be selected as design or operating cost.

Fig. 1. safety and risk assessment

Fig. 1 indicates how high safety and low risks lead to high primary cost and low secondary cost. The other extreme is low safety and high risks. One saves on primary cost but pays more because of high secondary costs. In between where the slopes of the primary and secondary costs, curves are equal in magnitude but opposite in direction, is the point of minimum total cost (M). If all costs can be quantified, that optimum point will be the goal. For an optimal design, we must be clear about how to determine the risk and how to compare losses with benefits.

But generally among the industries the information regarding losses and profits are not freely shared. New engineers and new companies have to start from scratch, although sometimes past experience be used effectively to educate the beginners or freshers.
1. Uncertainties in design

Risk is never intentionally incorporated into a product. Risk arises because of the many uncertainties faced by the design engineers, the manufacturing engineer and even applications engineers.

There are uncertainties regarding the quality of materials by which the products are made. The level of skill in manufacturing a product is also a factor for uncertainties.

Even a careful analyst will face difficulties when confronted with data as illustrated in the figure. The Fig. 2 gives the thermal conductivity of the copper over a wide range of temperatures as observed by different investigators. The variation in result will influence engineering decision about safety.

![Fig. 2: Thermal conductivity of copper wire under different temperatures studied by different investigators.](image)

An engineer has to be cautious even with the standard materials specified for normal use. For example, the compressive strength of concrete is routinely carried out, whereas the strength of steel is often taken for granted.

To account for uncertainties about materials or components, as well as incomplete knowledge about the actual operating conditions of the projects, engineers have introduced a factor called “factor of safety”. Factor of safety is defined as ultimate stress by working stress (Safe or allowable stress). When actual stress on the member exceeds the allowable stress it will fail. That is, the product may be said to be safe when the actual stress less than the allowable stress.
2. Testing for safety

Somehow the engineers have to ensure safety for this, mostly he has to rely on experience. But the experience gained by one engineer is not often passed on to others.

Another way of ensuring safety is gaining experience through test. Under certain conditions, testing can be a valuable source of information, if testing the materials of a product is carried out to destruction. The more useful procedure is prototype testing.

Even prototype test and routine quality assurance test are not carried out frequently and properly. For example, the general motor company at one time was found to have false emission test data.

In short we cannot trust testing procedures uncritically. Time pressure is one factor that will result in cheap testing. Sometimes the testers are bribed to give false results. Sometimes even without testing, the tester on the job certifies that testing have been undertaken.

4. Explain the concept of risk-benefit analysis.

Many large projects, especially public works are undertaken based on risk-benefit analysis.

The following are the questions to be answered:

i) Is the product worth risks connected with its use?
ii) What are the benefits?
iii) Are benefits more than the risks and so on?
iv) Are we willing to take a risk as long as the project gives sufficient benefit or gain?
v) If the risk and benefit can be readily expressed in a common set of units, say lives or rupees, it is relatively easy to carry out risk benefit analysis and we can try to come out on their benefit side. For example, an inoculation programme may result in some deaths, but it is worth the risk if more lives are saved by controlling an epidemic.

Another Example may be given to indicate the risk benefit ratio, which is as follows.
When a dam is constructed across a river, due to impounding of water on the upstream side of dam, large area will be submerged. Sometimes a number of villages have to be evacuated due to submergence by water on the upstream side. This are the risks.

Compared to those risks, benefits are more in the long run. Water stored can be used for irrigation, power production, drinking purpose, fishing and industries. Since here, the benefits are more than risks, it is worth taking up the dam project.

When risk can be expressed and measured in one set of units say deaths on highways and benefits in another set of units, say speed of travel, we can easily calculate the ratio of risk to benefits for different designs, when applied to the field. Risk benefit analysis like cost benefit analysis advises us about an undertaking a project.

While calculating the risks, the rights of the people should not be violated. If so, they should be provided with safer alternatives. Engineer’s decisions have direct impact for people who feel the impact directly.

**Personal risks**

When sufficient information is available, an individual will be able to decide whether to participate in a risky activity. Individuals are ready to take voluntary risks than involuntary risks. Involuntary risks are the activities over which they have no control. That is to say, even when the voluntary risks are many times likely to produce a fatality than involuntary risks, people are ready to take voluntary risks.

The difficulty in assessing personal risks arises when we consider involuntary risks. For example, Mr. Raman had a discomfort over living near a refinery. Let us assume that the public was in favour of building a new refinery at that location. Mr. Raman already lived in that area. The following questions arise.

1. Will others prevent the construction of “Refinery” at that location?
2. Are the local people entitled for any compensation if the plant is built even after objections?
3. How much compensation will be adequate?

These questions arise in many instances. Building a nuclear power plant is another example. The problem of quantification raises many problems in assessing personal safety and risk. For example, “how to assess the value of an individual's life in terms of rupees?

This question is as difficult as deciding whose life is worth saving.

The result of these difficulties in assessing personal risks is that analysis use whatever quantitative measures are readily available on hand. In respect of voluntary risks, one may make judgements on the basis by an individual or it is much easier to use statistical average to calculate the personal risk in terms of rupees.

5. Discuss various method of reducing risks.

The engineer is faced with a difficult task of designing and manufacturing safe products. They have to give a fair accounting of benefits and risks for those products. They have to meet production schedule and help his or her company to maintain profits all the time. Of these objectives, the product safety is to be given top priority. The various steps towards reducing risks are as follows:

1. The operator should not do any error in operation. He should not be negligent towards discharging his duties. Accidents are caused by dangerous conditions that can be corrected. Dangerous design characteristics are to be given due consideration in the design. Safety devices may be provided to reduce accidents.

2. It safety is built into a product in the beginning itself it may not increase the cost. Any changes in the design later, may lead to increase in the cost.

3. We become aware about safety after a product has been manufactured and tested. If safety is not built into the original design, people can be hurt during the time of usage. Hence one should not be reluctant to change the design, safety point of view.

4. Warnings about hazards should be adequate. It is also better to have insurance coverage, but a warning merely indicates that a hazard is known to exist. This
provides only minimal protection against harm. Sometimes, insurance rates are sky rocketing.

Engineers should understand that reducing risk is not an impossible task even under financial and time constraints. Hence in the design, safety I sto be given top priority by an engineer.

6. Explain with examples the methods of improved safety.

Examples of improved safety

1. The “magnetic door catch” introduced on refrigerators. This prevents death by suffocation of children trapped in them. The catch provided to the door makes possible, door to be opened from the inside without major effort. This is also cheaper compared to old type of latches.

2. The “Dead man-handle” used by the engineer (engine-driver) to control train’s speed. The train is accelerated only as long as some pressure is applied on the handle. If the engine driver reduces the pressure on the handle, the speed of the train also comes down. When the pressure is zero, the train automatically stops.

3. A car “safety belt” is a simple attachment on the door ensures that the belt automatically goes into the position whenever one enters the car.

7. Nuclear power plant reactor, disaster at three miles island-give a line diagram and discuss. (OR) Nuclear power plant reactor disaster at Chernobyl-give a line diagram and discuss.

Chernobyl Nuclear reactor plant disaster-case study

The Nuclear Power Plant at Chernobyl (Ukraine-then USSR) had six reactors by 1986. The output of the plant was 6,000 Megawatts.

The reactors were of a type called RBMK. They are graphite moderated and use boiling water pressure tubes. What happened in Chernobyl was “a terrible reactor fire”. On April 25th
1986, a test was under taken by the plant personnel and the plant was shut down for general maintenance purposes.

During the course of servicing and maintenance work, the reactor operators disconnected the emergency core-cooling system. So, its power consumption will not affect the test results. This was the first one of the many safety violations. Another error occurred when a control device was not properly reprogrammed, to maintain the power at 700 to 1000 Megawatts level.

![Fig.3. Line diagram – nuclear power plant](image)

This left the reactor in a dangerous position. The reactor was now running free, its control rods out, and its safety system disconnected. The reactor was free to do as it wished. As the core becomes hotter it allows fission to increase. This produced a sudden increase in power, in reactor 4, from 7% to many times of its rated thermal output. The effect was equal to that of half tone of TNT, exploding in the core. The fuel did not have time to melt. It simply shattered into fragments.

The fuel came in contact with water. A second explosion took place and it lifted and shifted a 1000 tonne concrete roof, separating the reactor from the refueling area above it. The fuel rods interacted with the circulating water to form hydrogen. This produced a wonderful display of fireworks. The radioactive fine materials were driven sky-high by the heat.

What followed was a large scale accident, while the fire fighters lost their lives extinguishing the blaze. It took many hours to warn the surrounding people. Not only the Soviet
Republic but also the entire Europe had not prepared themselves to handle such a grave
disaster, that is, radioactive fallout.

Acute radiation sickness and burn injuries severely affected about 300 Chernobyl plant
workers. 50 workers died immediately. By 1992, the total deaths of Chernobyl disaster was
about 6,000 to 8,000 plant workers. Contamination was also spread by agricultural products like
milk and meats which were exported to other parts of the Soviet Union. Thus Chernobyl
accident was a total economic disaster.

9. Distinguish between Three Miles Island and Chernobyl disaster

<table>
<thead>
<tr>
<th>Three Miles Island</th>
<th>Chernobyl</th>
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</thead>
<tbody>
<tr>
<td>1. Pressurized – water reactors (PWR) were used</td>
<td>RBMK reactors were used</td>
</tr>
<tr>
<td>2. Strong containment structures</td>
<td>Weaker containments structures</td>
</tr>
<tr>
<td>3. Radioactive products of the accident were fairly well contained</td>
<td>Radioactive products of the accident were not fairly well contained</td>
</tr>
<tr>
<td>4. Reactors were sensitive to perturbations</td>
<td>Reactors were sensitive to perturbations</td>
</tr>
<tr>
<td>5. Lack of emergency preparedness created disaster</td>
<td>Lack of emergency preparedness created disaster</td>
</tr>
<tr>
<td>6. Operating procedures were not continuously and thoroughly reviewed by engineers</td>
<td>The test protocol had not been discussed with plan engineers.</td>
</tr>
<tr>
<td>7. The operators were not fully conversant with the operating principles of the plant equipment</td>
<td>The operators were not fully conversant with the operating principles of the plant equipment</td>
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UNIT-4 RESPONSIBILITIES AND RIGHTS

1. Explain briefly collegiality and loyalty.

Collegiality

When engineering codes of ethics mention collegiality, they generally cite acts that constitute disloyalty,

“Engineers shall not attempt to injure, maliciously or falsely, directly or indirectly, the professional reputation, prospects, practice or employment of other engineers, nor untruthfully criticise other engineers’ work. Engineers who believe others guilty of unethical or illegal practice shall present such information to the proper authority for action”.

Definition of Collegiality

“Collegiality is a kind of connectedness grounded in respect for professional expertise and in commitment to the goals and values of the profession, and…as such collegiality includes a disposition to support and and cooperate with one’s colleagues”.

The central elements of collegiality are respect, commitment, connectedness, and cooperation.

Respect is valuing one's peers for their professional expertise and their devotion to the social goods promoted by the profession.

Commitment means sharing a devotion to the moral ideals inherent in the practice of engineering.

Connectedness means an awareness of being part of a cooperative undertaking created by shared commitment and expertise.

Why is collegiality a Virtue?

From society’s perspective, collegiality is an instrumental value, it is good in promoting professional aims, by sharing commitment with others, supports personal efforts to act responsibly in concert with colleagues and strengthen one’s motivation to live up to professional standards.
From professionals perspectives, collegiality is intrinsically valuable. It defines as professional community as composed of many individuals jointly pursuing the public good.

Collegiality, like most virtues, can be misused and distorted, such as when peers appeal to it in urging silence about corporate corruption. It is not an excuse or justification for shielding irresponsible conduct. Collegiality can degenerate into mere group interest, rather than shared devotion to the public good.

**Collegiality in the Roman Republic**

In the Roman Republic, collegiality was the practice of having at least two people, and always an even number, in each magistrate position of the Roman Senate. Reasons were to divide power and responsibilities among several people, both to prevent the rise of another king and to ensure more productive magistrates. Examples of Roman collegiality include the two consuls and censors; six praetors; eight quaestors; four aediles; ten tribunes and decemviri, etc.

There were several notable exceptions: the prestigious, but largely ceremonial (and lacking imperium) positions of pontifex maximus and princeps senatus held one person each; the extraordinary magistrates of Dictator and Magister Equitum were also one person each; and there were three triumviri.

**Collegiality in the Catholic Church**

Collegiality also refers to the doctrine held in the Roman Catholic Church that the bishops of the world, collectively considered (the College of Bishops) share the responsibility for the governance and pastoral care of the Church with the Pope. This doctrine was explicitly taught by the Second Vatican Council. One of the major changes of the Second Vatican Council was to encourage episcopal conferences (bishops' conferences). Roman Catholic institutions (e.g. collegiate churches, dioceses) and their endowments can be administered by canon-law colleges (as to dioceses called: cathedral chapters).

Proponents emphasise that the doctrine does not attempt to diminish the role of the Pope.

**Two Senses of Loyalty**

Loyalty to an employer can be two things:
a. Agency-loyalty is acting to fulfil one’s contractual duties to an employer. These duties are specified in terms of the particular tasks for which one is paid, as well as the more general activities of co-operating with colleagues and following legitimate authority within the corporation.

b. Identification-loyalty, by contrast, has much to do with attitudes, emotions, and a sense of personal identity as it does to actions. It can be regarded as agency-loyalty that is motivated by identification with the group to which one is loyal. It implies seeking to meet one’s moral duties to a group or organisation willingly, with personal attachment and affirmation. People who detest their employers and companies, who do their work grudgingly or spitefully, are not loyal in this sense, even though they may adequately perform all their work responsibilities and hence manifest agency-loyalty.

When code of ethics assert that engineers ought to be loyal to employers, or that they should act as their employer’s or client’s “faithful agents or trustees”, it means that engineers should avoid conflict of interest, to inform employers of any possible of conflicts of interest, to protect confidential information, to be honest in making estimates, to admit one’s errors etc.

What about identification-loyalty: Is it obligatory?

John H. Fielder argues that loyalty based on personal identification is obligatory when two conditions are met.

1. Employees must see some of their own important goal as met by and through a group in which they participate such as pleasures of affiliating with the group, recognition from the group that one’s contribution are valuable, and a sense of worth and accomplishment in pursuing the goals of the group.

2. Employees must be treated fairly, each receiving his/her share of benefits and burdens.

Once these conditions are met, employees acquire obligations to identify with groups and sometimes to support groups in particular ways.

Some corporations deserve identification-loyalty from their employees, and others do not. A company that regards its workers as mere tools for maximising profits can require agency-loyalty. A company that seeks to maintain a sense of community in which professionals and other employers are valued as stakeholders, will probably achieve identification loyalty.
Identification-loyalty is reciprocal: Employees can be expected to be loyal to companies only when companies show strong commitments to them as well.

**Misguided Loyalty**

Sometimes inappropriate or misguided loyalty to a leader or employer can harm corporations, general public and also co-workers.

**Professionalism and Loyalty**

Agency and identification-loyalty are virtues depending on the specific group, organisation, cause involved and on the circumstances in which they are displayed. Loyalty is a virtue that has limits and needs to be balanced against virtues of responsible concern for the good of the public. Therefore, loyalty is a “dependent virtue”; it is desirability depends on the value of the projects and communities to which it contributes.

**Case Study**

An applicant for employment in a number of companies accepted employment with Company X, knowing that he preferred employment in Company Y. He did not get an offer from Company Y until he after he had worked for Company X for three months. He then changed to Company Y, and after several months there he discovered that employment conditions were not as good as they were in Company X. He then applied at Company X for re-employment.

Did the person fail to act loyally to Company Y?

2. Explain the different types of employers authority that are to be respected by the engineers.

**Respect for Authority**

Salaried engineers have obligation to respect their employers’ authority. The different types of authority are as follows:

1. Institutional Authority
2. Expert Authority
3. Power Authority
Institutional Authority

*Institutional authority* means the institutional right given to a person to exercise the power based on the resources of the institution. Institutional authority (or) the institutional right is given to the individuals in order to meet their institutional duties. For example, the tasks of a manager are

1. To allocate money or other resources:
2. To make policy decisions: and
3. To supervise the projects and issue directives to subordinates on particular jobs.

In order to enable the managers to meet these duties, organizations have assigned to them the required institutional authority.

*Institutional authority* and duties are the two sides of the same coin. Project engineers, for example, have their institutional duty to see that the projects they supervise are successfully completed. They are given the institutional rights or authority necessary to carry out these duties. No interference from the organization should be faced by the engineers in performing their assigned tasks.

Expert Authority

*Expert authority* means the authority given to the individuals best qualified to serve their institution’s goals in a given capacity. But in practice, there is not always a perfect match between the authority granted and the qualifications needed to exercise it. Incompetence is also commonly found in individuals in all institutions.

*Expert authority* also means the possession of special knowledge, skill or competence to perform the tasks and to give sound advice. In this meaning doctors are authorities on health. Civil engineers are authorities on structures and on transportation. Lawyers are authorities on law. In other words expert authority is “authority of leadership”. That is the expertise to effectively guide others.
Power Authority

Institutional authority must be distinguished from power authority. Institutional authority carries with it an allotment of the resources needed to complete their tasks. Ineffective persons may not be able to assume the power corresponding to their position and they will unable to implement anything. Authority and power should go hand-in-hand. Persons who are ineffective may not be able to exercise their power and make employees to be more productive. For example, a manager who lacks leadership qualities may be unable to motivate and encourage employees to produce more.

Conversely, professionals who are effective may acquire more power or influence even beyond their positions they hold. By doing so, they are capable of motivating and encouraging employees under their control. That is, to say, power authority can be exercised only by effective engineers.

3. Discuss the concept of collective bargaining.

Employees (workers) form an association, called “union”, in order to protect their rights. Union, as a faithful agent of employees, is to safeguard their interests and rights. When the management refuses to fulfill their legitimate rights, employees resort to strike. At this stage, the representative from both sides (employer and employee), meet to discuss the various issues. They ultimately reach a compromising solution, acceptable to both sides. This is known as “Collective Bargaining”.

Collective bargaining is explained in detail below,

Engineers as professionals, having highest ethical standards and professional conduct, cannot be loyal to their companies, while being members and supporters of a union.

Many observers have argued that the ethical aspects of professionalism in engineering are incompatible with unionism.
Unionism and professionalism are incompatible. Professionalism gives importance to the interest of the society, of the clients and of the employer.

Unionism gives importance for collective bargaining, being the agent of employees. It gives top priority to the interests of the members of the union, by neglecting the interest of their clients or employers. A number of professional societies view that loyalty to employers and to the public is not possible with any form of collective bargaining.

The Institution of Engineers, India [IE (I)], in its codes of ethics have mentioned that,

i) Engineers shall not actively participate in strikes, picket lines or other collective coercive action.

ii) The engineer will act in professional matters for each client for employer as a faithful agent or trustee.

Professional societies oppose unionization or unionism because unionization gives issues of conflicting loyalties and it is considered as unprofessional.

The “professional society” considers active support of a strike or other collective action used against an employer as a violation of professional ethics. The duty of engineers is to serve as their employers’ “faithful agents of trustees”.

The several features of strike that go against employers are

i) It goes against the desires or interests of the employer

ii) It uses coercion or force against the employer;

iii) It involves collective and organized opposition; and

iv) It is unprofessional and disloyal.

Example

There are a few supervising engineers in a company, who are being underpaid. They explained the situation to their employers but to no avail. They threatened in a polite way that they would seek employment elsewhere. In doing so, they acted against the desires and interests of their employer. They used a type of collective coercion. But they have not acted
unethically or violated their duty to their employers. The point is that the duty to an employer has limits. Loyalty and faithfulness do not always mean sacrificing one’s self interest to an employer’s business interest. It is not always true that a strike or other collective coercive action by the employees is unprofessional, unethical or disloyal to employers. One must look at merits and demerits of a union, strikes and situations.

The above example, that is, the question of under payment suggests two things

1. Employee duty to employers does not mean unlimited sacrifice of economic self-interest. Faithful agency primarily means carrying out one’s assigned tasks. It does not mean that one should never negotiate salary and other economic benefits.

2. The code of ethics states that the duty to employers is limited by the duty to protect public health, safety and welfare. Moreover duty to employers also means workers safety and the rights of employees. Here rights mean the rights of an employee to refuse to carry out illegal or unethical directions.

Collective action of a coercive nature may sometimes be the only effective way to resolve matters of overriding importance. The Professional Society like Institution of Engineers (India) recommends that the employees and engineers are to settle the disputes with employers, with reasonable dialogue. Certainly where it is feasible, dialogue is preferable in place of collective coercive force.

**How a union has to act in public service point of view**

The most important duty of an engineer is to serve the public. Generally unions try to safeguard the interest of their members, not the interest of the public. Strikes which are the ultimate source of power of unions, may play a havoc with the public good. We know what will happen if police officers, fire fighters, transport workers go on a strike. Then we can imagine what will happen to the economy of the country if all engineers and technicians were to go on a strike.
Sometimes engineering unions act irresponsibly. Of course, many unions have acted in that way but not all the unions. Union or an association, led by professional engineers can devote itself to promote the interest of engineers by collective bargaining. It can also devote itself to give positive support to ethical conduct by engineers.

4. What are the good and bad aspects of a union?

<table>
<thead>
<tr>
<th>Good Aspects</th>
<th>Bad Aspects</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Unions have been the primary factor in protecting the salaries and improve the standard of living for the workers.</td>
<td>Unions are a main source of inflation, which will destroy the economy of the country.</td>
</tr>
<tr>
<td>2. Unions give employees a sense of participation in company decision making. Union representatives serving as board of directors, has contributed to labour peace.</td>
<td>Unions encourage non co-operation in decision making. Sometimes representatives serving as board of directors, may contribute to labour unrest.</td>
</tr>
<tr>
<td>3. Unions are healthy balance to the power of employers to fire at will. They give workers greater job security and protection against harassment.</td>
<td>Unions encourage job security, promotion not based on personal achievement but based on seniority.</td>
</tr>
<tr>
<td>4. Unions give stability by attending to grievances represented by employees, by negotiating with the managements.</td>
<td>Unions encourage unrest and strained relations between the workers and the management.</td>
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</table>
5. Explain confidentially.

Keeping confidence or confidentiality is the most important duty of any professional. Lawyers must keep clients’ information confidential. Doctors must keep information about their patients confidential. Teachers must keep personal information about their students confidential. Similarly, employed engineers must keep information about their companies and clients confidential.

Definition

Confidential information is the information which is desirable to keep secret in a government department or a private company. Engineers and the employees are expected to keep information “confidential”. They are expected not to leak out any confidential information to unauthorized people both inside and outside the company.

Any information which is to be kept as “confidential”, if it is known to others, it will cause harm to the corporation or the clients. Any information to keep secret in order to compete effectively against business rivals, is known as confidential information.

Confidentiality related terms

There are two terms that are related to confidentiality, they are

1. “privileged information”
2. “Proprietary Information”

i) Privileged Information

“Privileged Information” is a similar expression for “confidential information”. Privileged information means the information that will be available only on the basis of special privileged. Special privilege means the privilege accorded to an employee working on a special
assignment. It covers information that has not yet become public or widely known within an organization.

ii) Proprietary Information

"Proprietary Information" is an information that a company owns. It is the information owned by the proprietor in a legal sense. This means “property” or “ownership”.

Trade secrets versus patents

An approximate synonym for “proprietary information” is “trade secrets”. A trade secret can be any type of information that has not been made public. That is, an employer wants to keep it secret. It may be data about designs and technical processes and so on. Trade secrets are given limited legal protection against employee or contractors. They are protected by common law. That is, the law generated by previous court rulings. An employer can sue en employee or contractors for divulging trade secrets.

Patents differ from trade secrets. Patent legally protect specific product from manufacturing and selling by competitors without the permission of patent holder. Trade secrets have no such protection.

A corporation may come to know about a competitor’s trade secrets through legal means, that is, by “reverse engineering”. In this, an unknown design can be traced out by analyzing the final product. But patents have a drawback of being made public and permitting competitors an easy way or working about the product any they may find alternative designs. In US, patents can be held only for 17 years. For trade secrets, there is no time limit. Patents are protected by “status laws” passed, in order to provide incentives for creativity.

6. Discuss Intellectual property rights and various forms of IPR.

Intellectual Property

An idea, a design, a manuscript, an invention, or a concept which will give rise to a useful product / application, is known as an “Intellectual Property”.
The inventor of an intellectual property likes to have a reasonable reward for his invention. The problem with an intellectual property is that it can be copied, imitated or reproduced. This reduces the returns to the inventor. The inventor has the right to derive monetary benefits for his invention, that is, intellectual property. This right is known as Intellectual Property Right (IPR). The IPR is also recognized by the Government so long as it is not detrimental to the society.

Protection of Intellectual Property Right

Intellectual Property Rights may be protected by several forms. Each form of protection has its own advantages and disadvantages. The various forms of IPR protection are as follows

1. Trade Secrets
2. Patents
3. Copyright

Trade Secrets

When an individual or an organization owns an intellectual property, does not disclose the property to any one and keeps it as a “secret” to safeguard his business interests, is called “Trade Secret”.

Advantages

i) Duration is unlimited for trade secrets.
ii) The cost of filing, contesting and enforcing patents are saved.
iii) Someone cannot easily improve upon the product or process. Thus the risk is reduced.
iv) There is no need for protection under, say, patents.
Disadvantages

i) Maintaining a trade secret is a costly affair.

ii) It is not protected from independent innovation or invention.

iii) Trade secret cannot be applied to many inventions like equipment design, books, trade secret of Coco Cola, Pepsi etc.,

Patent

The right granted by government to an inventor to prevent others from imitating, manufacturing, using or selling his invention for commercial use during a specified period, is known as “Patent” or “Patent Right”.

Patent Rights

Patents are granted for

1. An invention (including a product)
2. Innovation or improvement in an invention
3. The process of a product
4. A concept

Limits of a Patent

1. Time limit – A patent is valid for a specified period of time form the date of award, in most countries this period is 15 to 20 years.

2. Space limit – A patent is valid only in the country where it is awarded. It is not valid other countries.

Copy – right

Certain intellectual properties are not patentable. They are protected by “Copy right”. The copy right is limited both in time and extent. Copy right provides protection for a specified period from reproduction of materials either in full or in part. It, however, does not prevent
another person from using either the idea or the information contained in a copy right laws are at par with International Standards.

**Benefits of IPR**

i) IPR encourages and protects intellectual creations.

ii) It motivates investment in Research and Development (R&D) activities.

iii) Consumers are directly benefited with the results of inventions.

iv) It spreads new ideas and technology quickly and widely.

**7. Explain conflict of interest?**

Conflicts of interest are the situations where professionals have a self interest. If self interest is given importance, it may keep them away from meeting their obligations to their employers or clients. The following are the examples

1. To serve as a consultant for a competitor’s company
2. Personal interest, such as making private investments in a competitor’s company.

In this context, it is better to have a clear understanding of what the conflicts of interest are and in what way they are objectionable.

Conflicts of interest distort good judgement, especially where professionals are involved. Conflicts of interest threaten good judgement in serving an employer or client. Conflicts of interest arise when two conditions are met.

1. The engineer is in a position to exercise good judgement on behalf of the interest of an employer or the client.
2. The engineer has self interest that will threaten good judgement in meeting the interest of the employer or the client.

Because of the various possible outside interest, conflicts of interests may arise in many ways. A test for identifying conflicts of interest is whether there may be a possibility of outside interest influencing one’s judgements.
Confliction Interest

“Conflicts of interest” is different from “conflicting interest.

A student, for example has got 5 arrears of subjects. He knows that there is time to study adequately only 3 subjects. So he must choose which are the three subjects to be studied for the examination.

Another example is, an investor may desire to invest in two financial companies but has funds for investment in only one financial company. In such cases a person is surrounded by “conflicting interest”. “Conflicting interests” means a person has two or more desires that all cannot be satisfied simultaneously under the given circumstances. But we cannot say that he is wrong to try pursuing them all at a time.

Gifts and Bribes

A bribe is a substantial amount of money or goods offered apart from business contracts with the aim of gaining from the contract or keeping the contract. Bribes are made in secret Gifts are not bribes as long as they are small amount offered in the normal conduct of business. This amount or money is given for recognition of service. Pre-arranged payments made by contractors to the companies or their representatives in exchange for contracts awarded, are called, “Kickbacks”. This is also a form of bribe.

Often companies give gifts to employees of government agencies or partners in trade. Many such gifts are unobjectionable. Some are similar to bribes. Bribes are illegal or immortal because, they are capable of threatening fairness in competitive situations.

Since bribes can bias judgements, companies have given elaborate guidelines for their employees, illustrating acceptable and unacceptable gifts. But in some companies officials are prohibited by law from accepting anything of value.

Engineers should not accept money directly or indirectly from contractors, or their agents in connection with the work. This is one of the guidelines. If one receives any gifts which will cause an embarrassing consequence for the company when made public, then the gift is
considered as a bribe. Entertainment, travel and other social functions give rise to special difficulties. Many companies encourage their employers to form social relationships with the suppliers and the clients, in order to enhance their business interest. This is also another form of bribery. Engineers are the objects of bribery attempts.

8. Occupational crime and types of occupational crime-explain.

Occupational crimes are illegal activities in one’s company or an organization. It is the violation of laws regulating the work activities. When workers or professionals are committed, occupational crime is called “White-collar crime”. Many occupational crimes fail to meet professional obligations. Occupational crime sometimes promote the interest of one’s employer rather than oneself. Occupational crime deserves attention because it frequently takes place, in a greater magnitude. Also it invites the attention of the public. A theft by an employee is a type of occupational crime during the time of employee’s assigned tasks. Similarly, leaking out certain trade secrets to other companies is also an occupational crime.

Types of occupational crimes

I. Industrial Espionage.

II. Price Fixing

III. Endangering Lives

Industrial Espionage

Industrial espionage means betraying one’s own company to other companies for his own benefits or gains. For example, the army secrets, of our own country and atomic energy secret were once sold to Pakistan.

Employees who betray the company secrets need not be criminals. An employee even without being a criminal may buy trade secrets from one company and sell them to another company. A typical example of industrial espionage is given below.
Mr. Kumar was a semiconductor expert in Silicon Valley, U.S.A. He established his own company in 1973. He became a familiar figure in the valley and he developed close contacts that enabled him to buy and sell competitors secrets.

Mr. Kumar sold National Semiconductor secrets to Intel Corporation. He also stole from Intel and sold to National Semiconductor, though Intel has the tightest security system in Silicon Valley. Kumar found it easy to buy a number of major trade secrets from former employees and sold the secrets to both American and European companies.

At last, Mr. Kumar was booked for this domestic crime and convicted by the court.

**Price Fixing**

Law prevents companies from fixing the price of a product that will prevent free competition and trade, but this sort of habit is often violated by many industries.

For examples, let us consider the project namely, the construction of a dam. Tenders are floated in which different construction companies take part in bidding. Before bidding starts, the managing directors of various companies may meet together and may arrive at common understanding in the cost of the project in the name of lowest bidding. This type of bidding is a conspiracy by the construction companies. This is an occupational crime.

**Endangering Lives**

Employers who expose their employees to safety hazards escape criminal penalties, but the victim will sue the companies for compensation under civil law.

Workers are prone to diseases like heart diseases, lung diseases, eye problems when they happen to work in chemical industries, cement industries, asbestos industries and so on. When the employees are appointed in the company, the employer is expected to brief them about the environmental hazards, they have to face at the time of their works. In case, employees are affected by any of the disease as said above, they are eligible for compensation in the form of monetary benefits. The employers should be prepared for this.
Not briefing about environmental hazards and not paying compensation for victims are considered to be occupational crimes. To protect the employers from safety hazards, they are to be provided with boots, rubber gloves, aprons, helmets, respirators and proper ventilation, including free medical and transport facilities.

9. What are the professional rights?

Engineers have several type of moral rights, apart from human, employee and professional rights, as human beings. Engineers have fundamental rights to live and to pursue their work in ethical ways. They should not be discriminated in employment on the basis of sex, race or age. As an employee, one has the right to receive one’s salary and other company benefits in return for performing one’s duties.

Engineers as professionals also have other rights which are as follows:

1. The right to express one’s professional judgement freely,
2. The right to refuse to carry out illegal and unethical activities,
3. The right to talk publicly about one’s work within bounds.
4. The right to be involved in the activities of professional bodies.
5. The right to protect clients and the public from the dangers of one’s work, and
6. The right to professional recognition for one’s services.

These rights may be called as fundamental professions rights.

A few important other professional rights are:

1. The Right of Professional Conscience
   Engineers have moral right to perform their professional responsibilities according to their professional conscience without interference from others. This is called “the right of professional conscience”.

2. Institutional Recognition of Rights
Moral rights of engineers is one thing that is required. At the same time the moral right is to be respected by other and given recognition within an organization. This is also required when engineers are entitled to the basic right of professional conscience. They may also expect recognition by the employers.

3. Specific Rights Recognition

Engineers have a general obligation to protect the safety and well being of the public. Correspondingly, they have a general right to protect the safety and well being of the public. The obligation to the public requires “Whistle-blowing”.

“Whistle-blowing” means when an employee or former employee conveys information about a moral problem to the authority to take action on the problem. Alerting the authority or cautioning the authority about a moral problem to take action on the problem, in the interest of the company, is known as “whistle-blowing”.

For example, let us say, an employee A is leaking out certain company trade secrets to a competitor’s company. An employee B who somehow comes to know about this and informs the authority to take action on A. This sort of alerting by an employee is known as “whistle – blowing”.


Conscientious refusal right is the right to refuse to be engaged in an unethical behavior.

5. Recognition Rights

Engineers have a right to professional recognition for their work and contributions. This recognition involves fair, and monetary remuneration. The right for reasonable remuneration is clear in corporations that make excessive profits while engineers are paid low salary. For creative engineers who make the discoveries leading to their patents, if a patent leads to lakhs of rupees of revenue for a company, it is unfair to give the discoverer a nominal bonus and a “thank you” letter.
Without a fair remuneration, engineers cannot concentrate in the production. While carrying out their duties and maintaining up-to-date skills, their time will be taken up by money worries. We can imagine how it is unhealthy to work hard at one’s job without proper recognition. Unrecognized work also demeaning. Hence engineers are to be given proper recognition by the management for the hard work and extra contributions by them.

10. What are the employee rights?

Employees are also entitled for moral or legal rights. For example, an employee is having the right to disobey unethical directives and to express dissent about company policies. Thus the professional rights are also employee rights, since both come under a category of salaried class.

Employee rights include fundamental human rights related to their employment situations. Employees should not be discriminated against one’s race, sex, age or nationality.

A few important “Employee Rights” are as follows

1. No organization shall discriminate against an employee for criticizing.
2. No organization discriminate against an employee for being engaged in outside activities of his or her choice.
3. No organization shall deprive an employee of the enjoyment of reasonable privacy in his or her place of work. No personal information about employees shall be collected.
4. No employee in an organization who finds fault that his rights have been violated, shall be discharged or penalized without a fair enquiry in the organization.
5. Rights to free speech and dissent, conscientious refusal right to obey unethical directives are also the rights of employees.

11. What is discrimination? Explain with any one example.
The word discrimination means preference given to an employees on the grounds of sex, race, nationality etc., whether such preference is justified or not. Discrimination means morally unjustified treatment of people, an arbitrary or irrelevant ground. Discrimination also means “Preferential treatment”.

Employees should not be discriminated because of one’s sex, race, skin colour, age or religious outlook. Such discrimination is dangerous in an organization because, work is fundamental to a person’s self-image, self-identify and self-respect. Accordingly, human rights are to be given fair and decent treatment at the work place.

Application of government rules within an organization towards non-discrimination, the extent of the right to non-discrimination are highly controversial issues. These issues have significance for the engineers.

Consider the following example, to show how the discrimination is dangerous (injurious) in a work environment. There exists a vacancy in a thermal plant for the post of thermal plant engineer. Normally such vacancies are filled by promotions within the plant. The best qualified person in terms of training and year of experience is an Indian – American engineer. As per the rules and regulations, this engineer is to be promoted as thermal plant engineer.

But the management believes, however the majority of workers being Americans, would be unhappy if an Indo-American engineer occupies that post. The management feared that there will be non-cooperation and inefficiency by the employees. The management decided to promote and transfer an American engineer from another plant to fill up the vacancy.

UNIT-5 GLOBAL ISSUES

1. Discuss briefly the role of multinational corporations on global issues.

On December 3rd 1984 in Union Carbide’s Plant in Bhopal, India, there was a gas leak and overheating in a storage tank. The tank contains Methyl isocyanate- a toxic ingredient used in manufacture of pesticides. Within an hour, the leak exploded in a gush that sent about 40 tones of poisonous gas into the atmosphere. The result was, the worst ever industrial accidents
in Indian history. As a result 7,000 people died, 10,000 people severely injured. Compensation for the victims was very small and that too was distributed very late.

The disaster happened probably by lack of safety measures and total judgement errors committed by plant operators.

Multinational Corporation do huge business in more than one country. For example, in 1984 Union Carbide operated in about 40 host countries, in addition to its own country, the United States.

The benefits to US companies on doing business in underdeveloped countries are very clear, namely, cheap labour, availability of natural resources, favourable tax arrangements, fresh markets for products, new jobs, higher profits, transfer of low end technologies and so on.

1. International Human Rights

Human rights mean that one has to be treated with dignity and respect by other. Accordingly all people have rights to life, liberty and their pursuit of happiness.

Corporations doing business in other countries should apply these, “Human rights” concept more practically. Thomas Donaldson has given a list of international human rights. Human rights imply liberty and fairness.

Thomas Donaldson suggest that there are ten international human rights which are as follows

1. The right to freedom of physical movements
2. The right to ownership of property
3. The right to freedom from torture
4. The right to a fair trial
5. The right to non discrimination against race or sex
6. The right to physical security
7. The right to freedom of speech and association
8. The right to minimal education
9. The right to political participation

10. The right to subsistence

According to Donaldson, a multinational corporation should do business in a country without violating the human rights. If they violate, they must simply leave that country.

2. When in Rome, do as the Romans do

When a country A sets up industry in another country B, country A (guest country) should follow the culture and the practices dominant in the country B (host country). This is the meaning of the old saying, “when in Rome, do as the Romans do”. Some countries have a view opposite to this, that is, country A practices the same customs in country B, as followed at home country A.

Prior to independence, in South Africa, its political and economic systems were based on the culture of racial separation called “Apartheid”. The blacks were paid less wages than the wages paid to the whites for same work. Promotions to higher posts were adopted to whites only. It was more difficult for black employees. Segregation was followed in common places like rest rooms, lounge areas, and assembly halls. No black person had the right to vote, to free expression and association.

The above example clearly shows how the whites of U.K. did not respect the local black people and their rights. That is “when in Rome, do as Romans do” principle was totally violated.

3. Promoting morally just measures

It is very clear that multinational corporations should respect the basic rights of the people in the countries where they do business. It also requires that more respect is to be given when wealthy countries do business in under developed countries. Acceding to the principle of utilitarianism, that is, doing the most good for the most people, it is also required that these
activities of multinational corporations should benefit the host countries in which they do business.

The business activities of multinational corporations must do good than bad. This means helping the host countries’ overall economy and its workers, instead of benefiting a few. Not only they must pay their fair share of taxes, but also they must make sure that products they manufacture and distribute are not causing any harm to the users. Corporations should respect the laws and culture of the host country. They should not violate the basic moral rights of the local people.

Workers are to be paid a “fair-wage” in very poor countries. “Fair – wage” means the salary that is to be paid to a worker, to live with dignity as a human being. If multinational corporations pay the same salary as that of the host country, this will amount to exploitation of the workers, especially when the salary is below a living wage. If the salary is higher, this will amount to attracting the most skilled workers from other companies, who are important in the local economy.

Another example, let us consider the workers’ safety in companies that manufacture hazardous chemicals like an asbestos production industry. In such industries workers have the right to “informed consent”. Corporations are required to inform the workers in a simple language they can prepared to work under any conditions since they want income to feed their families. Corporations must eliminate greater risks to the workers and still they can make a reasonable profit. They must also pay the workers for the extra risks they undergo. This is what exactly is meant as a matter of morally good judgements and negotiations.

4. Technology transfer and appropriate technology

Let us discuss the concepts of “Technology Transfer” and “appropriate technology”. “Technology Transfer” is the process of moving the technology to a novel setting and implementing it there. Her technology includes both hardware and technique.
A “Novel Setting” means atleast one new variable us added which may be helpful to the success or failure of a given technology.

The “appropriate technology” refers to identification, transfer and implementation of the most suitable technology for a new set of conditions. Appropriate technology also implies that a technology should contribute to the sustainable development of the host country without degrading its environment.

5. Bhopal Tragedy or Bhopal Disaster

In the year 1970, Union Carbide has established at Bhopal, a production plant, manufacturing chemicals, used in pesticides. Union Carbide was fully aware of the hazards of their new technology it transferred. It manufactured methyl isocyanate. As a concentrated gas, when it comes in contact with human body, methyl isocyanate burns any moist part of the bodies like throats and nasal passages, blinding eyes and destroying lungs. In designing the Bhopal plant, Union Carbide did not transfer all the safety mechanisms available. During the following 2 years, safety measures were not given due attention. There was high turn over of employees, the company failed to properly train new employees. Workers handling pesticides learned more from personal experience than from safety manuals about the dangers of the pesticides. The workers suffered from chest pains, vomiting and other symptoms. Even after that, they failed to wear safety gloves and masks, because of high temperature in the plant due to lack of air-conditioning.

The following are the major causes of Bhopal tragedy:

1. The tanks storing the methyl isocyanate gas were overloaded. According to Carbide’s manuals, they are never to be filled more than 60% of capacity. The extra space should be used to dilute the gas in emergencies. The tank that caused the problem actually more than 75% full.

2. A standby tank that was supposed to be kept empty for use as an emergency dump tank, already contained a large amount of chemical.
3. The tanks were supposed to be refrigerated to make the chemicals less reactive when trouble arises. The refrigeration unit had been shut down five months before the accident as a cost-reducing measure. This made the temperature of the tank three to four times greater than their normal temperature.

Due to the above said lack of safety measures, the chemical reactions took place for more than three hours, generating enormous pressure and heat in the tank. Within 2 hours, most of the chemicals from the tank escaped forming a deadly cloud covering a vast area in Bhopal. As a result about 7,000 people died, 10,000 people permanently disabled, and about 1,00,000 people injured.

The workers were not given proper training as to how to escape under emergency conditions. There was no proper plan for evacuation. The disaster was so great in the Indian history because of total unpreparedness.

2. Write a brief note on Environmental Ethics.

Increase in the number of automobiles on roads, chemical industries, tanneries, unlimited use of plastics cause a greater damage on environment. Such damages even spread across the continents.

As human beings we share a common environment, a common ecosphere. Protection of the environment globally should become a united commitment across national boundaries. Hence a new branch of applied ethics called “environmental ethics” has been developed which aims at total environmental protection.

We are misusing our scarce resources, fouling our environment. In general, the increase in consumption of limited resources and exploding population will ultimately make our “Spaceship Earth” very small for us.

Engineers must be aware of their role in protecting the environment for the present and future generations.
Case Studies

The disaster at Bhopal and Chernobyl Nuclear Plant explosion, have caused long term environmental effects. It is difficult to assess long-range changes in the climate due to the “green house effect” and “depletion of Ozone layer”.

Example

The following are a few examples that cause environmental pollution and hazards.

1. Acid Raid
2. Air and Water pollution
3. Asbestos Industries
4. Land subsidence due to over de-watering

1. Acid Rain

The atmosphere air is damaged by acid rain and acid deposition. It also pollutes the surface water and hence the ground water.

Normal rain water has a pH value of 5.6., but the typical rain water in the North Eastern Areas of North America has a pH value of 3.9 to 4.3. This is 10 to 100 times more acidic than the normal.

The result is “Acid shock”. This causes mass killings of fish. Acid rain harms fish-eggs and food sources. Aluminium, Zinc and many other metals that contain in acid rain water reach the steams and lakes. Due to this, the ground water is polluted. Also the seawater is polluted. Forests have also been steadily destroyed, animals have suffered decrease in population and farm lands are damaged. Drinking water sources are also being damaged due to acid rain.

The mechanisms involved in the process of acid rains is shown in the Fig. .4

Surface water and Ground water also are being polluted by acid rains.
Fig.4. Pollution due to acid rain

The use of fossil fuels by industrial nations is causing a buildup of Carbon-dioxide in the atmosphere. This results in a green house effect damaging the entire earth. The protective Ozone layer is also damaged due to the release of “Freon” that is related to technological products. Rivers collect the pollutants, flow and eventually dump their toxic contents into an ocean.

2. Air and Water Pollution

The rapid industrial growth all over the world has affected the environment, air and water to a greater extent. People living in cities are to undergo severe air pollution and water pollution. The Discharge of effluents with toxic contents in streams and rivers without treatment has polluted not only surface water but also the ground water. Increases in the number of chemical industries, the exhaust fumes from such industries pollute the air due to the contents like CO$_2$, CO, SO$_2$ and so on. United States of America, Japan are such countries which suffer from air and water pollution to a greater extent.

In india, metropolitan cities like New Delhi, Mumbai, Kolkata, Chennai and Hyderabad are few cities which are severely affected by air and water pollution.

The untreated effluents from dying industries at Tirupur, were let out into Noyyal river. The river water has been polluted to such an extent that it can not be used either for agriculture or for drinking purpose. Ground water along the river banks downstream of Tirupur has also been polluted.
Tanneries at Dindigul, discharged the untreated tannery effluent on open land and due to this, groundwater in this area has been polluted. Water has become unpotable.

Tanneries at Vaniambadi, Ambur in Vellore district let out the untreated tannery effluent on open land along the Palar river course. Due to this, the surface water and groundwater in these areas have been polluted. Water has become unpotable.

In order to save surface water and groundwater in the above said areas, government has formulated stringent laws. According to this law, no industry can let out the effluent untreated. If any industry violates this law, the licence will be cancelled. The implementation of these laws are being monitored by “Tamil Nadu Pollution Control Board”.

3. Pollution due to asbestos industries

Asbestos industries pollute the atmospheric aie and cause lung diseases, cancer and breathing problems.

4. Land subsidence

Over pumping of oil and water from the ground will result I land subsidence. As a result, roads will crack, rail roads will buckle. Sewer lines may burst. Such things happened in Tokyo, Osaka in Japan covering about 8000 square kilometers area. To prevent such land subsidence water was injected under high pressure into the ground.

The above examples show how human activities can change our environment in many different ways. To prevent the environmental pollution globally, international laws and regulations are to be framed and implemented strictly to save our mother earth from environmental hazards.
3. Briefly discuss about “Computer Ethics” as applicable to technological society.

Computers have become inseparable combinations of our technological society. Through networks they connect the globe.

It is clear that computers cause a variety of moral problems. To deal with these problems, a new area of ethics called “Computer Ethics” has come up. Computer ethics has special importance for professionals emerging with computer technology.

The various computer professionals are designers of computer, programmers, systems analysts and operators.

Computer ethics is a branch in Engineering Ethics. Many professionals who use and control computers, share the responsibility for computer applications.

**Issues in computer ethics are**

1. Power Relationships
2. Property
3. Invasions of Privacy

All these issues may involve “Computer abuse”, that is, unethical or illegal conduct in which computers play a central role.

**1. Power Relationships**

During 1960’s, there was some sense of fear that introduction of computers may lead to “concentration” and “centralization” of powers in the governmental and non-governmental agencies. It was earlier thought that only selective people (bureaucrats) can have access to the use of large computers. The subsequent use of “Microcomputers” at cheaper prices, erased the fear of centralization powers and created a decentralization of powers.

Computers as powerful tools cause moral issues in society. Below are a few examples.

1. Loss of more jobs by termination of employees.
2. Strained customer relations, because of “Computer Printed errors”.
4. Stock trading manipulation in buying and selling the shares.
5. Unrealistic expectations because of the monopoly of computer sales people.
6. Political power gaining by politicians.
7. Dangerous, computerized defence systems, even if they are working perfectly.

2. Property

   The other issues about property and computers are

1. Use of computers in embezzlement
2. Stealing money and financial assets
3. Data and software stealing

1. Embezzlement

   (a) Disguising one’s voice by means of computer as he talks into a phone.

   (b) Getting access to internet by using the phone number of someone else’s without his knowledge. Sometimes secret computer passwords have been used as a security measure.

2. Stealing Money

   When the communication lines linking the computers, cross national boundaries, stealing by employees at work, non – employees, and consumers, take place.

3. Date and Software Stealing

   “Date” refers to an information stored in a computer. “Software” refers to the programmes that direct electronic machine (hardware) to perform certain tasks, involving solving problems. Programmes have several aspects.

   (a) An algorithm – Steps in solving problems
(b) A source code – Express the algorithm in a general computer language such as C, C++, and Java, VB etc.,

(c) An object code – Translates a source code into the specific machine language of ones and zeros.

Property is anything they create through their labour. Also property is one what laws define as the permissible use of things.

In the United States, computer hardware is protected by Patent laws. Softwares can be protected by copyright and trade secret laws. Copying clearly denies the creators and producers of the programmes, the money to which they are entitled. This is a form of theft.

3. Privacy

Storage, retrieval and transmission of information using the computers as data processors pose moral threats to the right called “privacy”. By making more data available to more people with more ease, computers make privacy more difficult to protect.

Hackers

“Hackers” are those who challenge any computer security system. Some in-plant “time bombs” (unwanted codes that copy themselves into larger programmes) will “Choke” networks with dead-end tasks. Erase files and even destroy equipment. This action is a clear violation of property rights. Privacy in a computerized world can be protected only by making it inconvenient and expensive for others. To collect information about us, from data banks, is also a violation of “Privacy” in computer’s.

Professional Issues

Many issues in engineering ethics arise under the context of computer work. New difficulties are involved due to high degree of job complexity and required technical proficiency introduced by computers. Some examples are as follows.

1. Computer failures – Due to error in hardware of software
2. Computer implementation – Change over to a new computer system should never be attended without having the old system still operational.

3. Health conditions.

Engineers who supervise computer personnel should check that health considerations are taken care of to reduce back problems. Provisions are to be made for wrist support and good keyboard layouts. Good lighting and ventilation should all so be provided.

4. Discuss briefly weapons development and engineers involvement in weapons work, as a global issue.

The world’s technological activity has immense impact on weapons development. The military technology is discussed here. The moral issue because of engineers participation in military technology has no comparison. “Cold war” and the risk of “nuclear war” are the effects of weapons development. High technology weaponry, terrorism, and drugs are confronting issues between super power nations like USA, Russia, France and Chine.

There are several reasons for an engineer to do his or her best on a military job. Patriotism and interest are the two main reasons for one’s best on a military job.

There are several reasons for an engineer to refuse war work. Engineers are under ethical obligations to erect bridges that do not collapse. They have to build nuclear power plants that do not emit radiation. The other view is to see weapons development as a defensive measure against greater destruction by opponents.

1. The Weapons Sea-Saw

The trade in arms and military know-how have a long tradition of military expenditures throughout the world that comes about hundreds of billions of rupees annually. Of this amount, about 25% is allotted for purchase of weapons and related equipment.
20% of the amount spent on international trade on weapons. The most world's successful arms merchants and manufacturers are Krupp Company-Germany, Vickers-UK, Schneider-France. They supply arms to the China, Japan and Russia and Pakistan.

In the World War I and World War II destructive arms like tanks, air crafts, rockets and nuclear weapons were used. It caused great damage to the human lives and properties, which the world can never forget.

The atom bombs dropped on Hiroshima and Nagasaki had a huge impact because of larger number of death and many got permanently injures.

2. Engineers involvement in weapons work

The involvements of engineers in the manufacture of weapons are as follows:

1. “Manufacture of “anti personal bombs”. These bombs can be timed to explode hours after delivery. The fragments are made of steel, which will cause deep injuries.

2. A “Napalm” is manufactured by a chemical engineer. This is the most brutal and destructive weapons that has ever been created. This was used during the Vietnam War.

3. Missile control and guidance are also done by and engineer in the army field. This type of missiles will carry single or multiple warheads with a kind of dreadful fire power which will keep the enemy under check.

4. An engineer qualified in physical electronics and laser beams did research in “Particle beams”. He developed something similar to the “death ray”.

5. An electronics engineer developed “avionics” for fighter planes.

6. An engineering physics qualified engineer developed “Nuclear bomb” through we know and fully aware the serious consequences of a war, the entire world is fighting and competing with other in weapons work. It will not be a wonder if we say that weapons work is humankind’s most crucial.
Finally let us ask ourselves how long a nation can divert tremendous resources, that is funds, materials, talent, affecting nations economy. Every rupee spent on defense products results in reduction of number of jobs. Other important sectors such as education, roads, water supply, sewage disposal and poverty reduction are neglected.

5. Explain the role of professionals as managers.

**Engineers as Managers**

Engineers undergo intensive technical training compared to any other professionals but many of them move into managerial cadre for which they received little training as undergraduate students.

Many companies prefer engineers as managers because the technical understanding of engineers is essential to manage corporations. It is easier to teach engineers the business side of corporations than to teach non-engineering graduates. Corporations recognize engineers’ general strengths in analysis, their strong work ethic, and their confidence in problem solving.

Engineers are given higher salaries, greater authority and wider responsibility. But in practice, engineers are given less recognition within the business culture, for reasons unknown.

**Engineers as Professionals**

The transition from technical work to management work involves many adjustments. It requires knowledge about finances and scheduling skills in coordinating and motivating other people. They should have the ability to make risk taking decisions. Engineers have ethical responsibilities as per code or ethics but managers cannot be professionals as engineers.
Managers have responsibilities to employees, customers, dealers, suppliers and the general public. However the Nobel Laureate Milton Friedman attacks the managers by saying that “the social responsibility of business community is to increase the profits, and to conduct the business taking only their stock holders’ interest into account.

But engineers by contrast, are professional who have responsibilities to protect the public safety, health, and welfare of the public, in addition to their responsibilities to stock holders. The ultimate goal of managers and engineers should be alike to make valuable products that are also profitable.

Good business ethics and good sound ethics go together in the long run. Hence the moral roles of engineers and managers are to be alike, not opposed. As managers, engineers remain professionals whose primary responsibility is to make safe and useful products that are profitable.

The two responsibilities of engineers-cum-managers are

1. Promoting an ethical climate
2. Resolving conflicts

Sometimes, there are areas of overlap in which the responsibilities of engineers and managers move from technical work into management.

1) **Promoting an ethical climate**

“An ethical climate” is a working environment which is conducive to moral conduct and behaviour. Engineers make a vital contributions to such a climate, but managers have greater responsibility than engineers.

Tata, Birla, Reliance, TVS. L & T and such group of reputed companies are examples of large corporations that developed a successful ethical climate, for example, Himalayan Company appointed an “Ethics Director” who was also the Vice President of that corporation. The Director reported to an ethics committee and that committee in turn reported directly to the Board of Directors. He first surveyed the employees about their ethical concerns and degree of ethical awareness.
Later he conducted group discussions and workshops on ethics and wrote weekly articles addressing specific cases and concerns. He made himself directly available to all employees through a confidential phone line. In this way, he served as an ethics ombudsperson, in addition to his role as ethics director of corporation. In all his programmes, the importance was to support ethical conduct, rather than punishing wrong doers. But it was made clear that any unprofessional attitude would not be tolerated within the corporation.

Features of an Ethical Corporate Climate are:

1. The ethical values are to be appreciated by managers and employees alike.
2. The use of ethical language is to be recognized as a part of corporate dialogue.
3. The top management must set a “role model” both in words, policies and by personal example.
4. There should be procedures for conflict resolution. This can be achieved by creating ombudspersons for executives with whom employees can have confidential discussions about moral issues.

6. Write briefly about Engineers as consulting engineers.

Engineers do private practice. They receive fees for their services they render to the clients. They don’t receive any salaries from employees, because of this, they have greater freedom to make decisions about the projects they undertake. Anyhow, they have to share many things in common with salaried engineers.

Here, there are four areas in which consulting engineers have to play the role compatible with professional ethics they are,

1. Advertising
2. Competitive bidding
3. Contingency fees
4. Resolution of disputes.
1. Advertising

Some corporate engineers are involved in advertising because they work in product sales division. Consulting engineers as advertisers have greater responsibility for advertising their services.

Competitive advertising causes friction among those in the field. It reduces their mutual respect. It also damages the profession's public image making engineering as purely money-centered business. Professional advertising is acceptable, when it is honest. Deceptive advertising normally occurs when products are made to look better than they actually are. This can be done in many ways namely.

1. By outright lies
2. By Half-truths
3. By exaggeration
4. By making false promises and suggestions

Advertisers of consumer products generally suppress negative aspects of the items they are promoting. Even they can exaggerate to some extent about the positive aspects. For example, an advertisement for cigarettes which by law must carry health warnings. Strong restrictions on misleading advertisers in all areas are especially important.

2. Competitive Bidding

As per code of ethics, consulting engineers are prevented to take part in competitive bidding. Competitive bidding means quoting for the cost of a project confidentially. The work of a project is allotted based on low bidding, without reduction in quality.

Competitive bidding is permissible for construction companies, because they can prepare cost estimates more accurately based on specifications. Generally consulting engineer has to develop creative designs. To make precise bids, often it is difficult. Under such circumstances competitive bidding will encourage reduction in quality in case of lower bidding or over designing in case of higher bidding.
3. Contingency Fees

Contingency fee is the amount paid to the consulting engineer, based on the performance of satisfactory work. Contingency fee is paid to the consultant only if he saves client’s money. This is the reason why a client prefers a Consultant. A consultant is expected to save maximum or at least 10% of the project cost. If the consultant fails to do so, no contingency fee is paid. The fee paid may be a lump sum as agreed upon or a fixed percentage of the savings.

4. Revolution of Disputes

Large engineering projects involve the owner, the consulting engineer and the construction company. In such big projects, there may arise an inability to resolve disputes. The time in solving disputes, can be better used to improve the quality of the project.

Resolving disputes become more difficult when time of construction is extended for several years. When personnel changes resolution of disputes may be still more difficult.

In a project, a litigation is time-consuming one and costly. To solve disputes, it is better to avoid going to courts. Consulting engineers should always try to solve disputes by means of a dialogue.

7. Write briefly a) Engineer as expert witness.b) Engineer as advisor

At times, engineers have to serve as consultants to provide expert certificate in the court of law. They should be neutral and follow the path of truth. They should not be as “hired guns”, paid to support one side of the case as expert witness in the court.

Let us discuss the court system, wherein, engineers may be involved as expert witnesses either on the side of plaintiff or defendant, in civil and criminal cases. Engineers have to certify a number of cases like defective products, personal injury, damage to property, accidents or airplane crashes. Here, the main thing is, who is to pay “Compensation” for the loss that has happened.
Engineers have to do thorough investigations when they are called by the court to testify. They should keep all information about the case confidential. They should not leak out any information to the opponent, unless court wants to do so, when they are called as witnesses. They should not volunteer themselves to give evidence, favorable to the opponent. They must give evidences truthfully, when opponent lawyers ask related questions.

Engineers are responsible to discover the truth and inform it honestly. The court has to manage the complex system of legal rights and justice. The court should rely on engineers (experts)

Eye witnesses serve as witnesses to certify about the accidents or damages, they have seen by their own eyes. Expert witnesses serve to certify on facts and figures in their areas of expertise.

Expert witnesses have to identify the cause of accidents. They should not be considered as “enemies”. Universally, there is one opinion that engineers must not become “hired guns”, who provides false information, by receiving consulting fees. They are,

1. Hired guns
2. Financial biases
3. Ego biases
4. Sympathy biases

1. Hired Guns

A few engineers violate ethical standards while conducting investigations and act as “hired guns”. These engineers spoil the reputation of entire group of engineers, when they serve as expert witnesses.

A simple example is given below. A mason falls while coming down a ladder and it seriously injured. The mason files a case against the manufacturer of the ladder for compensation towards medical treatment and lost wages. Those who have seen the accidents (witness) gave different statements about whether the accident was caused by a crack in the
ladder or because of manufacturing defect or due to the carelessness of the mason. Mason climbed down very fast, which caused the crack and hence he fell down, which was seen by workers.

The manufacturer hired a structural engineer. He gave report in favor of the manufacturer, stating that, it is not due to structural defect; but due to carelessness of the mason.

The engineer has to be impartial but he acted partially, since he was tempted to favor one side in order to earn money as a “hired gun”.

2. Financial biases

Engineers receiving money from one side will give rise to a form of bias, though it is a small amount. Financial or money bias will influence or twist one’s investigations and certification.

3. Ego biases

Engineers generally give importance to the dispute of their own side. They always see the opponent side as guilty and his own side is always right. In order to get affection from their clients, the always are inclined to serve the interest of their own clients.

4. Sympathy biases

Sometimes court is like a drama stage in which the suffering of people is exposed. The victim’s plight can be easily understood, though they are opponent clients. It is human nature to sympathise with such victims. This sort of biases will influence the investigation of happenings. In order to overcome these biases, engineers should maintain their integrity while serving as expert witnesses.
8. Explain the concept of moral leadership by engineers and discuss the role played by professional societies.

**Moral Leadership**

Engineers as academicians, managers and government servants are to shoulder various forms of leadership. Engineers have to behave as “moral leaders” in their professional fields. The activities and challenges that will improve the quality of engineers as moral leaders and leadership among them will be discussed here.

1. **Morally Creative Leaders**

   It is not so easy to define “Leadership”. Leadership means success in making a group to move towards a goal. Moral leaders are persons who take the groups towards goals. Engineers as moral leaders are to contribute to the communities, professional societies and profession in general. Engineers as more leaders are morally creative. Moral creativity means achieving valuable innovation. The innovation consists of possibilities and values, for putting into practice.

2. **Professional Societies**

   Professional Societies are bodies or organizations recognized by Government in which engineers are members. These societies have been promoted to make the engineers behave and discharge their duties ethically. Professional societies solve the conflicts between engineers and employers amicably and also guide the engineers in the proper direction of discharging their duties. Any violation of “code of ethics” will be viewed seriously by the society and the member engineer will be unrecognized by the society. They cannot practice their profession, until then, recognition is withdrawn. Professional societies also protect the rights of engineers by being members of professional societies, engineers get social status and recognition in the public. Thus, professional societies are “Care taker” and Controlling Authority” for member engineers.
With these ideas in mind, professional societies for different group of engineers have been formed. They are

**Societies in India**

1. Institution of Engineers, India - IE(I)
2. Indian Institute of Materials Management – (IIMM)
3. Institution of Electronics and Telecommunication Engineers – (IITE)

**Societies in USA**

1. American Society of Civil Engineers – (ASCE)
2. American Society of Mechanical Engineers – (ASME)
3. Institution of Electrical and Electronics Engineers – (IEEE) and so on

The above said professional societies have drafted rules and regulations known as “code of ethics” and “code of conduct” for engineers. Engineers are made to follow the “code of ethics”, so as to enable them to discharge their duties ethically.

**Participation in Professional Societies**

Professional societies serve for their members and provide continuing education for updating their knowledge. Professional societies are forums for exchanging knowledge, ideas and concepts in latest developments. Professional societies are neither pro-employer nor pro-management. The members of society are engineers in management, production and supervision. Such professional societies can play a vital role in solving moral issues of engineers.

Professional societies conduct workshops and continuing education programmes on ethics. Such programmes create an awareness among engineers about ethical standards and ethical behaviour.

Engineers haply a dominating role because they create awareness in society about industrial pollution, air pollution, noise pollution, automobile safety and safe disposal of nuclear waste. But nevertheless, the representation by engineers in Government and advisory bodies, is a limited one for small reasons that problems may arise in offering such services.
9. Describe how the sample code of ethics serves as a model guide for professional conduct.

**Code of Ethics by the Institution of Engineers, India – IE(I)**

While the engineers practice their profession for the welfare of the community, they have to bear in their mind the following

1. Ethical Standard
2. Social justice, social order and human rights
3. Protection of the environment
4. Public safety and peace

**The Principles of code of ethics are**

1. A corporate member (engineer) shall utilize his/her knowledge and expertise for the welfare, health and safety of the community without any discrimination for private interest.
2. A corporate member shall maintain the honor, integrity and dignity in all his professional actions.
3. An engineer shall act only in the domains of his competence and with diligence, care, sincerity and honesty.
4. An engineer shall apply his/her knowledge and expertise in the interest of his employer or the clients for whom he shall work without compromising with other obligations.
5. A corporate member shall not misrepresent his/her own or his / her associates qualifications, experience.
6. An engineer shall take all responsible steps to inform his/her employer or clients about the environmental, economic, social consequences which may arise out of his / her actions.
7. He / She shall maintain at most honesty and fairness in making statement or giving witness.
8. He/she shall not directly or indirectly injure the professional reputation of another engineer.

9. He/she shall reject any kind of offer that may be considered as unfair practice.

10. A corporate member shall be concerned about and shall act in the best of his abilities for maintenance of substantiality of the development. He shall not act in any manner which may injure the reputation of the company.

“Code of ethics” includes the professionals and society. It tells a professional about discharging his / her duties and responsibilities in the way of practicing the profession of engineering in society.

“Code of conduct” involves the professional himself/herself. It guides the professional how to conduct himself / herself in the way discharging his / her duties and responsibilities.