DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

PROFESSIONAL ETHICS AND HUMAN VALUES

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PROFESSIONAL ETHICS

HUMAN VALUES

The Story of a Carpenter

An elderly carpenter was ready to retire. He told his employer-contractor of his plans to leave the house- building business and live a more leisurely life with his wife enjoying his extended family.

He would miss his paycheck, but he needed to retire. They could get by. The contractor was sorry to see his good worker go and asked if he could build just one more house as a personal favor.

The carpenter said yes, but in time it was easy to see that his heart was not in his work. He resorted to shoddy workmanship and used inferior materials. It was an unfortunate way to end his career.

When the carpenter finished his work and the builder came to inspect the house, the contractor handed over the house key to the carpenter. "This is your house," he said, "it is my parting gift to you."

What a shock! What a Shame! If only he had known he was building his own house, he would have done it all so differently. Now he had to live in the home he built none too well.

(Modified from LIVING WITH HONOUR by SHIV KHERA)

Do we find ourselves in similar situations as the carpenter?

Moving through our work hours fast paced, driven to "get the job done", without much thought to moral values.

How do we regain our focus as individuals and organizations?

This is the challenge for the employee and the employer.

Ethics are fundamental standards of conduct by which we work as a professional.

VALUES

- Values are individual in nature.
- Values are comprised of personal concepts of responsibility, entitlement and respect.
- Values are shaped by personal experience, may change over the span of a lifetime and may be influenced by lessons learned.
- Values may vary according to an individual's cultural, ethnic and/or faith-based background.

"Never change your core values."

In spite of all the change around you, decide upon what you will never change: your core values.

Take your time to decide what they are but once you do, do not compromise on them for any reason.

Integrity is one such value.

MORALS

- Morals are guiding principles that every citizen should hold.
- Morals are foundational concepts defined on both an individual and societal level.
- At the most basic level, morals are the knowledge of the difference between right and wrong.

PERSONAL ETHICS

- Simply put, all individuals are morally autonomous beings with the power and right to choose their values, but it does not follow that all choices and all value systems have an equal claim to be called ethical.
- Actions and beliefs inconsistent with the Six Pillars of Character - trustworthiness, respect, responsibility, fairness, caring and citizenship - are simply not ethical.

PERSONAL ETHICS - everyday examples

- Software piracy
- Expense account padding
- Copying of homework or tests
- Income taxes
- "Borrowing" nuts and bolts, office supplies from employer
- Copying of Videos or CD's
- Plagiarism
- Using the copy machine at work

RELIGION AND ETHICS

- The "Golden Rule" is a basic tenet in almost all religions: Christian, Hindu, Jewish, Confucian, Buddhist, Muslim.

- "Do unto others as you would have others do unto you."
    - "Treat others as you would like them to treat you" (Christian).
    - "Hurt not others with that which pains you" (Buddhist)
    - "What is hateful to yourself do not do to your fellow men" (Judaism)
    - "No man is a true believer unless he desires for his brother that which he desires for himself" (Islam)

MORALITY AND ETHICS

- Concerns the goodness of voluntary human conduct that affects the self or other living things
- Morality (Latin *mores*) usually refers to any aspect of human action
- Ethics (Greek *ethos*) commonly refers only to professional behavior
- Ethics consist of the application of fundamental moral principles and reflect our dedication to fair treatment of each other, and of society as a whole.
- An individual's own values can result in acceptance or rejection of society's ethical standards because even thoughtfully developed ethical rules can conflict with individual values.

ASPECTS OF ETHICS

There are two aspects to ethics:

- The first involves the ability to discern right from wrong, good from evil and propriety from impropriety.
- The second involves the commitment to do what is right, good and proper. Ethics entails action.

An ALGEBRA course will teach you ALGEBRA.
A HISTORY course will teach you HISTORY.
A MANAGEMENT course will teach you principles of MANAGEMENT.

But, Will an *ETHICS* course teach you to be E*THICAL*?
Think !

ENGINEERING ETHICS

"Technology can have no legitimacy unless it inflicts no harm"-Adm.H.G. Rickover, father of the US nuclear navy.

- *What does Adm. Rickover mean by this?*
- *Should engineers avoid technology that has the potential for inflicting harm on a society or its members?*

- Engineers have an ethical and social responsibility to themselves, their clients and society.
- Practically (although there is much debate about this), engineering ethics is about balancing cost, schedule, and risk.

ENGINEERING ETHICS is:

- the study of moral issues and decisions confronting individuals and organizations involved in engineering and
- the study of related questions about moral ideals, character, policies and relationships of people and organizations involved in technological activity.

TRAINING IN PREVENTIVE ETHICS

- Stimulating the moral imagination
- Recognizing ethical issues
- Developing analytical skills
- Eliciting a sense of responsibility
- Tolerating disagreement and ambiguity

IMPEDIMENTS TO RESPONSIBILITY

- Self-interest.
- Fear.

- Self-deception.
- Ignorance.
- Egocentric tendencies.
- Microscopic vision.
- Groupthink.

QUESTIONABLE ENGINEERING PRACTICES

- Trimming – "smoothing of irregularities to make data look extremely accurate and precise"
- Cooking – "retaining only those results that fit the theory and discarding others".
- Forging – "inventing some or all of the research data…"
- Plagiarism – misappropriating intellectual property.
- Conflicts of interest (such as accepting gifts.)
  - actual
  - potential
  - apparent

CLEARLY WRONG ENGINEERING PRACTICES

- Lying
- Deliberate deception
- Withholding information
- Failing to adequately promote the dissemination of information
- Failure to seek out the truth
- Revealing confidential or proprietary information
- Allowing one's judgment to be corrupted.

<u>SENSES OF EXPRESSION OF ENGG. ETHICS</u>

⇨ Ethics is an activity and area of inquiry. It is the activity of understanding moral values, resolving moral issues and the area of study resulting from that activity.

- ⇨ When we speak of ethical problems, issues and controversies, we mean to distinguish them from non moral problems.
- ⇨ Ethics is used to refer to the particular set of beliefs, attitudes and habits that a person or group displays concerning moralities.
- ⇨ Ethics and its grammatical variants can be used as synonyms for 'morally correct'.

VARIETIES or APPROACHES OF MORAL ISSUES

MICRO-ETHICS emphasizes typically everyday problems that can take on significant proportions in an engineer's life or entire engineering office.

MACRO-ETHICS addresses societal problems that are often shunted aside and are not addressed until they unexpectedly resurface on a regional or national scale.

MORAL PROBLEMS IN ENGINEERING
(SOME EXAMPLES)

4.1. An inspector discovered faulty construction equipment and applied a violation tag, preventing its use. The supervisor, a construction manager viewed the case as a minor abrasion of the safety regulations and ordered the removal of the tag to speed up the project. When the inspector objected to this, he was threatened with disciplinary action.

4.2. An electric utility company applied for a permit to operate a nuclear power plant. The licensing agency was interested in knowing what emergency measures had been established for humans safety in case of reactor malfunctioning. The utility engineers described the alarm system and arrangements with local hospitals for treatment. They did not emphasize that this measures applied to plant personnel only and that they had no plans for the surrounding population. When enquired about their omission, they said it was not their responsibility.

4.3. A chemical plant dumped wastes in a landfill. Hazardous substances found their way into the underground water table. The plant's engineers were aware of the situation but did not

change the method of disposal because their competitors did it the same cheap way, and no law explicitly forbade the practice.

4.4. Electronics Company ABC geared up for production of its own version of a popular new item. The product was not yet ready for sale, but even so, pictures and impressive specifications appeared in advertisements. Prospective customers were led to believe that it was available off the shelf and were drawn away from competing lines.

TYPES OF INQUIRIES

1. NORMATIVE INQUIRY

These are about 'what ought to be' and 'what is good'. These questions identify and also justify the morally desirable norms or standards.

Some of the questions are:

A. How far engineers are obligated to protect public safety in given situations?

B. When should engineers start whistle blowing on dangerous practices of their employers?

C. Whose values are primary in taking a moral decision, employee, public or govt?

D. Why are engineers obligated to protect public safety?

E. When is govt justified in interfering on such issues and why?

2. CONCEPTUAL INQUIRY:

These questions should lead to clarifications on concepts, principles and issues in ethics. Examples are:

A) What is 'SAFETY' and how is it related to 'RISK'

B) 'Protect the safety, health and welfare of public'-What does this statement mean?

C) What is a bribe?

D) What is a 'profession' and who are 'professionals'?

3. FACTUAL (DESCRIPTIVE) INQUIRIES

These are inquiries used to uncover information using scientific techniques. These inquiries get to information about business realities, history of engineering profession, procedures used in assessment of risks and engineers psychology.

Why study *ENGINEERING ETHICS*

ENGINEERING ETHICS is a means to increase the ability of concerned engineers, managers, citizens and others to responsibly confront moral issues raised by technological activities.

MORAL DILEMMMA

There are three types of complexities.

- ⇨ VAGUENESS: This complexity arises due to the fact that it is not clear to individuals as to which moral considerations or principles apply to their situation.

- ⇨ CONFLICTING REASONS: Even when it is perfectly clear as to which moral principle is applicable to one's situation, there could develop a situation where in two or more clearly applicable moral principles come into conflict.

- ⇨ DISAGREEMENT: Individuals and groups may disagree how to interpret, apply and balance moral reasons in particular situations.

Steps in confronting MORAL DILEMMAS:

i) Identify the relevant moral factors and reasons.

ii) Gather all available facts that are pertinent to the moral factors involved.

iii) Rank the moral considerations in the order of their importance as they apply to the situation.

iv) Consider alternative course of action, tracing the full implications of each, as ways of solving dilemma.

v) Talk with colleagues, seeking the suggestions and perspectives of the dilemma.

vi) Arrive at a carefully reasoned judgment by weighing all the relevant moral factors and reasons in light of facts.

All the above steps are distinct, even though they are inter-related and can often be taken jointly

MORAL AUTONOMY

- This is viewed as the skill and habit of thinking rationally about ethical issues on the basis of moral concerns independently or by self-determination.
- Autonomous individuals think for themselves and do not assume that customs are always right.
- They seek to reason and live by general principles.
- Their motivation is to do what is morally reasonable for its own sake, maintaining integrity, self-respect, and respect for others.

"One who breaks an unjust law must do so openly, lovingly, and with a willingness to accept the penalty. I submit that an individual who breaks a law that conscience tells him is unjust and willingly accepts the penalty… is in reality expressing the highest respect for the law." *Rev. Martin Luther King, Jr.* in Letter from a Birmingham Jail, 1963.

A person becomes morally autonomous by improving various practical skills listed below:

i) Proficiency is recognizing moral problems and issues in engineering.

ii) Skill in comprehending, clarifying and critically assessing arguments on opposing sides of moral issues.

iii) The ability to form consistent and comprehensive viewpoints based upon consideration of relevant facts.

iv) Awareness of alternate responses to issues and creative solutions for practical difficulties.

v) Sensitivity to genuine difficulties and subtleties

vi) Increased precision in the use of a common ethical language necessary to express and also defend one's views adequately.

vii) Appreciation of possibilities of using rational dialogue in resolving moral conflicts and the need for tolerance of differences in perspective among orally reasonable people.

viii) A sense of importance of integrating one's professional life and personal convictions i.e. maintaining one's moral integrity.

KOHLBERG'S THEORY

STAGES OF MORAL DEVELOPMENT

- ***Pre-conventionalLevel***

  Whatever benefits oneself or avoids punishment. This is the level of development of all young children. -Avoid punishment & Gain Reward

- ***ConventionalLevel***

  Uncritical acceptance of one's family, group or society are accepted as final standard of morality. Most adults do not mature beyond this stage. -1.Gain Approval & Avoid Disapproval & 2. Duty & Guilt

- ***Post-conventionalLevel***

  Motivation to do what is morally reasonable for its own sake, rather than solely from ulterior motives, with also a desire to maintain their moral integrity, self-respect and the respect of other autonomous individuals. They are 'Morally autonomous' people. -1. Agreed upon rights & 2. Personal moral standards

GILLIGAN'S THEORY

- ***Pre-conventional Level***

  This is the same as Kohlberg's first level in that the person is preoccupied with self centered reasoning, caring for the needs and desires of self.

- ***Conventional level***

  Here the thinking is opposite in that, one is preoccupied with not hurting others and a willingness to sacrifice one's own interests in order to help or nurture others (or retain friendship).

- ***Post-conventional Level***

  Achieved through context-oriented reasoning, rather than by applying abstract rules ranked in a hierarchy of importance. Here the individual becomes able to strike a reasoned balance between caring about other people and pursuing one's own self-interest while exercising one's rights.

Differences between the TWO THEORIES

KOHLBERG	GILLIGAN
I. Ethics of rules and rights	*Ethics of care*
II. Studies based on well educated, white male's only, tending male bias.	*Studies included females and colored peoples*
III. Application of abstract rules ranked in the order of importance	*Application of context-oriented reasoning.*
IV. Studies were hypothesized for both the genders even though the study was conducted mostly on males	*Study was conducted on both genders and it was found, men based their reasoning on 'justice' and women based theirs on 'care'*

HEINZ'S DILEMMA

The famous example used by Kohlberg was called "Heinz's dilemma". A woman living in Europe would die of cancer unless she was given an expensive drug. Her husband, Heinz, could not afford it. But the local pharmacist, who had invented the drug at only one tenth of the sale price refused to sell it to Heinz who could only raise half the required money from borrowings. Desperation drives Heinz to break into the pharmacy and steal the drug to save his wife.

When respondents were asked whether and why Heinz should or should not steal a drug to save his wife from a life-threatening illness. The responses of the individuals were compared with a prototypical response of individuals at particular stages of moral reasoning. Kohlberg noted that irrespective of the level of the individual the response could be same, but the reasoning could be different.

For example, if a child reasoning at a 'preconventional' level might say that it is not right to steal because it is against law and someone might see you.

At a 'conventional' level, an individual might argue that it is not right to steal because it is against law and laws are necessary for society to function.

At a 'postconventional' level, one may argue that stealing is wrong because is against law and it is immoral.

CONSENSUS AND CONTROVERSY

CONTROVERSY:

- All individuals will not arrive at same verdict during their exercising their moral autonomy.
- Aristotle noted long ago that morality is not as precise and clear-cut as arithmetic.

- Aim of teaching engg ethics is not to get unanimous conformity of outlook by indoctrination, authoritarian and dogmatic teaching, hypnotism or any other technique but to improve promotion of tolerance in the exercise of moral autonomy.

CONSENSUS:

The conductor of a music orchestra has authority over the musicians and his authority is respected by them by consensus as otherwise the music performance will suffer. Hence the authority and autonomy are compatible.

On the other hand, tension arises between the needs for autonomy and the need for concerns about authority. The difference between the two should be discussed openly to resolve the issue to the common good.

PROFESSIONS AND PROFESSIONALISM

Engineers normally imagine that they are servants to organizations rather than a public guardian. Responsibility to the public is essential for a professional.

Who is a professional?

- Obviously a *member* of a profession.

What is a profession?

'JOB' or 'OCCUPATION' that meets the following criteria from which a person *earns his living.*

- Knowledge – Exercise of skills, knowledge, judgment and discretion requiring extensive formal criteria.
- Organization - special bodies by members of the profession to set standard codes of ethics,
- Public good-The occupation serves some important public good indicated by a code of ethics.

Who is a professional engineer?

- Has a bachelor's degree in engineering from an accredited school
- Performs engineering work
- Is a registered and licensed Professional Engineer
- Acts in a morally responsible way while practicing engineering

Differing views on Professionals

"Only consulting engineers who are basically independent and have freedom from coercion can be called as professionals." -Robert L.Whitelaw

"Professionals have to meet the expectations of clients and employers. Professional restraints are to be imposed by only laws and government regulations and not by personal conscience."
-Samuel Florman

"Engineers are professionals when they 1) attain standards of achievement in education, job performance or creativity in engineering and 2) accept the most basic moral responsibilities to the public as well as employers, clients, colleagues and subordinates."
-Mike Martin & Roland Schinzinger

MOTIVES FOR PROFESSIONALISM

- A desire for interesting and challenging work and the pleasure in the act of changing the world.
- The joy of creative efforts. Where a scientist's interest is in discovering new technology, engineers interest is derived from creatively solving practical problems.
- The engineer shares the scientist's job in understanding the laws and riddles of the universe.

- The sheer magnitude of the nature – oceans, rivers, mountains and prairies – leads engineers to build engineering marvels like ships, bridges, tunnels, etc., which appeal to human passion.
- The pleasure of being in the presence of machines generating a comforting and absorbing sense of a manageable, controlled and ordered world.
- Strong sense of helping, of directing efforts towards easing the lot of one's fellows.

The main pleasure of the engineer will always be to contribute to the well-being of his fellow-men.

MODELS OF PROFESSIONAL ENGINEERS

1. SAVIOR: The representative engineer is a savior who will redeem society from poverty, inefficiency, waste and the drudgery of manual labour.
2. GUARDIAN: Engineers know, the directions in which and pace at which, technology should develop.
3. BUREAUCRATIC SERVANT: The engineer as the loyal organization person uses special skills to solve problems.
4. SOCIAL SERVANT: Engineers, in co-operation with management, have the task of receiving society's directives and satisfying society's desires.
5. SOCIAL ENABLER AND CATALYST: Engineers play a vital role beyond mere compliance with orders. They help management and society understand their own needs and to make informed decisions.
6. GAME PLAYER: Engineers are neither servants nor masters of anyone. They play by the economic game rules that happen to be in effect at a given time.

TYPES OF ETHICAL THEORIES

S.NO	TYPES	BASED ON
1	Virtue ethics	Virtues and vices

2	Utilitarianism	Most good for most people
3	Duty ethics	Duties to respect persons
4	Rights ethics	Human Rights

VIRTUE ETHICS

- *"The unexamined life is not worth living."* (Socrates, 470-399 B.C.)
- *"The happy life is thought to be virtuous; now a virtuous life requires exertion and does not consist in amusement."* (Aristotle, 384-322 B.C.)

The Four Main Virtues

- Prudence (mind): to think about a moral problem clearly and completely
- Temperance (emotions): control attraction to positive emotions
- Fortitude (emotions): control aversion for negative emotions
- Justice (will): choose according to truth and fairness.

Virtue Ethics

- Focuses on the type of person we should strive to be
- Actions which reflect *good character* traits (virtues) are inherently *right*
- Actions which reflect *bad character* traits (vices) are inherently *wrong*
- Virtue ethics are tied more to individual behavior than to that of an organization (e.g. business, government)

ARISTOTLE says that moral virtues are tendencies, acquired through habit formation, to reach a proper balance between extremes in conduct, emotion, desire and attitude i.e. virtues are tendencies to find the Golden Mean between the extremes of too much and too little.

Some of the virtues are defined using examples here:

Virtue	Too much	Too less
(Golden mean between extremes)		
Courage	*Foolhardiness*	*Cowardice*
Truthfulness	*Revealing all in violation of tact and confidentiality*	*Being secretive or lacking in candor*
Generosity	*Wasting one's resources*	*Being miserly*
Friendliness	*Being annoyingly effusive*	*Sulky or surly*

PROFESSIONAL RESPONSIBILITY

- Being morally responsible as a professional.
- Most basic and comprehensive professional virtue.
- Creation of useful and safe technological products while respecting the autonomy of clients and public, especially in matters of risk taking.

This encompasses a wide variety of the more specific virtues grouped as follows:

1. **SELF DIRECTION VIRTUES:**
   Fundamental virtues in exercising our moral autonomy and responsibility. e.g. self understanding, humility, good moral judgment, courage, self discipline, perseverance, commitments, self-respect and dignity
2. **PUBLIC SPIRITED VIRTUES:**
   Focusing on the good of the clients and public affected by the engineers' work by . not directly and intentionally harming others i.e. 'nonmaleficence'.
   Benificence, sense of community, generosity are other virtues falling in this category.
3. **TEAMWORK VIRTUES:**
   Enables professionals to work successfully with others. E.g. collegiality, cooperativeness, the ability to communicate, respect for authority, loyalty to employers and leadership qualities.

4. PROFICIENCY VIRTUES:

Mastery of one's craft that characterize good engineering practice e.g. competence, diligence, creativity, self-renewal through continuous education.

MORAL INTEGRITY

Moral integrity is the unity of character on the basis of moral concern, and especially on the basis of honesty. The unity is consistency among our attitudes, emotions and conduct in relation to justified moral values.

SELF-RESPECT

- Valuing oneself in morally appropriate ways.
- Integral to finding meaning in one's life and work
- A pre-requisite for pursuing other moral ideals and virtues.
- Self-respect is a moral concept of properly valuing oneself but self-esteem is a psychological concept of positive attitude towards oneself.

Self-respect takes two forms.

1. *Recognition self-respect* is properly valuing oneself because of one's inherent moral worth, the same worth that every other human being has.

2. *Appraisal self-respect* is properly valuing ourselves according to how well we meet moral standards and our personal ideals.

VARIOUS SENSES OF RESPONSIBILITY

Responsibility ascribed by i) virtue, ii) obligations, iii) general moral capacities of people, iv) liabilities and accountability for actions and v) blameworthiness or praiseworthiness.

1. By virtue: A person is said to be a responsible person when we ascribe a moral virtue to the person. We expect that the person is regularly concerned to do the right thing, is conscientious and diligent in meeting obligations. In this sense, professional responsibility is the central virtue of engineers.

2. By obligation: Moral responsibilities can be thought of as obligations or duties to perform morally right acts.

3. By general moral capacity: When we view a person as a whole rather than one with respect to a specific area, we are actually thinking about the active capacity of the person for knowing how to act in morally appropriate ways e.g. the capacity of children grow as they mature and learn.

4. By accountability: Responsibility also means being accountable, answerable or liable to meet particular obligations. The virtue of professional responsibility implies a willingness to be accountable for one's conduct.

5. By being blameworthy: When accountability for a wrongdoing is at issue, responsible becomes a synonym for blameworthy. When right conduct is the issue, the context is praiseworthiness.

CAUSAL AND LEGAL RESPONSIBILITIES

Causal Responsibility: consists simply in being a cause of some event. E.g. lightning as being responsible for a house catching fire.

Legal Responsibility: consists simply in being a cause for harm that was so unlikely and also unforeseeable that no moral responsibility is involved

UTILITARIANISM

- That which produces the maximum benefit for the greatest number of people (e.g. Democracy)
- Tries to achieve a balance between the good and bad consequences of an action
- Tries to maximize the well-being of society and emphasizes what will provide the most benefits to the largest group of people
- This method is fundamental to many types of engineering analysis, including risk-benefit analysis and cost-benefit analysis

Drawbacks:

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

Organizing Principles to Resolving Ethical Issues

- Utilitarian thinking

– a standard that promotes those individual actions or rules that produce the greatest total amount of utility to those affected.

– A code that enjoins engineers to promote the safety, health, and welfare of the public.

– What is utility, though? Happiness?

- Preference utilitarianism

– promote those conditions that allow each individual to pursue happiness as he or she conceives it.

– Two conditions necessary for this: freedom and well-being.
– Practically, for engineers, this advocates cost/benefit analyses.

Problems with Utilitarianism

- Difficult to quantify benefits for ALL those affected.
- "Greatest good" difficult to apply to an all-inclusive population.
- Someone gets "shafted" – approach justifies perpetrating injustice on individuals, i.e., someone gets left out.

- Three approaches:

1. Cost/benefit – quantifiable approach. Maximize positive utilities (benefits) against negative utilities (costs).
2. Act utilitarian – "Will the course of action produce more good than any alternative course of action that I could take"?
3. Rule utilitarian – "Would utility be maximized if everyone did the same thing in the same circumstances"? Adoption of commonly accepted rules.

1. COST-BENEFIT ANALYSIS:

- Assess the available options
- Assess the costs and benefits of each option for the entire audience affected
- Make the decision that is likely to result in the greatest benefit relative to cost.

2. ACT-UTILITARIANISM:

(professed by John Stuart Mills)

- Focuses on individual actions, rather than general rules.
- An act is right if it is likely to produce the most good for the most people involved in the particular situation.
- Rules may be broken whenever doing so will produce the most good in a specific situation.

- Happiness is the only 'intrinsic' good and all others are 'instrumental' goods that serve as the means of happiness.

3. RULE-UTILITARIANISM:

(professed by Richard Brandt)

- This regards moral values as primary.
- We should follow the rules and avoid bribes, even when those acts do not have the best consequences in a particular situation, because the general practice of following rules and not bribing produce the most overall good
- Rules should be considered in sets called 'moral codes'. A moral code is justified when followed, would maximize the public good more than alternative codes would.

DUTY ETHICS (Immanuel Kant's view)

Contends that certain acts (or duties) should be performed because they are inherently ethical such as:

- be honest,
- keep promises,
- do not inflict sufferings on other people,
- be fair,
- make reparation when you have been unfair,
- how gratitude for kindness extended by others
- seek to improve own intelligence and character,
- develop one's talents,
- don't commit suicide.

- Duties, rather than good consequences, is fundamental.
- Individuals who recognize their ethical duties will choose ethically correct moral actions

These duties should meet Kant's 3 conditions i.e.

1. It should express respect for persons,

- People deserve respect because they have capacity to be *autonomous and for exercising goodwill*.
- Goodwill is the *conscientious and honest effort* to do what is right according to universal principles of duties.
- Moral motives and intentions play a prominent role in duty ethics rather than utilitarianism.

2. It is an universal principle
   - Duties are binding on us only if they are applicable to everyone. They must be universalisable.

3.It expresses command for autonomous moral agents. Duties prescribe certain actions categorically, without qualifications or conditions attached. Valid principles of duties are *Categorical Imperatives*. They contrast with non-moral commands called *Hypothetical Imperatives* which are conditional.

The above ➡ 'RESPECT for PERSONS'

<u>*Drawback of Kant's duty ethics:*</u> It has failed to be sensitive to how principles of duty can *conflict* with each other thereby creating Moral dilemmas.

Rawls Development on Kant's Duty Ethics

Rawls argues that all rational people would agree to abide by two basic moral principles:

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

RIGHTS ETHICS (JOHN LOCKE – 1632-1704)

- Everyone has inherent moral rights
- Everyone has rights that arise from *EXISTING* (i.e. right to Life, maximum individual Liberty, and human Dignity are Fundamental Rights).
- Other rights arise as a Consequence.
- Duties arise because people have rights, not vice versa.
- Any act that violates an individual's moral rights is ethically unacceptable.
- Rights ethics was highly individualistic.
- Rights are primarily entitlements that prevent other people from meddling in one's life. These are referred to as Liberty Rights or Negative Rights that place duties on other people not to interfere with one's life.

e.g. Individuals do not have rights to life because others have duties not to kill them. Instead, possessing the right to life is the reason why others ought not to kill them.

Drawbacks

- How do we prioritize the rights of different individuals?
- Rights ethics often promote the rights of individuals at the expense of large groups/society

A.I.Melden's version of Rights Ethics

- Human rights are intimately related to communities of people.
- This version is known as POSITIVE WELFARE RIGHTS and is defined as rights to community benefits for living a minimally decent human life.

EVALUATION OF ETHICAL THEORIES

We are basically not interested in which of the ethical theories is the best. It is believed that there are areas in which each theory complements others by how they differ.

Procedure for General Evaluation:

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

SELF-INTEREST AND ETHICAL EGOISM

Psychological Egoism

All of our actions can be reduced to self-interest

- We always do what we most *want* to do. e.g., a man who helps others has *chosen* to do so, so he sees doing it, is in his *self-interest*
- We do what makes us feel good. e.g., a man who helps others must get *pleasure* from doing it – hence it is in his *self-interest*

The Problem of Counter Examples

What about *charity* and *pity*?

These require the egoist to distinguish selfish and unselfish *acts* from selfish and unselfish *motives*

- Charity – I enjoy showing *my power*
- Pity – I worry that it might happen to *me*

So again, doing these, we act from *self-interest*

Confusion over self-interest and selfishness

- Not all actions are done from selfishness
- Brushing my teeth (self-interested but not selfish)

Also confusion over self-interest and pleasure

- Not all actions are done from self-interest
- Smoking cigarettes (pleasurable but not self-interested)

- *Self-interest = any interest the self has*

What do all major Ethical Theories say about this?

All major theories acknowledge the *importance* of Self Interest.

- Utilitarians take into account one's own good as well as others.
- Duty ethics emphasizes duties to ourselves.
- Right ethicists talk about our rights to pursue our own good.
- Virtue ethicists emphasize the importance of self-respect.

But all these theories also emphasize that the pursuit of self interest must be balanced with our moral responsibilities to others.

Ethical Egoism

- A different view, which talks of morality as only the pursuit of self interest
- Self interest is a 'rational concern' requiring consideration of one's long-term interests.

E.g., taking bribe may appear to serve one's self interest but it does not serve the long-term interest of self. Hence taking bribe is not acceptable since it would not do any good on a long-term. This was professed by Thomas Hobbes (1588-1679) and Ayn Rand (1905-1982).

- Ayn Rand – with only one life to live, the individual is of utmost importance
- It is in one's self-interest to adopt the Moral Point of View (Hobbes' Social Contract)

CUSTOMS and ETHICAL RELATIVISM

Relativism:

- Distinction between "morals" ("treatment of others") and "mores" ("harmless customs")

Cultural (Descriptive) Relativism:

- Factual Claims: "x is considered right in society y at time t" and "is considered wrong in society z at time t"
- Empirical Conclusion: Moralities are relative
- This is either true or false (anthropology –a study of mankind , its customs, beliefs, etc.can figure it out)

Normative (Ethical) Relativism:

- Normative Claim: "What is considered right in society x at time t *is right for that society*"
- A particular culture cannot be judged from outside of that culture.
- 'Ethical Relativism' says that actions are morally right when they are approved by law and custom.
- They are wrong when they violate laws and custom.
- Ethical *egoism* tries to reduce moral reasons to matters of self interest, 'ethical *relativism*' attempts to reduce moral values to laws, conventions and customs of particular societies.

Consequences of Normative Relativism

- We cannot say other "morals" are inferior to our own society's
- We decide the value of our actions based only on what our particular society thinks
- We should show a lot of tolerance for different customs and outlooks in a society in which we live in. It means that customs can have moral significance in deciding how we should act. This view is called 'ethical pluralism'.

Reasons for Acceptance Of Ethical Relativism

The reasons professed for acceptance of ethical relativism is threefold.

1. Laws seem so tangible and clear-cut. They provide a public way ending seemingly endless disputes about rights and wrongs. But many times, moral reasons seem to be at variance with laws e.g. apartheid laws.

2. Moral standards vary dramatically from one culture to another. The only kind of objectivity possible is limited to a given set of laws in a given society. Acknowledging this relativity of morality encourages the virtue of tolerance of differences among societies.

3. Moral judgments should be made in relation to factors that from case to case, usually making it impossible to formulate rules which are simple. Customs and laws are usually morally relevant factors that should be taken into account.

RELIGION and DIVINE COMMAND ETHICS

Ethics and Religion:

Moral issues and religious belief are related in several positive ways.

- First, they are shaped over time from the central moral values of major world religions.
- Second, religious views often support moral responsibility by providing additional motivation for being moral.

- Third, sometimes religions set a higher moral standard than is conventional.
- Societies often benefit from a variety of religions that make prominent particular virtues, inspiring their members to pursue them beyond what is ordinarily seen as morally obligatory.

Divine Command Ethic:

- This says that an act which is right is commanded by god and the one which is wrong is forbidden by God.
- The difficulty in this is to know precisely what God's commands are and in knowing whether God exists.

We can view that moral reasons are *not reducible* to religious matters, although religious belief may provide an *added inspiration* for responding to them.

Uses Of Ethical Theories

1. Ethical theories aid in identifying the moral considerations or reasons that constitute a dilemma.
2. They provide a precise sense of what kinds of information are relevant to solving moral development.
3. They sometimes, offer ways to rank the relevant moral considerations in order of importance and provide a rough guidance in solving moral problems.
4. The theories help us identify the full moral ramifications of alternative courses of action, urging a wide perspective on the moral implications of the options and providing a systematic framework of comparing alternatives.
5. The theories augment the precision with which we use moral terms and they provide frame works for moral reasoning when discussing moral issues with colleagues.
6. By providing frame works for development of moral arguments, the theories strengthen our ability to reach balanced and insightful judgments.

UNIT III - ENGINEERING AS SOCIAL EXPERIMENTATION

To undertake a great work and especially a work of novel type means, carrying out an experiment. It means taking up a struggle with the forces of nature without the assurance of emerging as a victor after the first attack.

Louis Marie Henri Navier (1785 - 1836) - *Founder of Structural Analysis*

ENGINEERING AS EXPERIMENTATION

- Experimentation (Preliminary tests or Simulations) plays a vital role in the design of a product or process.
- In all stages of converting a new engineering concept into a design like,
    - ⇨ first rough cut design,
    - ⇨ usage of different types of materials and processes,
    - ⇨ detailed design,
    - ⇨ further stages of work design and
    - ⇨ the finished product,

Experiments and tests are conducted to evaluate the product. Modifications are made based on the outcome of these experiments.

- The normal design process is thus iterative (modifications being made on the basis of feedback information acquired from the tests).

Even though various tests and experiments are conducted at various stages, the engineering project as a whole in its *totality* can be viewed as an *experiment.*

SIMILARITIES TO STANDARD EXPERIMENTS

1. Any project is carried out in partial ignorance due to
    - The uncertainties in the abstract model used for the design calculations,
    - The uncertainties in the precise characteristics of the materials purchased,

- The uncertainties caused by variations in processing and fabrication of materials and
- The uncertainties about the nature of stresses the finished product will encounter.

Indeed, Engineer's success lies in the *ability to accomplish tasks* with only a *partial knowledge* of scientific laws about nature and society.

2. The final outcome of engineering projects, like those of experiments, is generally uncertain. Very often, possible outcomes are not even known and great risks may be presented which could never be thought of.

3. Effective Engineering relies upon knowledge gained about products both before and after they leave the factory- knowledge needed for improving current products and creating better ones. That is, ongoing success in engineering depends upon gaining new knowledge.

LEARNING FROM THE PAST

Engineers should learn not only from their own earlier design and operating results, but also from other engineers.

Engineers repeat the past mistakes of others due to the following reasons.

- Lack of established channels of communication.
- Misplaced pride in not asking for information
- Embarrassment at failure or fear of litigation (legal problems).
- Negligence.

***Examples**:*

1. The *Titanic* lacked sufficient number of life boats resulting in the death of 1522 out of 2227 (life boat capacity available was only 825), a few decades later *Arctic* perished due to the same problem.

2. In June 1966, a section of the Milford Haven Bridge in Wales collapsed during construction. A bridge of similar design, erected by the same bridge- builder in Melbourne, Australia, also partially collapsed in the month of October, same year. During this incident 33 people were killed and many were injured.

3. Malfunctions occurred at nuclear reactors at various locations and the information reports were with Babcock and Wilcox, the reactor manufacturer. In spite of these, no attention was paid leading to a pressure relief valve giving rise to the Three Mile Island nuclear accident on March 28, 1979.

CONTRASTS WITH STANDARD EXPERIMENTS

1. EXPERIMENTAL CONTROL: In standard experiments, members are in two different groups. Members of *one group receive special* experimental treatment. The other group members, called '*control group' do not receive* special treatment, though they are from the same environment in all other respects.

But this is not true in engineering, since most of the experiments are not conducted in laboratories. The subjects of experiments are human beings who are outside the experimenter's control.

Thus it is not possible to study the effects of changes in variable on different groups. Hence only historical and retrospective data available about various target groups has to be used for evaluation. Hence engineering as a social experimentation seems to be an extended usage of the concept of experimentation.

2. INFORMED CONSENT: has two elements, *knowledge* and *voluntariness*. The subjects (human beings) should be given all the information needed to make a reasonable decision. Next, they must get into the experiment without being subjected to *force, fraud or deception*. Supplying complete information is neither necessary nor in most cases possible. But *all relevant information* needed for making a reasonable decision on whether to participate should be conveyed. Generally, we all prefer to be the subject of our own experiments rather than those of somebody else.

Conditions defining *Informed or Valid Consent*

a. The consent is given voluntarily
b. The consent is based on information a rational person would want, together with any other information requested and presented to them in understandable form.
c. The consenter was competent to process the information and make rational decisions.
d. Information has been widely disseminated.
e. The subject's consent is offered by proxy by a group that collectively represents many subjects like interests, concerns and exposure to risk.

'Engineering experiments are not conducted to gain new knowledge unlike scientific experiments'. Is this distinction necessary?

This distinction is not vital because we are concerned *about the manner* in which the experiment is conducted, such as *valid consent* of human subjects being sought, *safety measures* taken and means exist for *terminating* the experiment *at any time* and providing all participants a *safe exit*.

Features of morally responsible engineers in social experimentation

***Conscientiousness*:** A primary obligation to protect the safety of human subjects and respect their right of consent.

***Relevant information*:** A constant awareness of the experimental nature of any project, imaginative forecasting of its possible side effects and a reasonable effort to monitor them.
Moral autonomy: Autonomous, personal involvement in all steps of the project.
Accountability: Accepting accountability for the results of the project.

CONSCIENTIOUSNESS:

- Conscientious moral commitment means sensitivity to the full range of relevant moral values.
- Sensitivity to responsibilities that is relevant.
- Willingness to develop the skill and expend the effort needed to reach the best balance possible among these considerations.
- Conscientiousness means consciousness because mere intent is not sufficient.

Conceiving engineering as social experimentation restores the vision of engineers as guardians of the public interest in that they are duty bound to guard the welfare and safety of those affected by engg projects.

RELEVANT INFORMATION:

Conscientiousness is blind without relevant factual information. Moral concern involves a commitment to obtain and assess all available pertinent information. Another dimension to factual information is the consequences of what one does. While regarding engg as social experimentation points out the importance of context, it also urges the engineer to view his or her specialized activities in a project as part of a larger whole having a social impact that may involve a variety of unintended effects. It may be better to practice 'defensive engg' (Chauncy Starr) or 'preventive engg' (Ruth Davis).

MORAL AUTONOMY

- People are morally autonomous when their moral conduct and principles of action are their own.

- Moral beliefs and attitudes must be a critical reflection and not a passive adoption of the particular conventions of one's society, religion or profession.
- Moral beliefs and attitudes cannot be agreed to formally and adhered to merely verbally.
- They must be integrated into the core of one's personality and should lead to committed action.
- It is wrong to think that as an employee when one performs '*acts'* serving company's interests, one is no longer morally and personally identified with one's actions.
- Viewing engg as a social experimentation helps to overcome this flawed thought and restores a sense of autonomous participation in one's work.
    - As an experimenter, an engineer is exercising the specialized training that forms the core of one's identity as a professional.
    - A social experiment that can result in unknown consequences should help inspire a critical and questioning attitude about the adequacy of current economic and safety standards.
    - In turn, this leads to better personal involvement with work.

ACCOUNTABILITY:

- Responsible people accept moral responsibility for their actions.
- Accountability is the willingness to submit one's actions to moral scrutiny and be open and responsive to the assessment of others.
- It should be understood as being culpable and blameworthy for misdeeds.

Submission to an employer's authority creates in many people a narrow sense of accountability for the consequences of their action. This is because of

i) Only a small contribution is made by one individual, when large scale engineering work is fragmented. The final product which is far away from one's immediate workplace, does not give a proper understanding of the consequences of one's action.

ii) Due to the fragmentation of work, a vast diffusion of accountability takes place. The area of personal accountability is delimited to the portion of work being carried out by one.

iii) The pressure to move on to another new project does not allow one to complete the observations long enough. This makes people accountable only for meeting schedules and not for the consequences of action.

iv) To avoid getting into legal issues, engineers tend to concentrate more on legal liabilities than the containment of the potential risks involved in their area of work.

Viewing engineering as a social experimentation makes one overcome these difficulties and see the problem in whole rather than as part.

ENGINEERING CODES OF ETHICS

Engineering Codes of Ethics have evolved over time

EARLY CODES

- Codes of personal behavior
- Codes for honesty in business dealings and fair business practices
- Employee/employer relations

NEWER CODES

- Emphasize commitments to safety, public health and environmental protection
- Express the rights, duties and obligations of members of the Profession
- Do not express new ethical principles, but coherently restate existing standards of responsible engineering practice
- Create an environment within the Profession where ethical behavior is the norm
- Not legally binding; an engineer cannot be arrested for violating an ethical code (but may be expelled from or censured by the engineering society)

***Are Engineering Codes Needed*? NO:**

–Engineers are capable of fending for themselves

–Common law is available to defend in ethical disputes

–Offended public can seek redress through courts

***Are Engineering Codes Needed*? YES:**

–Engineers have few or no resources to defend themselves in an ethical dispute

–Common law is available in reality only with great difficulty

–Conversely, the public has similar problems in seeking redress through legal channels

***Objections* to Existing Engineering Codes of Ethics:**

–Relatively few engineers are members of engineering societies.

–Non-members don't necessarily follow the ethical codes.

–Many engineers either don't know that the codes exist, or have not read them.

Which ethical codes apply?

–Depending upon your discipline and organizational affiliations, you may be bound by one, two or even more ethical codes:

•Discipline related (ASME, IEEE, ASCE, IIE etc.)

•National Society of Professional Engineers (NSPE)

•Employee codes (corporation, university, etc.)

•Union Codes

Engineering Ethics

Our engineering ethics codes are derived from a Western cultural tradition

–Ancient Greeks

–Judeo-Christian religions

–Philosophers and thinkers (e.g. Locke, Kant, Mills)

The Hammurabi Code

If a builder has built a house for a man and has not made his work sound, and the house he has built has fallen down and so caused the death of the householder, that builder shall be put to death. If it causes the death of the householder's son, they shall put the builder's son to death….

(Hammurabi, King of Babylon, 1758 B.C.)

Code of Ethics for Engineers

Accreditation Board for Engineering and Technology

(ABET)

The Fundamental Principles

Engineers shall uphold and advance the integrity, honor, and dignity of the engineering profession by:

- *using their knowledge and skill for the enhancement of the human race;*
- *being honest and impartial and serving with fidelity the public, their employers, and clients;*
- *striving to increase the competence and prestige of the engineering profession.*
- *supporting the professional and technical societies of their discipline.*

The Fundamental Cannons

Engineers shall

- *hold paramount the safety, health, and welfare of the public in the performance of their professional duties;*
- *perform service only in areas of their competence;*
- *issue public statements only in an objective and truthful manner;*

• *act in professional matters for each employer or client as faithful agents or trustees, and shall avoid conflicts of interest;*

• *build their professional reputations on the merits of their services and shall not compete unfairly with others*

• *act in such manner as to uphold and enhance the honor, integrity and dignity of the profession;*

• *continue their professional development throughout their careers, and shall provide opportunities for the professional development of those engineers under their supervision.*

CODES OF ETHICS - *ROLES OR FUNCTIONS*

1. Inspiration and Guidance:

- ❖ Codes provide positive stimulus for ethical conduct and helpful guidance by using positive language.
- ❖ Codes should be brief to be effective and hence such codes offer only general guidance.
- ❖ Supplementary statements or guidelines to give specific directions are added by a number of societies or professional bodies.

2**. Support:**

- ❖ Codes give positive support to those seeking to act ethically.
- ❖ An engineer under pressure to act unethically can use one of the publicly proclaimed codes to get support for his stand on specific moral issues.
- ❖ Codes also serve as legal support for engineers.

3. Deterrence and discipline:

- ❖ Codes can be used as a basis for conducting investigations on unethical conduct.
- ❖ They also provide a deterrent for engineers to act immorally.
- ❖ Engineers who are punished by professional societies for proven unethical behaviour by revoking the rights to practice as engineers are also subjected to public ridicule and loss of respect from colleagues and local community.

- This helps to produce ethical conduct even though this can be viewed as a negative way of motivation.

4. Education and mutual understanding:

The codes can be used for discussion and reflection on moral issues and thereby improve the understanding of moral responsibilities among all engineers, clients, public and good organizations.

5. Contributing to the profession's public image:

Codes present the engineering profession as an ethically committed society in the eyes of the public thus enhancing their image.

6. Protecting status quo:

Codes establish ethical conventions, which can help promote an agreed upon minimum level of ethical conduct.

7. Promoting business interests:

Codes can place unwarranted restraints of commerce on business dealings.

Relative importance of the various functions of codes of ethics

- The perspective of engg as social experimentation clearly emphasizes the primary role 'supportive function' of the codes of ethics. This is so because, only this support enables engineers, speak out clearly and openly their views, to those affected by engg projects.
- The, 'inspiration and guidance' and 'educative' functions are also important in promoting mutual understanding and in motivating engineers to act with higher moral standards.
- The 'disciplinary' function in engg codes is of secondary importance. Those with unethical conduct when exposed are subject to law. Developing elaborate paralegal procedures within professional societies duplicates a function which can be done better by legal system. At best, codes should try to discipline engineers in areas which are not covered by law.

- ❖ The worst abuse of codes has been to restrict honest moral effort in the name of 'preserving profession's public mage' and 'protecting status quo'. The best way to increase trust is by encouraging and aiding engineers to speak freely and responsibly about public safety.

***Limitations* of Codes of Ethics**

1. Codes are restricted to general and vague wording. They cannot be straightaway applied to all situations. It is impossible to foresee the full range of moral problems that can arise in a complex profession like engg.

2. It is easy for different clauses of codes to come into conflict with each other. Usually codes provide no guidance as to which clause should have priority in those cases, creating moral dilemmas.

3. They cannot serve as the final moral authority for professional conduct. If the code of a professional society is taken as the last word, it means that we are getting into a particular set of conventions i.e. ethical conventionalism.

4. Andrew Oldenquist and Edward Slowter pointed out how the existence of separate codes for different professional societies can give members the feeling that ethical conduct is more relative than it is and that it can convey to the public the view that none is 'really right'. The current codes are by no means perfect but are definitely steps in the right direction.

The problems of law in engineering

1. The greatest problem of law in engg is of 'minimal compliance'. Engineers and employers can search for loop holes in the law to barely keep to its letter while violating its spirit. Engineers will tend to refer to standard readymade specifications rather than come up with innovative ideas. Minimal compliance led to the tragedy of the 'Titanic'.

2. Continually updating laws and regulations may be counter-productive and will make law always lag behind technology. This also overburdens the rules and regulators.

3. Many laws are 'non-laws' i.e. laws without enforceable sanctions. These merely serve as window dressing, frequently gives a false sense of security to the public.

4. The opponents of the law may burden it intentionally with many unreasonable provisions that a repeal will not be far off.

5. Highly powerful organizations, like the government can violate the laws when they think they can get away with it by inviting would be challengers, to face them in lengthy and costly court proceedings. This also creates frustration with the law.

Role of law in engineering

- It is wrong to write off rule-making and rule following as futile. Good laws, effectively enforced, clearly produce benefits.
- Reasonable minimum standards are ensured of professional conduct.
- It also provides a self-interested motive for most people and corporations to comply.
- They also serve as powerful support and defense for those who wish to act ethically in situations where ethical conduct might not be welcome.
- Viewing engineering as social experimentation provides engineers with a better perspective on laws and regulations.
- Precise rules and enforceable sanctions are appropriate in cases of ethical misconduct that involve violations of well established and regularly reexamined procedures that have as their purpose the safety of public.
- In areas of experimentation, rules must not attempt to cover all possible outcomes of an experiment, nor must they force the engineer to adopt a rigidly specified course of action. Here the regulations should be broad based guidelines but should hold the engineer accountable for his or her decisions.

UNIT IV – SAFETY, RESPONSIBILITIES AND RIGHTS

SAFETY AND RISK

Imagine you are a fresh graduate.

You get a job as an engineer in a large atomic power plant.

- Would you take it or not?
- Under what conditions would you take it?
- Under what conditions would you not?
- Why?

People as Consumers:

- *Active Consumers*: directly involve themselves e.g., mowing the lawn, washing clothes or toasting bread.
- *Passive Consumers*: have less choice and less control e.g., Water, Electricity, Petrol,
- *Bystanders*: e.g., exposed to Pollution from unknown sources

.What is safe to Entrepreneurs, may not be so to Engineers. e.g., Pilots: "Indian Airports are not safe; Low Vision in Fog“

What is safe to Engineers, may not be so to Public. e.g., Top loading Washing Machine

Typically several groups of people are involved in safety matters but have their own interests at stake. Each group may differ in what is safe and what is not.

Concept of Safety

1. “A ship in harbor is safe, but that is not what ships are built for” – John A. Shedd

2. ‘A thing is safe if its risks are judged to be acceptable’ - William W. Lawrence

- We buy an ill-designed Iron box in a sale-> Underestimating risk
- We judge fluoride in water can kill lots of people -> Overestimating risk
- We hire a taxi, without thinking about its safety -> Not estimating risk
- How does a judge pass a judgement on safety in these 3 cases?

….*So, this definition won't do in real life.*

Then, what is acceptable also depends upon the individual or group’s value judgment. Hence a better, *working definition* of *concept of safety* could be,

“A thing is safe (to a certain degree) with respect to a given person or group at a given time if, were they fully aware of its risks and expressing their most settled values, they would judge those risks to be acceptable (to that certain degree).” -Mike Martin and Roland Schinzinger

A thing is NOT SAFE if it exposes us to unacceptable danger or hazard

RISK is the potential that something unwanted and harmful may occur.

a. We take a risk when we undertake something or use a product that is not safe.

Risk in technology could include dangers of

b. bodily harm,
c. economic loss, or
d. environmental degradation.

- Some may assume that “safety” is a concrete concept, while “risk” is a vague, hypothetical concept
- In fact, its the other way around
- Risks always exist. But true safety never exists, except in hypothetical situations
- So, risk is *reality*, safety is *fantasy*

What degree of risk is acceptable?

Safety is a matter of how people would find risks acceptable or unacceptable, if they knew the risks, and are basing their judgments on their *most settled value* perspective.
So, to this extent, it is *objective*.

Perspectives differ.
To this extent, it is *subjective*.

So, Safety is *'acceptable risk'*.

Acceptable Risk

'A risk is acceptable when those affected are generally *no longer (or not) apprehensive* about it.'

Apprehension (i.e. anxiety) depends largely on factors such as

- whether the risk is assumed voluntarily.
- how the probabilities of harm (or benefit) is perceived.
- job-related or other pressures that causes people to be aware of or to overlook risks.
- whether the defects of a risky activity or situation are immediately noticeable or close at hand .
- whether the potential victims are identifiable beforehand.

Voluntary risk and Control

A person is said to take *'VOLUNTARY RISK'*
-when he is subjected to risk by either his own actions or action taken by others and
-*volunteers* to take that risk without any apprehension.

-For example, John and Ann Smith enjoy riding motorcycles over rough ground for amusement. They take voluntary risk, part of being engaged in such a potentially dangerous sport.

Connected to this notion of voluntarism is the matter of *Control*. In the example cited, the Smiths are aware of the high probability of accident figures in such a sport, but they display characteristically *unrealistic confidence* of most people when they believe the dangers to be *under their control.* In terms of engineering as social experimentation, people are more *willing to be the subjects of their own experiments* than of someone else's (whether social experiment or not).

Chauncey Starr informs us that individuals are more ready to assume voluntary risks than involuntary risks, even when voluntary risks are 1000 times more likely to produce a fatality than the involuntary ones.

- A DISASTER = A seriously disruptive event + A state of unprepared ness.
- e.g., Titanic collision with an iceberg, at night: Emergency
- Fewer lifeboats, inadequate training and warnings of icebergs unheeded -> Disaster.

Effect of information on risk assessments

The manner in which information necessary for decision making is presented can greatly influence how risks are perceived. Consider this example:

In a particular case of disaster management, the only options available are provided in 2 different ways to the public for one to be chosen (where lives of 600 people are at stake).

Alternate 1

If program A is followed, 200 people will be saved. If Program B is followed, 1/3 probability is 600 people will be saved and 2/3 probability that nobody will be saved.

Response

72% of the target group chose option A and 28% option B

Alternate 2

If program A is followed, 400 people will die. If Program B is followed, 1/3 probability is that nobody will die and 2/3 probability that 600 people will die.

Response

This time only 22% of the target group chose option A and 78% option B

Conclusion:

1. The option perceived as yielding firm gain will tend to be preferred over those from which gains are perceived as risky or only probable.
2. Option emphasizing firm losses will tend to be avoided in favour of those whose chances of success are perceived as probable.

Secondary Costs of Products

Cost of products is High, if designed unsafely

- Returns and Warranty Expenses
- Loss of Customer Goodwill
- Cost of litigation
- Loss of Customers due to injuries in using it
- Cost of rework, lost time in attending to design problems

Manufacturer's understanding of the risk in a product is necessary:

- To help reduce secondary costs
- To know the possible risk for purposes of pricing, disclaimers, legal terms and conditions, etc.
- To know the cost of reducing the risks
- To take a decision before finalizing the design.

Buyer's understanding of the risk in a product is necessary:

- To judge whether he/she wants to take the risks
- To judge whether the 'risk vs. costs' justifies taking the risk.

'JOB RELATED RISKS'

- Many workers *are taking risks in their jobs* in their stride like being exposed to asbestos.

- *Exposure to risks* on a job is in one sense of *voluntary nature* since one can always refuse to submit to the work or may have control over how the job is done.

- But generally workers have *no choice* other than what they are told to do since they *want to stick to the only job* available to them.

- But they are *not* generally *informed* about the exposure to toxic substances and other dangers which are *not readily* seen, smelt, heard or otherwise sensed.

- Occupational health and safety regulations and unions can have a better say in correcting these situations but still things are far below expected safety standards.

- Engineers while designing work stations must take into account the casual attitude of workers on safety (esp. when they are paid on piece rate).

Problems faced by engineers about *public concept of safety*

The optimistic attitude that things that are familiar, that have not caused harm before and over which we have some control *present no risks*.

The serious shock people feel when an accident kills or maims people *in large numbers* or *harms those we know*, even though statistically speaking such accidents might occur infrequently.

'Safety in a commodity comes with a price' – Explain.

Absolute safety is never possible to attain and safety can be improved in an engineering product only with an increase in cost.

On the other hand, *unsafe* products *incur secondary costs* to the producer beyond the primary (production) costs, like warranty costs loss of goodwill, loss of customers, litigation costs, downtime costs in manufacturing, etc.

Figure indicates that P- *Primary costs are high for a highly safe* (low risk) product and S- *Secondary costs are high for a highly risky* (low safe) product.

If we draw a curve T=P+S as shown, there is a *point at which costs are minimum* below which the cost cannot be reduced.

If *the risk* at Minimum Total Cost Point is *not acceptable*, then the producer has to *choose* a *lower acceptable risk* value in which case the *total cost* will be *higher* than M and the product designed accordingly.

It should now be clear that '*safety comes with a price'* only

.

Knowledge of risk for better safety

- Robert Stephenson writes that all the accidents, the harms caused and the means used to repair the damage *should be recorded* for the benefit of the younger Members of Profession.
- A faithful account of those accidents and the damage containment was really *more valuable* than the description of successful work.

- Hence it is imperative that knowledge of risks will definitely help to attain better safety.
- But it should be borne in mind, that still gaps remain, because

i)there are some industries where information is *not freely shared* and

ii)there are always *new applications of old technology* that render the available information *less useful.*

Uncertainties encountered in design process

- A decision on maximising profit or maximising the return on investment.
- Uncertainties about applications like dynamic loading instead of static loading, vibrations, wind speeds.
- Uncertainties regarding materials and skills required in the manufacturing.
- Changing economic realities.
- Unfamiliar environmental conditions like very low temperature.
- The available standard data on items like steel, resistors, insulators, optical glass, etc are based on statistical averages only.
- Due to the inherent nature of processes, all compts have a tolerance in design leading to the probability statistics by which assemblies' capability is assessed.

Testing strategies for safety

***Some commonly used testing methods*:**

- Using the past experience in checking the design and performance.
- Prototype testing. Here the one product tested may not be representative of the population of products.
- Tests simulated under approximately actual conditions to know the performance flaws on safety.
- Routine quality assurance tests on production runs.

The above testing procedures are not always carried out properly. Hence we cannot trust the testing procedures uncritically. Some tests are also destructive and obviously it is impossible to do destructive testing and improve safety.

In such cases, a simulation that traces hypothetical risky outcomes could be applied.

- Scenario Analysis (Event -> Consequences)
- Failure Modes & Effects Analysis (Failure modes of each component)
- Fault Tree Analysis (System Failure -> Possible Causes at component level)
- What if there is a combination of factors?
    - All Analysis pre-suppose a thorough understanding of the physical system

Failure modes and effect analysis (FMEA) :

This approach systematically examines the failure modes of each component, without however, focusing on relationships among the elements of a complex system.

Fault Tree Analysis (FTA) :

A system failure is proposed and then events are traced back to possible causes at the component level. The reverse of the fault-tree analysis is 'event – tree analysis'. This method most effectively illustrates the disciplined approach required to capture as much as possible of everything that affects proper functioning and safety of a complex system.

Risk Benefit Analysis

Ethical Implications

- When is someone entitled to *impose* a risk on another in view of a supposed benefit to others?
- Consider the worst case scenarios of persons exposed to *maximum risks* while they are reaping only *minimum benefits.* Are their rights *violated*?
- Are they provided *safer* alternatives?
- Engineers should keep in mind that *risks to known persons are perceived differently* from statistical risks

- Engineers may have *no control* over grievance redressal.

Conceptual difficulties in Risk-Benefit Analysis

Both risks and benefits lie *in future*

- Heavy discounting of future because the very low present values of cost/benefits do not give a true picture of future sufferings.
- Both have related uncertainties but difficult to arrive at expected values
- What if *benefits* accrue to *one party* and *risks to another*?
- Can we *express* risks & benefits in a *common set of units*?
    - e.g. Risks can be expressed in one set of units (*deaths* on the highway) and benefits in another *(speed of travel)*?

Many projects, which are highly beneficial to the public, have to be *safe also*.

Hence these projects can be justified using RISK-BENEFIT analysis. In these studies, one should find out

i) What are the risks involved?
ii) What are the benefits that would accrue?
iii) When would benefits be derived and when risks have to be faced?
iv) Who are the ones to be benefited and who are the ones subjected to risk-are they the same set of people or different.

The issue here is *not*, say, *cost-effective* design but it is only *cost of risk taking Vs benefit* analysis. Engineers should *first recommend* the *project feasibility* based on risk-benefit analysis and once it is justified, *then* they may get into *cost-effectiveness* without increasing the risk visualized.

In all this, engineers should ask themselves this ethical question: 'Under what conditions, is someone in society entitled to *impose a risk on someone* else on behalf of a *supposed benefit to others.'*

Difficulties in assessing Personal Risks

- Individuals are ready to *assume voluntary* risks than *involuntary* risks.

- The difficulty here is generally in assessing personal risks which are involuntary.

- The problem of quantification of risk raises innumerable problems.

- For example, how to assign a rupee *value to one's life*. There is no over the counter trade in lives.

- Even for a sale, it has to be clear *under what conditions* the sale is to take place.
- If one buys a kg of rice it matters whether it is just one additional purchase one makes *regularly* or it is the first rice purchase *after quite sometime*.

- Even when compensations are made to people exposed to involuntary risk, the basis on which it is made or even the intensity of risk could be *different for different people*.

- As of now, the one suggestion could be to employ an *open procedure*, overseen by trained arbiters, in each case, where *risk to individuals is to be studied and remedied*.

Public Risk and Public Acceptance

- Risks and benefits to public are more easily determined than to individuals
- National Highway Traffic Safety Administration (NHTSA)- proposed a value for life based on:
    - loss of future income
    - other costs associated with the accident
    - estimate of quantifiable losses in social welfare resulting from a fatality
    - NOT a proper basis for determining the optimal expenditure allocated to saving lives

Accounting publicly for benefits and risks

Engineers should account publicly for benefits and risks in the following manner:

- Engineers must remain as *objective* as humanly possible in their investigations and conclusions.
- They must also *state* openly any *personal biases* that they may have about the project being investigated.
- Engineers, even if they are acknowledged experts, may *not have complete knowledge* of the issues at hand.
- They should, if necessary, *admit* their *lack of knowledge*, in any particular area publicly.
- A willingness to *admit uncertainty* and also to *reveal methodology* and sources particularly when numerical data is presented.
- The way statistical information is presented can create misconceptions in the public mind. Hence it should be *presented in a way to improve realistic interpretations.*
- They must *consider the views of the parties affected* by the project under study *before* coming to conclusions.
- The type of action taken should be morally evaluated regardless of its consequences. If it is wrong to violate certain rights, then figuring out the benefit of the consequences of doing so is irrelevant.

Difficulties in establishing Safeguards

- Incomplete knowledge of the engineering subject
- Refusal to face hard questions caused by lack of knowledge
  - False sense of security
  - e.g. Nuclear waste disposal problem
- Caution in stating probabilities of rare events
- Varying understanding of risk based on presentation of facts
- Risk assessments based on incorrect/unacceptable assumptions/data

- Only a few persons/groups participate in the exercise

Some of the ways by which engineers may try to reduce risks.

- ⇨ In all the areas of works, engineers should give top priority for product safety.
- ⇨ They should believe that accidents are caused by dangerous conditions that can be corrected. Negligence and operator errors are not the principal causes of accidents.
- ⇨ If a product is made safe, the initial costs need not be high if safety is built into a product from the beginning. It is the design changes done at a later date that are costly. Even then life cycle costs can be made lower for the redesigned or retrofitted product (for safety).
- ⇨ If safety is not built into the original design, people can be hurt during testing stage itself.
- ⇨ They should get out of the thinking that warnings about hazards are adequate and that insurance coverage is cheaper than planning for safety.
- ⇨ All it takes to make a product safe is to have different perspective on the design problem with emphasis on safety.

Examples of Improved Safety

- Magnetic door catch introduced on refrigerators
  - Prevent death by asphyxiation of children accidentally trapped inside
  - The catch now permits the door to opened from inside easily
  - Cheaper than older types of latches
- Dead-man Handle for Drivers in trains
- Semaphore signaling
- Volkswagen's car safety belt
  - Attachment on the door so that belt automatically goes in place on entry

Liability

Early logic and social philosophy: (Richard C. Vaughan)

- ‘Caveat Emptor’: buyer beware
- Examine what you want before you buy
- If he is negligent, he suffers the bad bargain.
- Law will not aid those who are negligent
- ‘Privity of Contract’: User, if he is not a party to the contract, has no rights for any claim (user buys from the retailer and not from the manufacturer).

Gradually....

Manufacturer was made liable for injuries resulting from negligence in the design/manufacture

- The new law: concept of Strict Liability was established in the case ‘Green man vs. Yuba Power Products’ in California.
- If the product sold is defective, the manufacturer is liable for any harm that results to users

<u>Implications to Engineers:</u>

- Engineers must weigh chances of *defect causing injury* against *cost of minimizing defects*
- *Minimal compliance is insufficient* – adhering to accepted practices & standards not enough
- Standards are *mere checklists* - use them creatively and judgmentally
- Engineers *can be sued* personally even when *acting according* to guidelines set by *employers*
- e.g. One county highway engineer was sued for failure to repair roads-- had to pay $2 million
- Some Cos. protect their engineers and allow themselves to be sued for such money damages

- Independent engineers can write liability limits into their contracts

- Good knowledge of liability is necessary for engineers

'SAFE EXIT'

It is almost impossible to build a completely safe product or one that will never fail. When there is a failure of the product *SAFE EXIT* should be provided.

Safe exit is to assure that

i) when a product fails, it will fail safely,
ii) that the product can be abandoned safely and iii) that the user can safely escape the product.

More than the questions of who will build, install, maintain and pay for a safe exit, the most important question is who will recognize the need for a safe exit. This responsibility should be an integral part of the experimental procedure.

Some examples of providing 'SAFE EXIT':

- Ships need lifeboats with sufficient spaces for all passengers and crew members.
- Buildings need usable fire escapes
- Operation of nuclear power plants calls for realistic means of evacuating nearby communities
- Provisions are needed for safe disposal of dangerous materials and products.

Colleagiality & Its Elements

'Collegiality is a kind of connectedness grounded in *respect for professional expertise* and in a *commitment to the goals and values of the profession* and as such, collegiality includes a disposition to *support and co-operate with one's colleagues*'.

- Craig Ihara

The central elements of collegiality are *respect, commitment, connectedness and co-operation*.

Respect: Acknowledge the worth of other engineers engaged in producing socially useful and safe products.
Commitment: Share a devotion to the moral ideals inherent in the practice of engineering.
Connectedness: Aware of being part of a co-operative undertaking created by shared commitments and expertise.
Collegiality, like most virtues, can be misused and distorted.
It should not be reduced to 'group interest' but should be a shared devotion for public good. It is not defaming colleagues, but it does not close the eyes to unethical practices of the co-professionals, either.

Classifications of Loyalty

⇨ *Agency-Loyalty*

- Fulfill one's contractual *duties* to an employer.
- Duties are particular *tasks for which* one is *paid*
- *Co-operating* with colleagues
- *Following* legitimate *authority* within the organization.

⇨ *Identification-Loyalty*:

- It has to do with attitudes, emotions and a sense of *personal identity*.
- Seeks to meet one's moral duties with personal *attachment and affirmation*.
- It is against *detesting* their employers and companies, and do work *reluctantly* and *horribly* (this is construed as *disloyalty*)

This means

- Avoid conflicts of interest,
- Inform employers of any possible conflicts of interest,

!

- Protect confidential information,
- Be honest in making estimates,
- Admit one's errors, etc.

Loyalty - *Obligation of Engineers*

Agency-Loyalty

- Engineers are *hired* to do their duties.
- Hence *obligated* to employers within proper limits

Identification-Loyalty

Obligatory on two conditions;

1. When some important *goals are met* by and through a group in which the engineers participate
2. When employees are *treated fairly*, receiving the share of benefits and burdens.

But clearly, identification-loyalty is a *virtue* and *not* strictly an *obligation*.

Relationship - Professionalism and Loyalty

1. Acting on professional *commitments* to the public is *more effective* to serve a company *than* just *following* company orders.

2. *Loyalty to employers* may *no*t mean *obeying* one's immediate *supervisor*.

3. Professional obligations to both an employer and to the public might *strengthen rather than contradict* each other.

Need for Authority

Authority is needed since

a) Allowing everyone to exercise *uncontrolled individual discretion creates chaos* (confusion).
b) Clear lines of authority *identifies areas of* personal responsibility and *accountability*.

Institutional Authority and Expert Authority

Institutional authority

'The institutional right given to a person to exercise power based on the resources of the institution'.

- It is acquired, exercised and defined within institutions.
- It is given to individuals to perform their institutional duties assigned within the organisation. There is not always a perfect match between the authority granted and the qualifications needed to exercise it.

Expert authority

'The possession of special knowledge, skill or competence to perform some task or to give sound advice'.

Engineers may have expert authority but their institutional authority, *may only be*, to *provide management* with analysis of possible ways to perform a technical task, after which they are *restricted to following management's directive* about which option to pursue. In large companies, *engineers, advisors and consultants* in staff function carry *expert authority*, while *institutional authority* is vested only with *line managers*.

Authority Vs Power

Ineffective persons, even if vested with authority by their institution, *may not be able to summon* the power their position allows them to exercise. On the other hand, people who are

effective may be *able to wield greater power* that goes beyond the authority attached to the positions they hold. Highly respected engineers of proven integrity belong to this class.

Authority - Morally justified

Observations on authority.

- An *employer* who has institutional authority may *direct engineers* to do something that is *not morally justified.*
- Engineers may feel that they have an institutional *duty to obey* a directive that is *morally unjustified*, *but* their moral *duty*, all things considered, *is not to obey.*

- To decide whether a specific act of *exercising institutional authority is morally justified*, we need to know whether the institutional *goals are* themselves *morally permissible* or desirable and whether that *act violates* basic moral duties.

'Zone Of Acceptance' of Authority

'A subordinate is said to accept authority whenever he permits his behaviour to be guided by the decision of a superior, without independently examining the merits of that decision'
- Herbert Simon

- Simon notes that all employees tend to have a *'zone of acceptance'* in which they are willing to accept their employer's authority.

- *Within that zone*, an individual, relaxing his own critical faculties, *permits* the decision of the *employer to guide* him.

- Employees generally *do not make an issue* of questionable incidents on morality, *out of a sense of responsibility* to give their employer leeway within which to operate and often *not to risk their jobs*.

- The *problem increases* when employees slowly *expand* the boundaries of *tolerance and rationalize* it.

This only shows that engineers should *never stop* critically *reviewing* the employer's *directives* especially *on moral issues*.

'Faithful Agent Argument'

National Society of Professional Engineers (NSPE) Code states,

"The engineer ……will act in professional matters for client, or employer *as a faithful agent or trustee*……He will *not actively participate* in strikes, picket lines or other *coercive action*"

meaning that when one is a faithful trustee of one's employer he cannot actively participate in any collective forcible action.

Board of Ethical Review argued that engineers *have a higher standard* than self interest and that their ethical duty is to act for their employer as a faithful agent or trustee.

Collective bargaining is *inconsistent with loyalty* to employers because it

- is against the desires of the employer
- uses force or coercion against the employer and
- involves collective and organized opposition.

But *every instance* of such conduct *need not be unethical.*

An example:

Three engineers sincerely feel that they are underpaid. After their representations to their bosses are in vain, they threaten their employer, politely, that they would seek employment elsewhere. Here, even though, they act against the desires of their employer and have acted collectively, they have not acted unethically or violated their duty.

Conclusion: '*Faithful agency*' only *concerns with performing one's duty* but *does not mean* that safety, salary and other economical *benefits cannot be negotiated* from a position of strength. Employee's duty to employer *does not mean unlimited sacrifice* of self-interest.

'Public Service Argument'- Collective bargaining.

- 'Public Service Argument' is an *argument against* collective bargaining.
- The paramount duty of engineers is *to serve the public.*
- *Unions*, by definition, *promote* the *interests of their members* and whenever there is a clash of interests, the interest of the general public is ignored by them. Though the argument is a valid one, it looks at the worst possible scenarios with unions and *decides that* engineering *unions act* only *irresponsibly.*
- A body of engineers can *promote engineers' interest* within limits set *by professional concern* for the public good.

Benefits of Collective Bargaining.

a) Unions have created *healthy salaries* and *high standard of living* of employees.
b) They give a *sense of participation* in company *decision making*.
c) They are a good *balance to the power* of employers to fire employees at will.
d) They provide an *effective grievance redressal* procedure for employee complaints.

Harms Caused by Collective Bargaining.

a) Unions are *devastating the economy* of a country, being a main *source of inflation*
b) With unions, there is *no congenial (friendly)*, cooperative *decision making*.
c) Unions *does not promote* quality performance by making job *promotion and retention based on seniority*.
d) They *encourage unrest and strained relations* between employees and employers.

'Confidentiality or confidential information'

- Information considered desirable to be kept secret.
- Any information that the employer or client would like to have kept secret in order to compete effectively against business rivals.

- This information includes *how business is run, its products, and suppliers,* which directly affects the ability of the company to compete in the market place
- *Helps* the competitor to *gain advantage* or catch up

Privileged information, Proprietary information and Patents.

- *Privileged information:*
  - ⇨ 'Information available only on the *basis of special privilege*' such as granted to an employee working on a special assignment.

- *Proprietary information:*
  - ⇨ Information that a company *owns or is the proprietor of.*
  - ⇨ This is primarily used in *legal sense*.
  - ⇨ Also called *Trade Secret*. A trade secret can be virtually any type of information that has *not become public* and which an employer has *taken steps to keep secret*.

- *Patents:*
  - ⇨ *Differ* from trade secrets.
  - ⇨ *Legally protect specific products* from being manufactured and sold by competitors *without* the express *permission of the patent holder*.
  - ⇨ They have the *drawback of being public* and competitors may *easily work around them* by creating alternate designs.

Obligation of Confidentiality

1. Based on ordinary moral considerations:

   I. *Respect for autonomy*:
   - *Recognizing the legitimate control* over private information (individuals or corporations).
   - This control is required *to maintain their privacy* and protect their self-interest.

II. *Respect for Promise*:

- Respecting promises in terms of *employment contracts* not to divulge certain information considered sensitive by the employer

III. *Regard for public well being*:

- Only when there is a *confidence* that the physician *will not reveal* information, the patient will have the *trust to confide* in him.
- Similarly *only when companies maintain* some degree of *confidentiality* concerning their products, the benefits of *competitiveness* within a free market are *promoted*.

2. Based on Major Ethical Theories:
   - All theories profess that employers have *moral and institutional rights* to decide what information about their organization should be released publicly.
   - They acquire these rights as *part of their responsibility to protect the interest of the organization*.
   - All the *theories*, rights ethics, duty ethics and utilitarianism *justify this confidentiality* but in different ways.

Effect of Change of Job on Confidentiality

- Employees are *obliged* to protect confidential information regarding former employment, *after a change of job*.
- The *confidentiality trust* between employer and employee *continues beyond* the period of employment.
- But, the employee *cannot be forced not to seek* a change of job.
- The *employer's right* to keep the trade secrets confidential by a former employee *should be accepted* at the same time, the *employee's right* to seek career advancement *cannot also be denied*.

Conflict of Interest

Conflict of Interest arises when two conditions are met:

1. The professional is in a relationship or a role that requires exercising good judgment on behalf of the interests of an employer or client and

2. The professional has some additional or side interest that could threaten good judgment in serving the interests of the employee or client. E.g. *When an engineer is paid based on a percentage of the cost of the design and there is no incentive for him to cut costs*- The distrust caused by this situation compromises the engineers' ability to cut costs and calls into question his judgement.

<u>'An act of gift' and 'An act of bribe'</u>

'A *gift* is a *bribe* if you can't *eat, drink or smoke it in a day*'.

'If you think that your offer of acceptance of a particular gift would have *grave* or merely *embarrassing consequences for your company if made public*, then the gift should be considered a bribe'.

'*Bribe* can be said to be a *substantial* amount of money or goods offered beyond a stated business contract with the *aim of winning an advantage* in gaining or keeping the contract'.

Here '*substantial*' means that which is *sufficient to distort the judgment* of a typical person.

Conflict of Interest created by Interest in other companies

- ⇨ When one *works actually for the competitor* or subcontractor as an employee or consultant.
- ⇨ Having *partial ownership or substantial stock holdings* in the competitor's business.

- ⇨ It may *not arise* by merely having a *spouse working for sub-contractor* to one's company, but it *will arise* if one's *job also includes granting contracts* to that subcontractor.
- ⇨ *Tempting customers away* from their current employer, while still working for them *to form* their own *competing business*.
- ⇨ *Moonlighting* usually creates *conflicts* when working for competitors, suppliers or customers but *does not conflict when working for others without affecting* the present employer's business.

  'Moonlighting' means working in one's spare time for another employer.

Conflicts of Interest created by Insider information

- o *Using inside information* to *set-up a business* opportunity for *oneself or family or friends*.
- o *Buying stock* in the company for which one works is *not objectionable* but it should be based on the *same information* available to the public.
- o The *use* of any company *secrets* by employee to *secure a personal gain* threatens the interest of the company.

Avoiding Conflicts Of Interests

- o Taking guidance from *Company Policy*
- o In the absence of such a policy taking a *second opinion from a coworker or manager*. This gives an impression that there no intension on the part of the engineer to hide anything.
- o In the absence of either of these options, to *examine ones own motives* and *use the ethical* problem solving *techniques*.
- o One can look carefully into the professional codes of ethics *which uniformly forbid conflicts of interest*. Some of these codes have very explicit statements that can help determine whether or not the situation constitutes conflict of interest.

Types Of Crime

- *Domestic crime*

  Non-accidental crime committed *by members* of the family
- *Professional Crime*

  When crime is *pursued as a profession* or day to day occupation
- *Blue collar crime (or) Street crime*

  Crime *against person, property* (theft, assault on a person, rape)
- *Victimless crime*

  Person *who commits* the crime *is the victim* of the crime. E.g. Drug addiction
- *Hate crime*

  Crime done on the banner of *religion, community, linguistics*

Occupational Crime

- ⇨ Occupational crimes are *illegal acts* made possible through one's *lawful employment.*
- ⇨ It is the *secretive violation of laws* regulating work activities.
- ⇨ When committed by office workers or professionals, occupational crime is called '*white collar crime*'.

People Committing Occupational Crimes

- Usually have *high standard of education*
- From a *non-criminal family background*
- Middle class male around *27 years of age* (70% of the time) with *no previous history*
- *No involvement in drug* or alcohol abuse

- Those who had *troublesome life* experience in the childhood (Blum)
- People *without firm principles* (Spencer)
- Firms with *declining profitability* (Coleman, 1994)
- Firms in highly *regulated areas and volatile market* -pharmaceutical, petroleum industry.(Albanese, 1995)

Price Fixing

An act was passed, which *forbade* (prevented) companies from *jointly setting prices* in ways that *restrain free competition* and trade. Unfortunately, many senior people, well respected and positioned were of the opinion that '*price fixing'* was good for their organizations and the public.

Employees Endangering Lives of Employees

Employers indulge in exposing their employees to safety hazards. They *escape criminal action* against them, by paying *nominal compensations* even if their crimes are proved in court. And even this happens *only when the victim sues company* for damages under civil law.

Engineers' Moral Rights

Engineers' moral rights fall into categories of *human, employee, contractual and professional rights.*

Professional rights:

The right to form and *express one's professional judgment freely*

The right to *refuse* to carry out *illegal and unethical activity*

The right to *talk publicly* about one's work *within bounds* set by confidentiality obligation

The right to *engage* in the activities of *professional societies*

The right to *protect* the clients and the public *from the dangers* that might arise from one's work

The right to professional *recognition* of one's services.

Right of Professional Conscience

- There is one *basic* and generic professional right of engineers, the *moral right to exercise responsible professional judgment* in pursuing professional responsibilities.
- Pursuing these responsibilities involves *exercising* both *technical judgment* and *reasoned moral convictions.*
- This basic right can be referred to as *the right of professional conscience.*

Right of Conscientious Refusal

The right of Conscientious refusal is the right to *refuse to engage in unethical behaviour* and to refuse to do so *solely because one views it as unethical.*

Two situations to be considered.

1. Where there is widely shared agreement in profession as to whether an act is unethical
Here, professionals have a moral right to refuse to participate in such activities.

2. Where there is room for disagreement among reasonable people over whether an act is unethical.
Here, it is possible that there could be *different ethical view points* from the professional and the employer.
In such cases the engineers can have a *limited right* to *turn down* assignments that violates their personal conscience *only in matters of great importance* such as threats to human life.

This right also depends on the *ability* of the employer *to reassign* the engineer to alternate projects *without serious economic hardships* to the orgn.

The *right of professional conscience does not extend to the right to be paid for not working.*

Right to Recognition
Right to Recognition involves two parts.

The right to *reasonable remuneration* gives the moral right for fighting against corporations making good profits while engineers are being paid poorly. Also is the case where patents are not being rewarded properly by the corporations benefiting from such patents.

The other *right to recognition* is non-monetary part of recognition to the work of engineers.

But *what is reasonable remuneration or reasonable recognition* is a difficult question and should be resolved by discussions between employees and employers only.

Professional Rights & Ethical Theories

1. Rights Ethics:

- The most basic human right, which needs no justification, as per A.I.Meldon, is to pursue one's legitimate (those that do not violate others' rights) interests.
- The right to pursue legitimate interests gives a person right to pursue professional moral obligations.
- This may be viewed as a human right of conscience directly derived from the basic human right.

2. Duty Ethics:

- I have a right to something only because others have duties or obligations to allow me (and not interfere) to do so.
- If we derive the meaning of 'others' as employers, then the basic professional right is justified by reference to others' duties to support or not interfere with the work related exercise of conscience by professionals.

3. Utilitarianism*:*

- Public good can be served by allowing professionals to meet their obligations to the public.

- These obligations arise due to the professional's role in promoting public good.
- The basic goal of producing the most good for the greatest number of people is enough to justify the right of professional conscience.

Whistle-blowing and Its Features

Whistle blowing is an *act of conveying information* about a *significant moral problem* by a *present or former employee*, *outside approved channels* (or against strong pressure) to someone, in a position to take action on the problem.

The features of *Whistle blowing* are:

- Act of Disclosure: *Intentionally conveying information outside approved organizational channels when the person is under pressure not to do so from higher-ups.*
- Topic: *The information is believed to concern a significant moral problem for the organization*.
- Agent: *The person disclosing the information is an employee or former employee.*
- Recipient: *The information is conveyed to a person or organization who can act on it.*

Types of Whistle Blowing

External Whistle blowing*:* The act of passing on information outside the organisation.
Internal Whistle blowing: The act of passing on information to someone within the organization but outside the approved channels.
Either type is likely to be considered as disloyalty, but the second one is often seen as less serious than the latter. From corporations' point of view both are serious because it leads to distrust, disharmony, and inability of the employees to work together.

Open Whistle blowing: Individuals openly revealing their identity as they convey the information.
Anonymous Whistle blowing*:* Individual conveying the information conceals his/her identity.

Procedures to be followed before Whistle Blowing

- *Except* for extreme *emergencies*, always try *working through normal* organizational *channels*.
- Be *prompt* in expressing objections.
- Proceed in a tactful manner with *due consideration to the feelings* of others involved.
- As much as possible, *keep supervisors informed* of your actions, both informally and formally.
- Be accurate in observations and claims and *keep all formal records* documenting relevant events.
- *Consult* colleagues for *advice* and also to *avoid isolation*.
- *Consult the ethics committee* of your professional society before going outside the organization.
- *Consult a lawyer* regarding potential legal liabilities.

A great deal of introspection and reflection are required before WB. Motive should neither be for revenge upon fellow employee, supervisor or company nor in the hope of future gains like book contracts or speaking tours etc.

Conditions to be satisfied before Whistle Blowing

Richard T. De George suggests the following:

1. The *harm* that will be done by the product to the public is *serious* and considerable.

2. The individual makes his/her concern *known to his/her superiors*

.

3. If one does not get any proper response from immediate superiors, then one should *exhaust the channels* that are available *within the organization* including the board of directors.

4. One must have *documented evidence* that would *convince* a reasonable and impartial *observer* that one's view of the situation is correct and the company policy is wrong.

5. There must be *strong evidence* that making the information public will in fact *prevent the threatened serious harm.*

Prevention of Whistle Blowing

The following *actions* will *prevent/reduce* whistle blowing:

1. Giving *direct access* to higher levels of management by announcing '*open door'* policies with guarantee that *there won't be retaliation.* Instead such employees should be *rewarded for fostering ethical behavior* in the company.
2. This gives greater freedom and promotes open communication within the organization.
3. Creation of an Ethics Review Committee with *freedom to investigate complaints and make independent recommendations* to top management.
4. Top priority should be given to *promote ethical conduct* in the organization *by top management*.
5. Engineers should be *allowed to discuss in confidence*, their moral concerns with the ethics committee of their professional societies.
6. When there are differences on ethical issues between engineers and management, *ethics committee members* of the professional societies *should be allowed* to enter into these discussions.

7. *Changes and updations* in law must be explored by engineers, organizations, professional societies and government organizations on a continuous basis.

Employee Rights

Employee rights are any rights, moral or legal, that involve the status of being an employee.

Employee rights are:

- ⇨ There should be *no discrimination* against an employee *for criticizing* ethical, moral or legal policies and practices of the organization.

- ⇨ The organization will *not also discriminate* against an employee for *engaging in outside activities* or for objecting to an organization directive that violates common norms of morality.

- ⇨ The employee *will not be deprived of* any enjoyment of *reasonable privacy* in his/her workplace.

- ⇨ *No personal information* about employees *will be collected* or kept other than what is necessary to manage the organization efficiently and to meet the legal requirements.

- ⇨ *No employee* who alleges that her/his rights have been violated *will be discharged* or penalized *without a fair hearing* by the employer organization.

Some clear examples: falsifying data, avoidance on the safety of a product

Discrimination

- Discrimination generally means *preference* on the grounds of *sex, race, skin colour, age or religious outlook.*
- In everyday speech, it has come to mean *morally unjustified treatment of people on arbitrary or irrelevant grounds.*
- Therefore to call something 'Discrimination" is to condemn it.
- But when the question of justification arises, we will call it *'Preferential Treatment'*.

Intellectual Property Rights

- ❖ *Intellectual Property* is a product of the *human intellect* that has *commercial value*
- ❖ Many of the rights of the ownership common to real and *personal property* are also *common* to *Intellectual Property*

- Intellectual Property can be *bought, sold, and licensed*
- Similarly it can be *protected against theft* and *infringement* by others

Patent, Design & Trademark* together with *Copyright* form *TOTAL INTELLECTUAL PROPERTY

PATENT

1. Derived from the Latin word 'LITTERAE PATENTES' which means 'Open Letters' or 'Open Documents' to confer rights and privileges.
2. A contract between an Inventor and the Government
3. An exclusive privilege monopoly right granted by the Government to the Inventor
4. Invention may be of an Industrial product or process of manufacture
5. Invention should be new, non-obvious, useful and patentable as per Patents Act
6. The right to the inventor is for limited period of time and valid only within the territorial limits of a country of grant.

Examples: *a drug compound, a tool, maybe software effects*

DESIGN

- Meant for beautifying an industrial product to attract the consumer public
- Shaping, Configuration or Ornamentation of a vendible Industrial product
- Exclusive 'Design Rights' to the originator for a limited term
- Patents & design embrace the production stage of an industrial activity

TRADE MARK

- Trade Mark is a name or symbol adopted for identifying goods
- Public can identify from the Trade Mark from whom the product is emanating
- Trade Marks protection is given for an industrial product by the Government

Examples: Channel No.5's smell, Jacque Villeneuve's face!

COPY RIGHTS

❖ The right to original literary and artistic works

- Literary, written material
- Dramatic, musical or artistic works
- Films and audio-visual materials
- Sound recordings
- Computer Programmes/software
- SOME databases

Example: Picasso's Guernica, Microsoft code, Lord of the Rings

Need For A Patent System

- Encourages an inventor to disclose his invention
- Encourages R & D activities as the industries can make use of the technology, & avoids reduntant research
- Provides reasonable assurance for commercialisation.
- Provides an inducement to invest capital in the new lines of production and thus , help for technical development and upgradation.
- One may get a very good return of income through Patent Right on the investment made in R & D.

Effect of Patent

- A patentee gets the exclusive monopoly right against the public at large to use,sell or manufacture his patented device.
- A patentee can enforce his monopoly right against any infringement in the court of law for suitable damages or profit of account.
- The Government ensures full disclosure of the invention to the public for exchange of exclusive monopoly patent right to the inventor.

UNIT V - GLOBAL ISSUES

1. Give an account of Bhopal Gas Tragedy.

On December 3, 1984, Union Carbide's pesticide-manufacturing plant in Bhopal, India leaked 40 tons of the deadly gas, methyl isocyanate into a sleeping, impoverished community - killing 2,500 within a few days, 10000 permanently disabled and injuring 100,000 people. Ten years later, it increased to 4000 to 7000 deaths and injuries to 600,000.

Risks taken:

- Storage tank of Methyl Isocyanate gas was filled to *more than 75%* capacity as against Union Carbide's spec. that it should *never be more than 60%* full.
- The company's West Virginia plant was controlling the safety systems and *detected leakages thro' computers* but the Bhopal plant *only used manual labour for control and leak detection*.
- The Methyl Isocyanate gas, being highly concentrated, *burns parts of body* with which it comes into contact, even *blinding eyes and destroying lungs*.

Causal Factors:

- Three protective systems *out of service*
- Plant was *understaffed* due to costs.
- Very *high inventory of MIC*, an extremely toxic material.
- The accident occurred in the *early morning*.
- Most of the people killed lived in a shanty (poorly built) town located very close to the plant fence.

Workers made the following attempts to save the plant:

- They tried to turn on the plant refrigeration system to cool down the environment and slow the reaction. (*The refrigeration system had been drained of coolant weeks before and never refilled -- it cost too much*.)

- They tried to route expanding gases to a neighboring tank. (*The tank's pressure gauge was broken and indicated the tank was full when it was really empty.*)
- They tried to purge the gases through a scrubber. (*The scrubber was designed for flow rates, temperatures and pressures that were a fraction of what was by this time escaping from the tank. The scrubber was as a result ineffective*.)
- They tried to route the gases through a flare tower -- to burn them away. (*The supply line to the flare tower was broken and hadn't been replaced.*)
- They tried to spray water on the gases and have them settle to the ground -- by this time the chemical reaction was nearly completed. (*The gases were escaping at a point 120 feet above ground; the hoses were designed to shoot water up to 100 feet into the air*.)

In just 2 hours the chemicals escaped to form a deadly cloud over hundreds of thousands of people incl. poor migrant labourers who stayed close to the plant.

2. What are the benefits of Multi National corporations doing business in less developed countries for both the MNCs and the host country?

Benefits to MNCs:

- Inexpensive labour
- Availability of natural resources
- Favourable tax conditions
- Fresh markets for products

Benefits to developing host countries:

- New jobs
- Greater pay and greater challenge
- Transfer of advanced technology
- Social benefits from sharing wealth

3. What are the three senses of relative values?

3.1. Ethical Relativism

- Actions are morally right in a particular society if they are approved by law, custom, or other conventions of the society.

3.2. Descriptive Relativism

- Value beliefs and attitudes differ from culture to culture and this is a fact.

3.3. Moral Relationalism or Contextualism (Ethical pluralism)

- Moral judgements should be made in relation to factors that vary between issues. Hence it is not possible to formulate rules that are simple and applicably to all situations.

4. Which standards should guide engineers' conduct when working in foreign countries?

Alternate 1: 'When in Rome, do as the Romans do'
Alternate 2. Follow the identical practices which were followed in the home country.
Both are unacceptable. A via media should be found based on the context.

5. What are the International Rights as enumerated by Thomas Donaldson?

- *The right to freedom of physical movement*
- *The right to ownership of property*
- *The right to freedom from torture*
- *The right to a fair deal*
- *The right to non-discriminatory treatment*
- *The right to physical security*
- *The right to freedom of speech and association*
- *The right to minimal education*
- *The right to political participation*
- *The right to subsistence*

6. What can MNCs do to promote morally just measures? Or what are Richard T. De George's guidelines for moral promotion by MNCs?

- MNCs business should do *more overall good* than bad towards the economy of the *host country than* doing good to a *few corrupt leaders* in oppressive regimes.
- They must *respect laws and regulations* of the local country *as long as they do not violate* basic *moral rights*.
- They must *pay a living wage*, even when local companies fail to pay such a wage, but otherwise pay only enough to attract competent workers.
- It is permissible for the US to transfer dangerous technology like asbestos production to another country and then simply adopt that country's safety laws *only under the following conditions*.
  - Workers may be so desperate for income to feed their families that they will work under almost any conditions
  - Pay workers for the extra risk
- *Good judgements exercised in good faith*, than abstract principles, is the only way to address practical problems.

7. Write in brief about Technology Transfer and Appropriate Technology?

7.1. Technology Transfer:

'The process of moving technology to a novel setting and implementing there.'

- Novel setting is any situation containing at least one new variable relevant to success or failure of given technology
- Transfer of technology from a familiar to a new environment is a complex process

7.2. Appropriate Technology:

'Identification, transfer, and implementation of the most suitable technology for a new set of conditions'

- Conditions include social factors that go beyond routine economic and technical engineering constraints
- Identifying them requires attention to an array of human values and needs that may influence how a technology affects the novel situation
- Intermediate technology

8. How is environment degraded?

1. By causing injuries to nature
    i. Usually this damage is caused slowly
    ii. Sometimes this also happens in sudden strikes
2. Misuse of our resources, fouling our environment
3. Practicing growths in consumptions and population leading to non-availability of resources
4. Industrial activity denudes land(to destroy all plant and animal life), pollutes atmosphere and water, reduces the yield from sea and land

9. What are the questions to be answered by Engineers in their role as experimenters?

- *How does an industry affect the environment?*
- *How far it can be controlled?*
- *Whether protective measures are available and implemented?*
- *Whether engineers can ensure safe & clean environment?*

10. What is acid rain? What are its effects?

***Acid rain*:**

- pH of normal rain is 5.6
- pH of rainfall in north eastern areas of North America is 3.9 to 4.3.
- It is 10 to 100 times more acidic than normal. This is 'acid rain'.
- Snowmelt into water releases huge amount of acid which got frozen during winter.

Effects:

- 'Acid shock' from snowmelt causes mass destruction of fish. On long term it also harms fish eggs and sources of food.
- Thousands of lakes were killed by acid rain in Scandinavia and North America.
- The causes are burning of fossil fuels leading to release of SO_2 in particular and Nitrogen oxides.
- Problems of Sweden caused by Industrial plants in England and North Europe.
- Problems of North America caused by utilities in Ohio valley, the largest polluter of SO_2 in USA.
- Some of the potential changes are still unknown
    - Micro organisms in soil are being affected
    - Groundwater is polluted but its ultimate effects are not known
    - The effects may be known only after another 100 years
- Effect on food sources are also unclear

11. What are the other problems caused to the environment?

- Build-up of CO_2 from the use of fossil fuels by Industrial nations could result in *Greenhouse effect*.
- Damage to protective OZONE layer due to the release of Freon is related to technological products used by the people of these nations.

12. What is Greenhouse effect?

'Greenhouse Effect' is defined as 'The progressive warming up of earth's surface due to blanketing effect of man made CO_2 in the atmosphere.'

A greenhouse is that body which allows the short wavelength incoming solar radiation to come in, but does not allow the long wave outgoing infra red radiation to escape. The earth's atmosphere bottles up the energy of the sun and it acts like a green house, where CO_2 acts like a glass windows.

13. What are the effects of Greenhouse?

- The temperature effect of the CO_2 and water vapour combined together has a long range impact on the global climate.
- Because of increased concentration of CO_2 and due to much warmer tropical oceans, there may occur cyclones and hurricanes and early snow melt in mountains will cause more floods during monsoon.
- Increase in global temperature can adversely effect the world food production.
- At higher altitudes in the atmosphere, CO_2 undergoes photochemical reactions producing CO, which is drastically dangerous.
- CFCs are responsible for 20% increase in warming. This may increase the chances of diseases in humans and animals.

14. Describe the case study of environmental degradation caused by PCB & Kanemi's Oil?

In Southern Japan, in 1968 a large number of people suffered by *disfigurement of skin, discolouration, fatigue, numbness, respiratory distress, vomiting and loss of hair.*

- 10,000 people *got affected & some died*
- Two groups of 121 people each were tested and results were as follows:
  - It was found that *fried food using rice oil* produced by Kanemi company was eaten which *caused the problem*
  - After 7 months of investigation….
    - It was found that the *presence of Polychlorinated biphenyl-PCB* was the *cause for the effects* and it was present in the rice oil.
    - Rice Oil was heated at low pressure to remove the odour thro' a heat exchanger and a liquid known as KANECHLOR *which contained PCB was used* for heat transfer
    - Pipes of the heat exchanger was *corroded* and *led to leakage thro' those pinholes*.

- In fact, Kanemi had been *replenishing 27 kgs of lost PCB per month for sometime* without realizing the seriousness.

- Indirect path – this rice was used as chicken-feed and half of one million chickens that were fed died.

Other Similar Effects:

- ❖ Plastic bakery *wrappers containing PCB* mixed with ground stale bread was *used as chicken-feed* and 140000 chickens had to be slaughtered in New York.
- ❖ *PCB leaked* into fishmeal from a heating system in North Carolina plant and 12000 tons of fishmeal were contaminated and 88000 chicken, fed with fishmeal had to be destroyed.
- ❖ High pressure *injection of water* near Baldwin Dam in Los Angeles *caused* the reservoir *crack* open along a fault line. The water released killed 5 and damaged property worth $14 million.

15. How can we internalise Costs of Environmental Degradation?

- ❖ Time cost of a product – includes numerous factors like effect of pollution, the depletion of energy and raw materials, social costs, etc.
- ❖ If these costs are internalized (added to the price), then the cost can be charged directly to the beneficiary of the degradation of environment.
- ❖ It is better to make the user to pay for all its costs than to levy higher taxes.
- ❖ An acceptable mechanism for price fixing must be found by the engineer with the help of the economist, scientist, lawyer and politician which could protect the environment through self correcting procedures.
- ❖ Good design practices may give better environmental protection without added cost.

16. Give a brief account of Technology Assessment?

- o Engineers are said to be finding the *right answers for the wrong questions*
- o *Finding the right questions* is much *more difficult than* finding the *right answers* to these questions

- Engineers should
  - ⇨ Try to assess the technology and its environmental impacts and focus on containing the major adverse effects.
  - ⇨ During assessment even if engineers were strongly believe that the projects have no adverse effect, they should continue to monitor the outcome even after its implementation which only would give the complete picture of the consequences of the project.

17. Write short notes on Sentient – Centered Ethics, Bio – Centric Ethics, Ecocentric Ethics and Human – Centered Environmental Ethics.

Sentient – Centered Ethics

Sentient animals are those which feel pain and pleasure. This version of Nature-centered ethics is advanced by some utilitarians, notably Peter Singer, who says that right action maximizing good for all should *include sentient animals as well as humans*. Failure to do so leads discrimination like racism, which is known as 'Speciesism'. There is always a dispute as to whether the inherent worth of animals can be equated to human beings or not.

Bio – Centric Ethics

This regards *all living organisms as having inherent worth*. We should live with the virtue of '*reverence to life*', as set forth by Albert Schweitzer (1875-1965). This will enable us to take decisions about when life can be sacrificed.

Ecocentric Ethics

This locates *inherent worth in Ecological systems* and this approach is different from the other two, as it is not individualistic. This is voiced by Aldo Leopold (1887-1948). There is another view that ecocentric ethic does not replace socially generated human-oriented duties to family, neighbours and humanity

Human – Centered Environmental Ethics

This is an extension of ethical theories to combat threats to human beings presented by the destruction of nature.

18. Define computer ethics?

Computer Ethics deals with 'the evaluation of and decision making in a variety of moral problems caused by computers'.

19. What shifts are caused in power relationships by Computers?

Power relationship caused by Computers:

1. ***Job Elimination*:**
   - Computers still continue to lead to elimination of jobs.
   - While employees cannot be paid when there is no work, all attempts are to be made by employers to readjust work assignments and retain employees.
   - The absence of this practice creates an employee or pubic backlash against introduction of Computers.

2. ***Customer Relations*:**
   - It is very easy for a customer to notice an error in a computer printout, of the price difference between what is shown at the shelf and what is shown in cash receipt register.
   - Here moral sense and long term business requirement requires that the policies should be made favourable to consumers.

3. ***Biased Software:***

   A group of people with known convictions, may tend to produce software which favours their views rather than views from all angles to let the user decide finally.

4. ***Stock Trading:***

Automatic, hands-off trading of stocks and currency can be performed, benefiting the trading community but it will harm the intended purposes.

5. ***Unrealistic Expectations:***

Sales personnel have a tendency to oversell systems that are too large for customers' requirements; sometimes even those which are not ready for delivery.

6. ***Political Power:***

By obtaining information about different groups of people regarding their attitudes and values, the computers can be made to help politicians to make speeches, send mails, etc. which would be appealing selectively to these groups.

7. ***Military Weapons:***

Computerised military weapons, even if perfected, will only make opposing countries to develop their striking or responding capability which is not healthy for the world.

20. What problems are encountered in the use of computers with properties?

The two major problems encountered in the use of computers with properties are:

1. Embezzlement and
2. Theft of software and information

21. How the problem of embezzlement takes place through computers and why?

- The speed and geographic coverage of the computer system and the difficulty of tracing the transactions through computers makes catching the thieves troublesome.
- Computers are abused in i) stealing by employees at work, ii) stealing by non-employees or former employees, iii) stealing from or cheating clients and consumers, iv) violating contracts for computer sales or service and v) conspiring to use computer networks to engage in widespread fraud.
- Penalties for computer crime are mild compared to conventional crimes.

- ❖ Passwords and more recently, data encryptions are used for security with limited effectiveness.

22. Explain briefly about Data and Software with respect to property problems.

- ❖ 'Data' is information stored in a computer.
- ❖ 'Software' or 'program' consists of i) an algorithm, ii) a source code and iii) an object code.
- ❖ Software can be protected by Copyrights and Trade secret laws. Patenting on software is limited to detailed coding sequences but not final products. Algorithms and object codes cannot be copyrighted. But source code can be copyrighted.
  Eg. Buying one copy and reproducing dozens of copies.

23. Describe how and in what ways 'violation of privacy' occurs in and through Computers.

Computers make more information available to more people. This makes protection of computer privacy difficult.

***1. Inappropriate Access*:**

- Documents recorded for a crime which one did not commit but was arrested.
- As a child you were arrested for drinking alcohol
- Medical data about visits to a psychiatrist.
- A loan default to a National Bank.

Any of the above information can be accessed by, let us say, a prospective employer during a security check.

***2. Data Bank Errors*:**

- Even erroneous information when generated by computers is taken to be authenticated.
- Immediate reaction to such wrong information may mostly prove to be incorrect.

*3. **Hackers***:

- 'Hackers' are people who compulsively challenge any computer security system, choke networks, give out false information, etc.
- This can be extremely harmful.
- It is a violation of property rights.
- At the least, it reduces productivity by shutting down systems.
- Individual privacy, national security, freedom to protect proprietary information are three values requiring limits on access to information.

24. How has law responded to computer abuses?

- A series of laws enacted to prevent abuse of information.
- Information can be accessed only by consumer consent or court order.
- Consumers have the right to examine and challenge information contained in computers.

25. What Professional Issues arise in Computer ethics?

Owing to the high degree of job complexity and technical proficiency required, a lot of issues arise in engineering ethics.

*1. **Computer failures***:

- Failures can occur due to either hardware or software
- Hardware errors do not occur frequently.
- Software errors are the major failures of the computers.
- Hardware errors are easily detected.
- Software errors are difficult to detect.
- Trial runs are absolutely essential to check the program.

*2. **Computer Implementation***:

- New computer system should be attempted successfully before the old one becomes inoperative. Many failure cases have been reported while switching over to a new system.

*3. **Health Conditions*:**

- Ergonomic conditions should be implemented to reduce back problems, provide wrist support, to become good looking.

26. Give one argument each for and against Weapons Development?

- **Weapons Development** is a **defensive measure** against greater destruction by political adversaries, terrorists and enemy states.
- They are **devices to kill** human beings, innocent civilians or equally unwilling soldiers on the other side.

27. What should engineers do in taking part in Weapons development?

Engineers need to examine one's conscience to take part in any form of weapon development.

- They have to consider the circumstances leading to the specific conflict and decide whether it is justified to take part in associated weapons development.
- If necessary, they should refuse to be a part of it and be prepared to face consequences.

28. How much is being spent in Defence expenditure and how Arms Trade gets promoted by private manufacturers of arms?

- Hundreds of billions of dollars, annually, throughout the world, are being spent for military operations.
- 25% of this is spent on just procurement of weapons.
- 17% of these are spent in transactions across countries

<u>Promotion of Arms Deals:</u>

1. Krupp, a family of successful arms merchants and manufacturers

⇨ Armies and navies invested in Krupp's nickel steel armour

- ⇨ Then Krupp made chrome steel shells that can pierce nickel leading to further investment by military.
- ⇨ Then they made a high-carbon armour plate that can resist the new shells resulting in more orders
- ⇨ Then Krupp again produces, 'capped shot' with explosive noses which can pierce through the high-carbon armoured plate also
- ⇨ Arms deals continued to flourish

2. Vickers and Schneider-another arms manufacturer

- ⇨ Supplying arms to Chinese, Japanese and Russians
- ⇨ Pointing out the growth of the Japanese navy to Chinese
- ⇨ Pointing out the growth of the Chinese to their rivals, Russians
- ⇨ Russia – Japanese war in 1905 was useful for the cause of arms manufacturers.
- ⇨ Russians lost the war, hence ordered fresh arms for rehabilitation
- ⇨ Japanese won the war, but were upset since terrible bloodbath was caused by Russians machine guns on land.

29. Describe the destructive nature and power of weapons and their development?

- Towards the end of World War II, night raids sometimes on civilian areas were very common
- The deaths caused by Atom bombs on Hiroshima, Nagasaki were not more than the deaths caused by single air raids in World War II
- But they were horrible because of their power in rapid delivery of destructive power in immense concentration
- Hiroshima Bomb – equivalent to 20000T of TNT powder carried on 267 bogies of railroad (2 miles long) for one bomb – again equivalent to 740-B52 bombers to carry this load.
- USSR exploded Hydrogen bombs in 1960 – 50 & 60 mega ton range for tests with capabilities such as:
    - ⇨ 2000 to 3000 times powerful than Hiroshima bomb

- ⇨ 4000 to 6000 miles long train required to carry an equivalent amount of TNT powder which will take 100 hours to pass any point
- ⇨ Will require one and a half million planes +(bombers) to carry the powder

Towards the end of cold war

- ⇨ *USSR had 5800 megatons (9500 warheads on 2700 launchers) and*
- ⇨ *USA had 3300 megatons (10800 warheads on 2000 launchers)*

30. Illustrate the involvement of engineers in Weapons Development with examples.

1. Bob is employed by a firm manufacturing anti-personnel bombs. These bombs tie up much of the enemy's resources in treating the wounded who survive its explosion (by showering its fragments on to the victims). Though he does not like to be involved in bomb mfr., he justifies himself that someone would have to mfr them. If he does not, then someone else will. Of course, his family also needs a steady income.
2. A chemical engineer, Mary, got into napalm mfg when she was promoted. She does not like wars, but she feels that govt. knows better about international dangers. She also knows that if she continues doing well in her job, she will again be promoted to work on a commercial product.
3. Ron is a specialist in missile control and guidance. He knows that he was one of the engineers instrumental in keeping any potential enemy in check through his work. At least, there is enough mutual deterrence for a third world war.
4. Joanne is an electronics engineer working also on avionics for fighter planes that are sold abroad. She does not want these planes to be sold to hostile countries. Since she does not have any say on who should be their customers, she even alerts occasionally her journalist friends with information about her work which she feels all public should have.

Anyone who is involved in weapons development should be very clear as to his/her motives for being in the industry.

31. What are the Problems of Defense Industry in brief?

1. Large military build-ups, massive projects all lead to unethical business practices and the urgency of completion of the weapons projects does not allow proper controlling and monitoring.
2. 'Technology creep' – development of cruise missiles alters diplomatic arrangements
3. The impact of secrecy surrounding any defense activity
4. Overall effect of defense spending on economy

32. Explain the problems of defense industry with examples.

1. Large military build-ups: $2 billion cost overrun on the development of C5-A cargo plane reported to the public by Ernest Fitzgerald due to poor operating efficiencies in defense industry. He pointed out how large suppliers felt secure in not complying to cost-cutting plans but small contractors were willing.
    - ⇨ *25% firms hold 50%of all defense contracts and 8 firms conduct 45% of defense research.*
2. *Technology creep:* The arms are not only growing in size, it is also becoming better. The development of a new missile or one that can target more accurately, by one country, can upset or destabilize a diplomatic negotiation. Sometimes this fad for modernization leads to undesirably consequences. The F15 fighter planes were supposed to be fastest and most maneuverable of its kind but most were not available for service due to repairs, defects and lack of spares. Engineers should be beware of such pitfalls.
3. *Impact of secrecy*: Secrecy poses problems to engineers. Engineers should be aware of the answers to the following questions:

    Should discoveries of significance to military be informed to govt.? Can they be shared with other researchers, in other countries? Should they be withheld from the scientific and public community? Will the secrecy in weapons development will also serve to hide corruption or their mistakes in defense establishments? Can secrecy help the promotion of weapons systems without criticism or interference from outsiders?

4. *Effect on economy:* Every dollar spent on defense produces less jobs than what could be provided for by using the resource on other neglected sectors such as education and road development. May be a changeover by training defense engineers to use their designs, processes and techniques to bring about better, competitive civilian products is what would be the most appropriate thing to do now.

33. What are the difficulties in Decommissioning Weapons?

1. Even now, shells (duds or live) which landed about 90 years back during World War I are found by farmers during ploughing. Special bomb disposal squads are being kept busy with hundreds of calls.
2. There are, still more, unexploded and hidden bombs allover the world that fell during World War II
3. Severed limbs and dead bodies are being discovered in lands filled with mines in Cambodia and Vietnam in 1960s and70s.
4. Anti-personnel weapons are found in Afghanistan, Angola, Bosnia, Mozambique, Nicaragua and Somalia.
5. These weapons are easily spread by air but are very difficult and dangerous to detect and remove.
6. About 100 million landmines remain still scattered in the above countries as per estimates by U.S.State dept.
7. Landmines present a serious ethical dilemma to leaders who want to be ethical in wars also
8. Design, mfr, deployment and eventually their disposal is a huge experiment.
9. Widespread ignorance on radiation amongst the public
10. Gas warfare experiments, Anthrax carriers, nuclear weapons all cause both known and unknown problems
11. Engineers dealing with dangerous material should consider both the intended use and also the unintended consequences and also their disposal.

34. Which studies are more useful to 'engineer managers' than even engineering?

Richard L.Meehan, a civil engg graduate from MIT, was retained by General Electric as a consultant to testify before Nuclear Regulatory Commission about the capability of GE's nuclear plant in California, U.S.A. to withstand earthquakes.

He found, while trying to understand the effect of earthquakes on nuclear plants, that

1. His basic study of physics is more useful in studying this area compared to the more advanced studies in engg.
2. His understanding of risk analysis was based not only on probability theory but also on value judgement about safety.
3. But more interesting was that understanding people was more important than anything else.
4. Person oriented skills are as important to engineers as technical skills.

35. Why managements prefer to make engineers as managers than non-engineers? / Why engineers find management positions attractive?

⇨ Engineers undergo the *most intensive technical training* amongst professionals. But still, many of them move to managerial positions early in their career for which they received no training.

⇨ Organisations find it easier to *teach the business side to engineers* than teaching engineering to non-engineers.

⇨ They also value the *quantitative analysis, strong work-ethics, and confidence in problem solving* exhibited by engineers.

⇨ Engineers also prefer the management attractive, since career in management offers *better recognition* than technical track.

36. 'Managers' responsibility is to conduct business to increase profits'. Discuss.

- Nobel laureate Milton Friedman said '*The social responsibility of business is to increase its profits……. The responsibility of managers is to conduct business in accordance with their stockholders' desires, which generally will be to make as much*

money as possible while conforming to he basic rules of society, both those embodied in law and those embodied in ethical custom'

- The ethical custom refered by Friedman means only 'refraining from fraud, deception and corruption.
- But Martin and Schinzinger say that Friedman is not correct in saying that managers' ethics reduce to only responsibility to maximize profits for stockholders.
- The primary responsibility of managers is to produce product or service while maintaining respect for persons, including customers, employees and public.
- Ethically, personnel and safety comes first before profits.
- By definition, compared to charitable institutions, religions, organizations, etc organizations and corporates operate only for profits.
- But the ultimate goal of managers should be to make valuable products that are also profitable since profit making is one of the conditions to be in business.
- Good business and sound ethics go together. Hence the moral roles of managers and engineers are complementary and not opposed.
- Engineer managers have two major responsibilities – promoting and ethical climate and resolving conflicts.

37. Explain how Ethical Climate is promoted in organizations through examples.

There are highly ethical organizations, examples of some of which are given below:

1. Marilyn Hamilton, founded Quickie Designs in 1980, who was a teacher and athlete who was paralyzed in hang-gliding accident. A highly mobile and versatile wheel chair was designed weighing 26 pounds, half the weight of chairs that were currently produced. The company grew up within a decade to $65 millions in sales. It had a policy of customer sponsored sports events for young people in wheelchairs. It is relatively small (500 strong) and exceptionally committed.

2. Martin Mariette Corpn began an ethics program in 1985 emphasizing basic value like honesty and fairness and responsibility for environment and high product quality. They drafted a code of conduct, conducted and ethics workshop for managers and created effective procedures for employees to express their ethical concerns.

3. Texas Instruments (TI) is an example of an ethical large corporation emphasizing on trust, respect for other persons, etc. TI appointed a full time Ethics Director, Carl Skooglund. He surveyed to know the ethical concerns of employees and their awareness. He conducted workshops on ethics, wrote brochures and was directly to all employees through a confidential phone line. Even though they made it clear that unprofessional conduct would not be tolerated, the focus was on supporting ethical conduct than punishing wrong doers.

4. A large defense contractor started an ethics program that was not successful. Higher management viewed the program as a success but the professional employees considered it as a sham/farce for public relations and window dressing. The primary difficulty was the gap between the intentions of top management and the unchanged behaviour of the Senior managers.

38. What steps can be taken to improve the ethical climate by managers?

1. Ethical values and their full complexity are widely acknowledged and appreciated by managers and engineers. Neither profits nor promoting the interests of the organization is neglected but the *moral limits* on profit-seeking *go beyond simply obeying the law* and avoiding fraud.
2. The sincere *use of ethical language* is recognized as a legitimate part of corporate dialogue. This is done either by formulating corporate code of ethics or by including ethical responsibilities in job descriptions at all levels.
3. Top management must *set a moral tone*, in words, in policies and by personal example. Everyone should be confident that management is serious about ethics.
4. There must be *procedures for conflict resolution*. Managers should be trained to resolve conflicts and on the other hand, a person should be exclusively made to have confidential discussions about moral concerns.

39. What are the most common conflicts?

- Conflicts over schedules, depending mostly on support depts. but where managers do not have any control.
- Conflicts over which is the most important dept or function at a given time

- Conflicts over personnel resources
- Conflicts over technical issues
- Conflicts over administrative procedures
- Personality conflicts
- Conflicts over costs

40. Can conflicts be managed by force or authority? How are different conflicts resolved?

- 'I am in-charge - see it my way or I will fire you'. This is generally perceived as self-defeating.
- Conflict arrangement sometimes means tolerating and even inviting some forms of conflict
- Manager's task is to create climate in which conflicts are addressed constructively
- Personality conflicts are ranked relatively low in intensity but they are most difficult to resolve.
- They are generally woven with technical/communication problems
- Properly managed technical and ethical conflicts are usually fruitful and not harmful. Differing views provide opportunity for improved creativity.

41. What are the 4 ways to resolve conflicts among persons suggested by Harvard Negotiation Project?

1) People: Separate people from the problem.

   Even though both the people and the problem are important, the personal aspect of the conflict should be separated from the problem to deal with it better. On personality clashes, the focus should be on behaviour and not on people.

2) Interests: Focus on interests and not position\s

   This principle applies most clearly to personnel matters and ethical views, rather than technical disputes. Positions are stated views but these may not really express their best interests.

3) Options: Generate a variety of possibilities before deciding what to do.

Create a wide range of options especially in technical and ethical issues and facilitate discussions.

4) Criteria: Insist that the result be based on some objective standard.
   Beyond the goals of efficiency, quality and customer satisfaction, it is important to develop a sense of fair process in how the goals are met.

42. What is the nature of work for Engineers as Consulting Engineers?

- Consulting engineers work in *private practice*.
- They earn by getting their *fee for services* rendered.
- They have greater *freedom in decision making* compared to salaried employees.
- But they also *have a need to earn* a living.

43. What are the major areas of work for engineer consultants?

1. Advertising
2. Competitive bidding
3. Contingency fees
4. Safety and client needs

44. 'Advertising, once thought to be unprofessional has now been accepted by law' – Explain.

Before 1976, advertising was thought to be '*unprofessional*', in U.S.A. The state felt that work should be won *through reputation* as engineer and *not through advertisement*.

But in 1976, Supreme Court ruled that

- ⇨ *Ban* on professional advertising is an *improper restraint*
- ⇨ It *reduces* public *awareness* of available professional *services*
- ⇨ They keep *prices higher* than they might otherwise.

Now the focus has been shifted to restrain *deceptive advertising* which is done through:

1. Outright lies
2. Half-truths

3. Exaggeration
4. Making false suggestions or implications
5. Obfuscation (confusion or not being clear) created by ambiguity, vagueness
6. Manipulation of the unconscious

45. When is advertising considered to be *deceptive*?

***Example 1*:** A consulting firm played actually a very minor role in a well-known project

Situation 1: Its brochure claims that it played a major role
Situation 2: It makes no claim but only shows the picture of the project
Situation 3: It shows the picture along with a footnote in fine print the true details about its role in the project
Situation 4: If the same statement is printed in larger type and not as footnote.

***Example 2*:** An ad shows an electronics device to convey that the item is routinely produced and available for sale. But actually the ad shows only the prototype or mock-up and the item is just being developed.

46. What are the norms to be followed by ethical consultants in advertising?

- Generally consumer products can be advertised suppressing the negative aspects and even some exaggeration is allowed.
- But *advertisement of professional services* like engineering services is governed by strict norms.

NSPE forbids the following:

"the use of statements containing a material misrepresentation of fact or omitting a material fact necessary to keep the statement from being misleading; statements intended or likely to create an unjustified expectation; statements containing prediction of future success; statements containing an opinion as to the quality of the showmanship including the use of slogans, jingles or sensational language format."

- Some degree of solicitation may be useful in encouraging healthy competition
- Or will it open the door to people who are not honest, who criticize unfairly or who exaggerate the merits of their services?
- In any case, restrictions on misleading advertisement are a must.

47. Why was Competitive Bidding prohibited earlier and then why was it approved by courts?

- ❖ Competitive bidding was prohibited for quite sometime due to the following reasons:
- ❖ Consulting jobs, unlike industrial and construction work, are not suitable for precise cost estimates and hence precise bids.
- ❖ Here competitive bidding, would encourage cutting safety and quality, in case of lower bids and padding/over designing in the case of higher bids.
- ❖ Later, Competitive bidding was approved by Courts of law on the reasoning that free trade is restrained in an unfair manner.

48. When consulting engineers reject competitive bidding, what can be the basis of their selection?

Consulting engineers, in the absence of competitive bidding can be selected only based on their reputation and proven qualification. But younger, competent engineers may be disadvantaged by this method.

49. What is your understanding of Contingency Fees?

Contingency fee is dependent on some specific conditions beyond normal, satisfactory performance in work.

- A client may hire a consultant engineer to find methods of cost saving on an ongoing project to save a minimum of 10%. If consultant saves 10%, he will get his fee; otherwise no fee will be paid. The fee can be either an agreed amount or a %age of savings.

- When the fee is a %age of saving, it becomes 'contingency fee'. In many cases, consultants tend to be biased and in order to gain the fee, they may specify inferior design or process to cut costs.

50. How does NSPE address the issue of 'Contingency Fee'?

NSPE has addressed this issue as follows:
"An engineer shall not request, propose, or accept a professional commission on a contingent basis under circumstances in which his professional judgement may be compromised, or when a contingency provision is used as a device for promoting or securing a professional commission."

51. When does the 'contingency fee' become permissible?

To decide whether 'contingency fee' practice may be allowed or not, the potential gains should be weighed against the potential losses. Hence, this again calls for contextual reasoning based on ethical theories, which provide a framework for assessing morally relevant issues of the problem.

52. How 'Safety and client needs' should be addressed by consulting engineers?

- ❖ Consulting engineers have greater *freedom with wider areas of responsible decision making* compared to salaried engineers.
- ❖ This creates *special difficulties* for consulting engineers.
- ❖ In '*design-only*' projects, consultants do not have any role in the construction or implementation as per the design specs.

    - ⇨ Ideally, only the designer would really know the areas of difficulty in execution.
    - ⇨ Even when changes in design are required during execution, the consultant may not be around to effect the changes

- ⇨ Client may not have capable people for inspection of the work based on the consultant's design.
- ⇨ Does the consultant have a moral responsibility to follow through the design in execution
- ⇨ In any case, job safety is one prime responsibility of the consultant engineer

53. What are the reasons that cause 'Disputes'? Who is the major loser in any dispute?

- Large projects involve owners, consultants and contractors and many participants at various levels in these three organizations.
- Overlapping responsibilities, fragmented control, delays and inability to resolve disputes are some of the problems encountered during these projects.
- Resolving disputes becomes especially difficult when projects last for several years and connected personnel also change during this period.
- Owners have the most to lose in such situations.
- Hence they try to shift the risks to others.
- Consulting engineers are generally tied to the contract provisions and they do not try any innovative ideas (do not want to add risks)
- All this have led to considerable litigation and any litigation is time consuming and costly.

54. What are the steps to be taken resolve disputes?

1. Define how risks are to be apportioned and payment of fees to be made
2. Make contractual provisions for dispute solving vehicles to avoid legal battles in lines of mediation – arbitration
3. Mediator attempts to resolve first and if it fails, the arbitrators' decision should be final.
4. National Joint Board for settlement of Jurisdictional Disputes will be called to provide a leaking board and appeals board.

5. The Consulting Engineer, from the "social experimentation" nature of engineering, has the obligation to include such clauses in contracts and should make sure that these clauses are adhered to by all.

55. What is the work done by Engineers as Experts?

Engineers, in their position as experts, explain the *happenings of the past in terms of* Causes of accidents, malfunctions of equipment and other technological events. They also help in *events of* the *future* lik*e,* public planning, potential of patents and policy making (in technology)

56. How should Expert Engineers function?

They should function as impartial seekers of facts & Communicators of truth but not as hired guns i.e. advocates for lawyers, officials, etc

57. What are the types of cases, expert witnesses are called upon to testify in court & what are the stakes?

57.1. Types Of Cases

I. Airplane crash
II. Defective products
III. Personal injury
IV. Property damage
V. Traffic accident

57.2. Stakes

I. Legal liabilities
II. Economic interests
III. Reputations of corpns. and professionals

58. What are the Expert engineers' responsibilities towards their hirers?

They should

- Present their qualifications to the client
- Investigate thoroughly the cases entrusted to them.
- Testify in court

59. How should the expert witness exhibit one's '*confidentiality responsibility*'?

The expert witnesses must

- *Not divulge* their investigations *unless called* upon to do so by the court
- *Not volunteer* evidence *favourable* to the *opponent*
- Answer questions *truthfully* when opposing attorney puts forth pertinent questions

But he should not *just be the client's mouthpiece*.

60. What are the *aims of a legal system?*

Aims Of A Legal System is

To *administer a complex system* of legal rights that define legal justice *achieved* through *adversarial relationships*, with rules about *admissible forms of evidence* and *permissible forms of testimony*

61. What is the role of an expert in a court system consistent with *Professional standards (codes of ethics)?*

Role of an Expert in a Court System

- Experts must earnestly try to be *impartial* in identifying and interpreting complicated data thrown up by the complexity of modern science and technology *to help the courts*
- Ideally, *if courts pay* the expert witness, the expert will become totally *unbiased*.
- But it is a very costly issue
- So parties to the dispute are called upon to pay and hire them on both sides and also allow them to be cross examined by both sides

62. What is the difference between *Eye witness* and *Expert witness*?

- *Eye Witness*

Is permitted to testify on *observed* and to some extent perceived facts.

- *Expert Witness*
  - ⇨ Is permitted to testify on *facts, perceptions and interpretations* of facts in the *area of their expertise*
  - ⇨ To comment on opponent's expert witness' view
  - ⇨ To report on applicable professional standards

63. What are the types of abuses of Engineers as Expert witnesses?

Expert witnesses are abused in the following ways:

- Hired Guns
- Financial Bias
- Ego Bias
- Sympathy Bias

64. Write short notes on: a) Hired Guns, b) Financial Bias, c) Ego Bias and d) Sympathy Bias

a) Hired Gun

An *unscrupulous* (unprincipled, crooked, immoral) engineer

- Makes his *living* by helping lawyers to *portray facts in favour* of their clients
- *Never* tries to be *objective*
- Violates standards of honesty and care in conducting investigations
- Overall a *shame on engineering community*

b) Financial Bias

- The expert witness is biased to the party which pays more money
- The bias increases substantially when payments are agreed as *Contingency Fee* to be *paid only* in case the *hirer wins the case*
- Full time forensic engineers, being *dependent on lawyers for their living*, try to create a *reputation of a winning engineer.*

c) Ego Bias

- Competitive attitudes, being on one side of the disputing parties makes an expert, *egoistic* and makes him *influence judgments*
- They start *identifying themselves with* their side of the *dispute*

d) Sympathy Bias

- The *plight* of the victims and their *sufferings* can *invoke sympathy* from the expert witness
- This *upsets impartial* investigation of facts

65. What is needed of the Expert Engineers?

- Engineer Experts should *maintain their integrity* in the face of all the above biases
- *Courts also must rely on balance* provided by expert witnesses on *both sides* of the case and provide *opportunities* to lawyers to *remove the bias* by cross-examination

66. What is the work of Engineers as Advisers?

Engineers act as Advisers in Planning and Policy-Making like Economists, sociologists, urban planners, etc.

In Policy-Making they advise about the Cost benefit analysis of alternate solutions for transport, housing, energy, defense, etc.

In Planning they check the feasibility, risks and benefits of the specific technological projects which affect public in local communities

67. What are the Stakes for the engineer advisers?

Their stakes are:

1. Opposing political views
2. Social perspectives
3. Economic interests
4. And their individual values like,
    - ⇨ Honesty
    - ⇨ Public trust
    - ⇨ Respect for common good

68. How should Engineer advisers act?

Advisers are to:

- Chart *all realistic* options
- Carefully *assess each* under different assumptions *about future* contingencies
- Act *favourable to the client* by basing their studies on particular assumptions about future contingencies

69. What are the factors that influence Advisers?

Advisers are influenced by:

- Large amounts of money involved
- Direct and overt (obvious and unconcealed) pressure applied by pro or anti-people involved in that project
- Hope of additional work in future
- Their wish to get the respect of clients

70. What are the normative models of Advisers? Briefly explain each of them.

Normative Models of Advisers

Three types:

- Hired Guns
- Value Neutral Analysts
- Value Guided Analysts

Hired Guns – This is the most undesirable role that can be played by the adviser.

- Here the obligation to clients only is paramount and other values are not bothered about.
- Studies are made just conforming to the client's wish.
- Adviser highlights only the favourable facts to the customer.
- All the unfavourable facts are very much downplayed.

Value Neutral Analysts

- Completely impartial engineers.
- They identify all options and analyze factual issues of each option.
- Cost-benefit analysis are made based on value criteria specified and made public

Value Guided Analysts

- Responsibility to public paramount
- Maintain honesty about technical facts and values
- They can adopt partisan views for the good based on their professional judgment

71. What are the virtues of independent expert advisers?

Virtues of Independent Experts

- *Honesty*- avoiding deception, being candid in stating relevant facts and truthful in interpreting facts
- *Competence*- being well trained, adequately experienced in the relevant field and having relevant skills
- *Diligence*- carrying out tasks carefully and promptly
- *Loyalty*- avoiding conflicts of interest, maintaining confidentiality and concern for the interests of the client

72. List the roles of engineers as 'leaders'.

Engineers perform as *Leaders* in the roles of

1. Managers
2. Business Entrepreneurs
3. Consultants
4. Academics and
5. Govt officials.

73. What is leadership and who are moral leaders?

Leadership is *'Successfully moving a group towards its common goal'*.
But Moral leaders are those who move the group successfully *towards goals which do public good* and not evils i.e. the *goals must be 'morally valuable'*. Hence ***Moral Leaders*** can be defined as,
'The individuals, who direct, motivate, organize, creatively manage and move groups toward morally valuable goals'

74. 'Technologists were best qualified to govern because of their technical expertise'. Discuss in detail.

Mussolini and Hitler were great leaders, but not 'Moral Leaders', since their goals were not morally valuable.
'An Utopian society shall be governed by a philosopher-king whose moral wisdom best qualifies him to rule' – *Plato*
'Technologists were best qualified to govern because of their technical expertise, as well as their logical, practical and unprejudiced minds'– *Frederick Taylor*

- ⇨ But no single profession has the only right to moral governance of society.
- ⇨ Leadership is also moving away from any narrow professional interests.
- ⇨ Moral leadership is not 'dominance by elite', but stimulating groups toward morally desirable ends.

75. Explain *Moral Creativity*.

Moral creativity is

- Identifying most important *values in particular situations*
- Focusing on them through *effective communication* within the group.
- Deep commitments *grounded in integrity* to implement them.

Creativity consists in *identifying new possibilities* for applying, extending and putting into practice, *rather than inventing values*.

76. How participation in Professional Societies will improve moral leadership?

Professional Societies

- *Promote* continuing *education* for their members
- *Unify* the profession, *speak and act* on behalf of them
- Are a forum for communicating, organizing and mobilizing change within, a change which *has a moral dimension.*
- *Cannot take* any *pro-employee or pro-management* stand since they have members in management, supervision and non-management.
- But they can play a *role in resolving* moral issues
- A moral responsibility as well as moral creativity is shared.

77. How can individuals *make a difference in leadership* of Professional Societies?

- Stephen H. Unger, as an individual was mainly responsible for persuading IEEE to focus on supporting responsible engineers than punishing wrong doers. He was instrumental in IEEE presenting awards to the three BART engineers.
- In 1988, NSPE created National Institute of Engineering Ethics with a mission to promote ethics within engineering. The focus was on education rather than propaganda.
- But effective professional activity, requires a substantial trust from clients and the public.
- Building and sustaining that trust is an important responsibility shared by all engineers.
- In this area also Moral Leadership within professional societies is important.

78. Write short note on 'Leadership in Communities'.

Leadership responsibilities of *engineers as citizens go beyond those of non-engineers.* They should *provide* greater leadership in social debates about

- ⇨ Industrial Pollution
- ⇨ Automobile Safety
- ⇨ Disposal of Nuclear Waste, etc.

79. What are the different views on 'leadership in communities'?

- One view is that *no one is strictly obligated* to participate in public decision making. It may be a moral ideal for citizens.
- An opposite view is that *all are obligated* to devote sometime and energy in public policy making.
- Non-engineers should at least *stay informed* about public issues and *professionals have obligations* as experts in their areas.
- Hence the need for identifying and expanding areas of possible good.

80. What are the arguments for and against Voluntary Service by engineering professionals?

- ❖ Should engineering professionals offer engineering services to the needy, without charging fee or at reduced fee?
- ❖ Voluntarism of this kind is already encouraged in Medicine, Law and Education.
- ❖ But ABET code states "Engineers shall not undertake or agree to perform any engineering service on a free basis" and other codes also insist that engineers are obligated to adequate compensations (which means full fee)
- ❖ Engineers find it difficult to donate their services individually compared to doctors and lawyers since their output is on a shared basis
- ❖ But, as suggested by Robert Baum, engineers can volunteer their services in the following areas, in groups, either free or at cheaper than normal fee.
    - ⇨ Environmental impact studies that is harmful to a community
    - ⇨ Health issues of polluted water and soil
    - ⇨ Minimal needs of elderly and minorities like running water, sewage systems, electric power and inexpensive transportation.

81. What can engineers and engineering society do to public in terms of 'voluntary service'?

Engineers can

- Urge Govt. to expand services of the Army Corps of Engineers
- Encourage students to focus their projects on service for disadvantaged groups
- Encouraging corporations to cut their fee by 5 to 10% for charitable purposes.

Morally concerned Engineering Profession-

- *Should recognize the rights of corporations and engineers to voluntarily engage in philanthropic engineering services.*
- Professional societies *should endorse* voluntary exercise as a *desirable ideal*.

Many engineers and some societies already are engaged in

- Tutoring disadvantaged students
- Advice local governments on their engineering problem.

******** ALL THE BEST*******