

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.*)

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- 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*

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- *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

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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 SO₂ 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 SO₂ 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 CO₂ 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 CO₂ 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 CO₂ acts like a glass windows.

13. What are the effects of Greenhouse?

- The temperature effect of the CO₂ and water vapour combined together has a long range impact on the global climate.
- Because of increased concentration of CO₂ 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, CO₂ 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 heatexchanger 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?

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

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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 public 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.

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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

Promotion of Arms Deals:

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

- ⇒ Armies and navies invested in Krupp's nickel steel armour

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- ⇒ 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 all over 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 and 70s.
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*

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accordance with their stockholders' desires, which generally will be to make as much

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

- The ethical custom referred 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 an ethics workshop for managers and created effective

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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?

- o 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

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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.”

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- 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* like, 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.

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- *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

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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.

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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

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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

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⇒ 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.