CONTENTS

CHAPTER 1

Appraisal of Human Values and Professional Ethics

1.1 UNIVERSAL HUMAN VALUES

Human Values are the *'habits of thought'* each of us acquires as we mature so that we can assess and deal with *'ethical'* problems (where *'ethical'* relates to the fundamental question of how we should live). Should we aim at happiness or knowledge, at virtue or the creation of beautiful objects ? If we choose happiness, will it be our own or will it make proper allowance for the happiness of others ? And what of the more particular questions that face us ? Is it right to be dishonest in a good cause ? Can we justify living in opulence while elsewhere in the world people are starving ? What are our obligations to the other creatures with whom we share this planet, and to the generations of humans who will come after us ? What do we regard as a *'good'* quality of life for us and for others ?

Human values can be formulated or expressed in many ways *i.e.*, anything from practical examples to moral principles at the highest levels of generality. However, genuine human values are not abstract principles developed by academics or preachers, but life-embedded ideas and precepts, along with their various justifications. Because they are human, values are not divinely ordained rules of behaviour - not commandments set in stone. They are related to differing cultures, unique persons and situations and are developed and expressed in human terms for the human aims they collectively represent.

All great people in this world held some values/ ethics very dear and close to their heart and showed results based on the universal human values and their sub-values as mentioned below :

S.No	Human Values	Sub-Values
1.	*Truth*	Truthfulness, honesty, fairness, flection, creativity, determination and trust.
2.	*Love*	Service, tolerance, compassion, forgiveness, friendship and kindness
3.	*Peace*	Positive attitude, thankfulness, concentration, patience, contentment, self-acceptance and self-discipline.
4.	*Justice*	Consideration, cooperation, global stewardship, loyalty, active citizenship, justice and respect.
5.	*Responsibility*	Health, manner, helpfulness, courage, perseverance, responsible and awareness.

1.1.1 Truth

The truth in any matter does not depend upon the will or wish of the individual, but is independent of desires and their related interests and opinions. Truth has both individual and communal aspects. Just as individual truthfulness is the basis of a secure society, the common effort towards truth about life and the cosmos is represented, for example, by the sciences, by jurisprudence and philosophy. The faculty for rational thinking possessed by all humans, however much developed or not - or in whatever form it takes, is in the first and last instance what enables us to distinguish the truth from the false in so far as this is humanly possible. Evidence that truth is an inherent value in the human psyche is found in the fact that no-one likes to be called a liar, not even most liars. Further, it is much harder to sustain a lie than to maintain the truth, because one lie leads to another until the complexity is unmanageable.

1.1.2 Love

The word *'love'* should be taken in the very wide sense of *'care'* or *'concern for'*. This can be taken as a basic category or general human value which relates to concern and respect for others and the environment. The word *'love'* is here used in a broader sense than in common parlance where personal and/or erotic love is the common interpretation. Love as care does not refer to an emotion or a state of mind so much as to a human faculty of identification with others, sympathy with all beings, creation and - in spiritual or religious beliefs - of Divinity. Love seeks many and various channels of realisation. It's essence can be characterised by the words *"Love is unselfish care and concern for the well-being of others and the world at large."* The less selfish it is, the more it enriches life. Being universal, it takes on different general forms in different relations ; mother love, fatherly love, conjugal love of one's partner, loving friendship etc. Patriotic love is for one's country, true brotherhood expresses love of mankind, care and respect for nature is love of creation and - for those who profess religious belief - devotion is love of the Creator. All these have in common the 'heart' and an intuitive identification with spirit, with the universal miracle of being. Thus, love of oneself (contrasted with egocentricity) is also a valid expression of this power and, moreover, a duty to all at the same time. Being neither a sensation, an emotion nor a mere conception, but being identifiable only at the heart or core of the human consciousness, love in this universal sense is the characteristic par excellence of the human soul or psyche. It is common to include altruism, understanding and forgiveness under the more encompassing (but vague and ambiguous) word 'love'. Universally valid human value can be most difficult to determine in respect of any given situation. Not all would agree that one must forgive wrongdoers regardless of what they did, whether they admit guilt and show remorse or whether they would do the same again if they could. For most people, forgiveness may have to wait upon the remorse of the guilty party, and far from all would see it as right to forgive certain crimes even so. This shows how human values cannot be fixed or unchanging 'universal' commandments, for in every case of a value being applied (or ignored) in practice, many situation-specific circumstances are unavoidably involved in moral decisions.

1.1.3 Peace

Peacefulness in a person's life, in society and in world terms is a product of all positive values working together sufficiently. Without truth, caring concern (or *'love'*) and justice, conflicts arise and peace is endangered or lost. While peace is the absence of disturbance, violence, war and wrongdoing generally, it is tangible present when experienced individually as peace of mind, the mutual respect and pleasure of friendliness and tolerance. As a universally-accepted positive value, peace refers to the experience of harmony, a balanced but nevertheless dynamic mental condition. Peace of mind can be independent of *'externals'* like the absence of disturbance in *'peace and quiet'*, or the intrusion of an environment through noise, violence, terror etc.). Peace of mind - as contrasted to mental agitation - is a primary goal for human strivings to reach happiness. Peacelessness, in whatever respect, is not conducive to the happiness of equanimity. Peacefulness is not to be confused with lack of activity or mere physical quiet. As a psychic condition it is closely related to control of the mind, positivity of attitude together with calmness of mind. Inner blissfulness which is not dependent upon external sensory or physical conditions is a high expression of peacefulness. The peace of nations at least partly arises and is sustained through the cumulative efforts of society, including the peaceful and just behaviour of at least an aggregate of individuals. It can first be fully realised when we have confidence in the inherent ability of humans to see good, do good and be good. Thus, its internal connection with rightness of action and other human values becomes evident. As a social condition, peacefulness is clearly a state of freedom from violence and from destructive influences generally, whether it is war, the over-exploitation of people or the destruction of nature. Because of the emotional and mental dependencies that arise from attachment to material things, peacefulness is related to controlling one's desires, limiting them when necessary. This implies temperance in all things from quantity and type of foodstuffs taken in, the number and type of material possessions as well as the type or quality of *'sensory impressions'* to which one subjects the mind. Peace of mind is individual, but peace in society is the result of positive acts, which are not violent or destructive but tolerant and constructive.

1.1.4 Justice

Humans have long embraced justice as one of the highest human values based upon the widest possible considerations which include right or wrong, good or ill, blame (responsibility) or guiltlessness. The institutions exercising justice take into consideration past events, behaviour, motives, intentions, personal and social change, and the circumstances conditioning all these. It is based on fairness, where the equality of every individual before the law is fundamental. As such it is a social value which aims to resolve and reduce conflict, guided by the principles of care and non-violence (involving the minimum use of force required). The aim to achieve social justice for the perceived common good (however ineffective or wrong in view of current standards) has certainly a long pre-history as a central idea in all human societies. The human value justice also has wide-ranging political relevancy, such as in the strivings of egalitarianism in political democracy and other systems of rule. As such, justice is a major human value that embraces most aspects of social life. This value is to be understood in the deep Vedic sense of Ahimsa, being universal in implying respect for all living beings. This is founded on recognition of the (truth of) the unitary nature or *'integrity'* of creation, in which all individual beings together make up one integral whole within which all parts or aspects are ultimately mutually-interrelated. Justice is expressed in all forms of human interest in and care for living nature, obviously including humans, while it clearly also remains an ideal to be striven for in the interests of peace of mind and love. Human values are the duties we owe towards our fellow men to avoid harming them physically, emotionally or otherwise. Many people consider forgiveness of one's enemies or wrongdoers as of high moral value, something which is *'truly human'*.

1.1.5 Responsibility

Human actions are physical events brought about through physical behaviour. However, no definitive and specific codes of behaviour can be prescribed for all times and places independently of environmental, social and other conditions. The human values themselves provide the general criterion for good behaviour, but because of the changing nature of life and society, they cannot be formulated as explicit norms, laws, rules or regulations. Towards living nature in general, the human value of doing one's duty is closely related to non-violence. This is the reasonable tendency to wish to avoid harm to creatures or their environment wherever avoidable. Respecting the integral nature of eco-systems or of a social-natural environment as against the destructive influences of pollution, misuse and excessive exploitation exemplify the spirit of non-violence (the Hindu concept of ahimsa as well-developed by Gandhi). It is the inherently-sensed value that prompts us to draw back from unethical meddling in life processes, such as where its consequences are beyond the range of well-tried and proven knowledge. Knowledge of what is true combined with insight into what is good are the basis of duty, also conceived as *'acting rightly'*. Behind any conscious act lies the thought. If the thought is fed by the will towards the true and the good - in contrast to purely selfish aims - the act is *'right'*. This is also found in the Eastern concept of dharma or action in accordance with the universal laws of nature (both physical and human nature).

Central to dharma is truth, that is - action based on truth and in accordance with one's deeper or potential nature. A full understanding of right action, whatever the circumstances, presumes thorough insight into the mutual relations of dependence between humans, between all beings and within creation as a whole.

1.1.6 Harmony with Self, Family, Society and Nature

1.1.6A Harmony with Self

Human being is co-existence of self and body. The body is the instrument of self and self is the seer, doer and enjoyer. Self is continuously active to fulfill its need for happiness. The self is the basis of everything we do. All the desires and expectations we have are all due to self. Happiness and unhappiness are the states in self. Study of self enables us to know our weaknesses and method to remove it.

The self is conscious in nature while the body is physic-chemical in nature. Our focus of attention is on two categories of attributes of the self, *i.e.*, the powers of the self and the corresponding activities. Self receives sensations from body, we see a car through the information given by the *'eyes'*, we start thinking about the car which further results in desire to have one. When desire is set we start forming thoughts about fulfilling this desire. The following is the pattern of activities of self and body.

Selection ⟶ Thoughts ⟶ Desires ⟶ Thoughts ⟶ Selection

Activity of imagination in *'I'* is continuous and not temporary. The power and taste may change but the activity of selecting/tasting is continuous. These activities keep going on in us irrespective of whether we want them or not.

Desires, thoughts and expectations are largely being set by pre-conditioning and sensations. Preconditioning means we have assumed something about our desires on the basis of prevailing notion about it. We have not verified the desires in our own right. Sensation is a perception associated with stimulation of a sense organ or with a specific body condition.

Since the desires are in conflict, the thoughts they give rise to, are also in conflict and in turn, the selection from the thoughts are also in conflicts. This conflict affects us in different manners *i.e.*,

(*i*) Wavering aspirations
(*ii*) Lack of confidence
(*iii*) Unhappiness/conflicts
(*iv*) Lack of qualitative improvement in us, and
(*v*) State of resignation.

The pleasure obtained from sensations is short-lived. We are driven by five sensations (sound from the ears, touch from the skin, sight through eyes, taste from the mouth, and smell from the nose). No matter how much we try to be become happy via the senses, or via bodily

sensation, it does not last. We can thus understand that living on the basis of preconditioning (*e.g., "good life means having a nice car"*) or sensations (*i.e.*, happiness out of taste from the body) means we are in a state which is being decided by the others. Start verifying your desires, thoughts and expectations on the basis of your natural acceptance. Accessing of natural acceptance resolves our misunderstanding. The basis of our *'natural acceptance'* leads to operating on the basis of our *'realization'* and *'understanding'*. Realization means to be able to see the reality as it is. Understanding means to be able to understand the self organization in all entities of nature/ existence which are inter-connected.

1.1.6B Harmony in Family

A family can be defined as a group of persons related by blood, adoption or marriage and whether or not living and cooking together as a single housekeeping unit. Family as a basic unit of interaction is a natural learning ground for the human being to understand the harmony in relationship with others in the society. Family relations give us strength to face the world. It feels wonderful to return to a happy home after a hard day's work, otherwise a person would actually hate going home having an oppressive atmosphere.

A Family with feuds can cause depression, anxiety, sadness, confusion and rage. No one wants to live like that. It is not surprising that children who grow up in happy families are more successful and well-adjusted in life. Some simple rules for turning family feuds into family fun are ;

(*i*) Parents are the real role models for the kids. Their wellbeing depends largely on parents conduct.

(*ii*) Children need strong emotional support along with adequate monetary support.

(*iii*) Complete respect to old generation can be a very good guide as they carry a very rich experience with them.

(*iv*) To maintain good relations, avoid any kind of disconnect and establish a dialogue.

When we live in relationships then, as a natural process we constantly evaluate ours' and the other's feelings. We are embedded in relationships, they are there and all that we need to do is to recognize them and understand. We may try to suppress them, or argue against them, or undermine them but, the feelings remain very much there. When we 'trust' someone, it is the person, and not the body. Trust is something to do with the self ('*I*') of the other person *i.e.*, the feelings in relationship are between '*I*' and the other '*I*'.

The main factors/values on whose strength family harmony stands are :

(*i*) ***Justice.*** We need to evaluate for ourselves whether we are able to ensure justice in relationships,

(*ii*) ***Trust.*** It is the expectation of people that they can rely on our word. It is built through integrity and consistency in relationships,

(*iii*) ***Respect.*** Any kind of over, under or otherwise evaluation makes us uncomfortable, we find it unacceptable and say we have been disrespected,

(*iv*) ***Affection.*** It is a process of social interaction of feelings for love between two or more persons,

(*v*) ***Care.*** The feeling of care is the feeling to nurture and protect the body of our relative, and

(*vi*) ***Love.*** It is the emotion of strong affection and personal attachment with others in the family.

1.1.6C Harmony in Society

Society or human society is the set of relations including their social status and roles among people. Society denotes the people of a region or country and even the world. Used in the sense of an association, a society is a body of individuals outlined by the bonds of functional interdependence, possibly comprising characteristics such as national or cultural identity, social solidarity, language or hierarchical organization. Human societies are characterized by patterns of relationships between individuals sharing a distinctive culture and institutions. Like other communities or groups, a society allows its members to achieve needs or wishes they could not fulfill alone. The word society may also refer to an association of people for religious, benevolent, cultural, scientific, political, patriotic, or other purpose.

As we begin to understand our relationship in the family and live harmoniously in these relationships, we become aware of our relatedness to all human beings. Family is the first place to understand our relationships to recognize the feelings in them and live according to these feelings to attain mutual happiness. Our natural acceptance is to feel related to everyone. We find that in reality we not only want ourselves to be happy but also want to make other happy. Our competence might be limited but we wish for their happiness as well. We enjoy company and feel relaxed when we are with people who feel related to us.

Harmony in the family is the building block for harmony in the undivided society. Our natural acceptance is related to all which can expand into the world family. A feeling of relatedness with all is the basis of an undivided society.

1.1.6D Harmony with Nature

The world family order is the state of realizing the freedom of individual in context of this universe. The respect towards mankind and nature is must to establish the universal order. Having understood the comprehensive human goal, we are able to be in harmony not only with human beings, but also with the rest of nature. We are able to see that we are related to every unit in the nature and ensure mutual fulfilment in that relationship. Working on the five dimensions of human endeavour in the light of right understanding, we are able to work for an orderly living of the human society, whose foundational unit is the family and the final destination is the world family.

All of us know how we have multiplied the environment problems in the process and how we have increased consumerism today. We have disturbed the ecological balance and our production activities have upset the cycles in the nature.

Following are some more facts :

(*i*) While nature's processes are all cyclic (close ended) our processes are acyclic (open ended). If nature functions in such a way that all resources are continuously renewed and replenished (like, water, manure in the soil, etc), man's process deplete them.

(*ii*) Are we enriching nature, or are we not ? Largely the answer is NO. Take the example of pesticides and fertilizers. It is common knowledge today that the land that has seen heavy use of chemical fertilizers becomes unfit for agriculture.

(*iii*) In terms of exchange and storage, we have developed efficient ways of selling and buying, but with these rising modes of exchange and storage, the exploitation of mankind and nature has shot up. The disparities have increased, and the madness for profit has become the general motivation.

(*iv*) The respect towards mankind and nature is must to establish the universal order. Having understood the comprehensive human goal, we are able to be in harmony not only with human beings, but also with the rest of nature.

1.2 REVIEW OF PROFESSIONAL ETHICS

Professional ethics means development of professional competence with ethical human conduct. Ethical human conduct means definitiveness of human conduct. Ethical human conduct is the foundation of professional ethics. The only effective way to ensure professional ethics is through correct appraisal and systematic development of ethical competence in the person (the human being). Profession is a significant domain of human activity targeted towards participating in the larger order which includes the society and nature around. Thus, it is a meaningful participation for each one in one or more of the five domains of human endeavor needed for a harmonious society. Of this, one important domain happens to be in the form of production and production related activities. It also makes available the necessary physical facilities (livelihood) for oneself and one's family. Here, one has to interact with other human beings as well as the living and non-living entities of rest of nature. Through professional education, one acquires the specific skills and knowledge in order to make this contribution in the larger order. Ethical conduct of profession implies the right utilization of one's professional skills towards the fulfillment of comprehensive human goal and thus, meaningfully participate in the larger order.

> *"Professional ethics may be defined as a form of applied ethics that examines ethical principles and moral or ethical problems that arise in a business environment."*

Professional ethics are concerned with the moral issues that arise because of the specialist knowledge that a professional attains, and uses this knowledge while providing a service to the public. However, to be able to achieve this, it is essential to develop the value competence or the ethical competence in the human beings along with the requisite skills. It may be easily appreciated that a significant implication of the right understanding is to develop this ethical competence and thereby facilitate professional ethics.

1.2.1 Professional Accountability

Professional accountability is a virtue in career practice that requires practitioners or service providers to show responsibility for all action that they undertake during their practice. It is aimed at eliminating or reducing malpractice among professionals. In ethics and governance, accountability is answerability, blameworthiness, liability, and the expectation of account-giving. Accountability conveys the notion of holding someone (or some organisation) responsible for failure to deliver services to an appropriate standard. Accountability in the workplace is defined as doing the right thing consistently, day in and day out, in tasks, relationship and interactions to fulfill or further the mission of the organization. There are many models of accountability, but one way to view it is as having three components :

(*i*) The individual's professional accountability for the quality of his or her own work.

(*ii*) The accountability of any/engineering professional within the organisations in which they work.

(*iii*) Accountability (with others), as a senior member of staff, for the organisation's performance and more widely for its provision of local services.

Everyone is accountable for Health and Safety of workers. Management is responsible for providing workers with the necessary tools, training and protective equipment to perform. Accountability is important because :

(*i*) It assures someone that the needs will be met. If someone is accountable, you can trust that they will do what they claimed. Without accountability you would not be able to put your trust in someone to complete a job for you, or even show up on time to an important event.

(*ii*) Holding individuals accountable for serious violations of the laws of war is important because it may deter future violations, promote respect for the law.

(*iii*) Investigating and prosecuting individuals responsible for serious violations of international human rights and humanitarian law is an obligation under international law.

(*iv*) It works as deterrence to future crimes.

(*v*) In accounts it is responsible for handling payments. They pay bills and receive payments. They also handle payroll for employees.

(vi) The forensic accounting is something that could be (or will be) used in a court of law.

(vii) When employers and employees are mutually accountable to each other, employees can trust that their work will be rewarded appropriately.

1.2.2 Collegiality

Colleagues are those explicitly united in a common purpose and respecting each other's abilities to work toward that purpose. A colleague is an associate in a profession or in a civil or ecclesiastical office. Sometimes *colleague* is taken to mean a fellow member of the same profession. Thus, the word collegiality can connote respect for another's commitment to the common purpose and ability to work toward it. Collegiality is the relationship between at least two people/colleagues. Collegiality means valuing diversity and recognizing the bare fact that everyone has something different and important to offer. Collegiality means being open with others, sharing with them and collaborating for the good of the profession, including acting as guides or mentors. Our shared expertise and wealth of knowledge can make our profession strong and much more viable in our field. A focus on the concept of abundance for all, rather than territory or turf, will serve us better than a divisive, suspicious, backbiting approach.

Collegiality is often contrasted with a managerial approach which has a more hierarchical structure, with professional managers in leading positions. A managerial approach is often proposed as being more agile and effective at quick decision making, whilst critics suggest that its appeal is rather that it is more likely to comply with commercial and government wishes.

There has traditionally been a strong element of collegiality in the governance of universities and other higher education institutions, where individual independence of thought and mutual respect are necessary. Professionalism and collegiality are very highly regarded attributes of the legal profession. In court, lawyers refer to each other as '*my friend*' or '*learned counsel*'. A lawyer would never publicly insult another lawyer nor suggest that they were not smart or perceptive. If such an insult were made in court, a judge would stop the proceedings and publicly reprimand the rude lawyer.

1.2.3 Loyalty

Loyalty is faithfulness or a devotion to a person, country, group, or cause. Organisational loyalty is a general term and denotes a person's commitment and attachment to the place they work. Loyalty is giving one's best when one is attached to a particular organisation. Loyalty to the current organisation and furthering one's career are not always mutual and are in fact in most cases closely related. The very skills one needs to acquire for his/her career growth may also be essential for the current company. Therefore, employers can foster loyalty, by encouraging career development and helping employees to master new skills required for their progression, ideally within the same company. In order to balance the

growth of the company and that of the employees, it is also favourable to strategically align career growth of the individuals to the goals of the company. Limited career progress is not the only cause that hinders loyalty because ; monotonous work routines, high stress levels and dictatorial management styles are factors that can also get in the way. In reality, the old definition of organisational loyalty of lifetime commitment is no longer valid for the modern organisations. However, compromises are possible and this will solely depend on how a company behaves in terms of, its transparency in decisions, allowing the employees time for adjusting in the face of crisis, keeping them happy and secure in both good and bad times and firing only in extreme conditions.

Loyalty is a bad quality when it is interpreted to mean in the wrong context *e.g.*, as was done by some Govt. officers during the investigations of cheating scandals/scams protecting friends who had done something wrong. This is immoral, because it puts the interests of individuals ahead of the interests of the group.

1.2.4 Responsibility

It involves around a few ethical principles to be adopted and followed by a person in any profession. The guiding principles can be described as below :

(i) ***Integrity.*** To provide professional services with integrity. It demands honesty which must not be subordinated to personal gain and advantage. Allowance can be made for innocent error and legitimate differences of opinion, but integrity cannot co-exist with deceit or subordination of one's principles.

(ii) ***Objectivity.*** To provide professional services objectively. It requires intellectual honesty and impartiality. Regardless of the particular service rendered or the capacity in which a professional functions, one should protect the integrity of his/her work, maintain objectivity and avoid subordination of his/her judgment.

(iii) ***Competence.*** To maintain the knowledge and skill necessary to provide professional services competently. Competence means attaining and maintaining an adequate level of knowledge and skill, and application of that knowledge and skill in providing services to clients. Competence also includes the wisdom to recognize the limitations of that knowledge and when consultation with other professionals is appropriate or referral to other professionals necessary.

(iv) ***Fairness.*** Be fair and reasonable in all professional relationships. Fairness requires impartiality, intellectual honesty and disclosure of material conflicts of interest. It involves a subordination of one's own feelings, prejudices and desires so as to achieve a proper balance of conflicting interests. Fairness is treating others in the same fashion that you would want to be treated.

(v) ***Confidentiality.*** Protect the confidentiality of all customer information. Confidentiality means ensuring that information is accessible only to those authorized to have access. A relationship of trust and confidence with the customer can only be built upon the understanding that the customer's information will remain confidential.

(*vi*) ***Professionalism.*** To act in a manner that demonstrates exemplary professional conduct. Professionalism requires behaving with dignity and courtesy to clients, fellow professionals, and others in business-related activities. Professionals should cooperate with fellow professionals to enhance and maintain the profession's public image and improve the quality of services.

(*vii*) ***Diligence.*** Provide professional services diligently. Diligence is the provision of services in a reasonably prompt and thorough manner, including the proper planning for, and supervision of, the rendering of professional services.

1.2.5 Ethical Living

The right understanding gained through self-exploration enables us to identify the definition of human conduct which may also be called the ethical human conduct. It is the same for all human beings. So we are also able to understand the universality of ethical human conduct which is in consonance with the universal human values. Accordingly, all debates and confusion about what is ethical for one may not be ethical for others etc. also lose their base. Let us now understand the salient features of this definite human conduct *i.e.*, the ethical human conduct.

Each one of us wants to have a definite conduct but presently we may not be able to ensure that. This is because we are presently living on the basis of our pre-conditionings or assumptions which do not match with the truth or the right understanding. But, this situation neither gives satisfaction to us nor to others. We do see the human beings struggling to find out what the right conduct is and in the process, exhibit a wide variety of attributes. We also see people debating endlessly about what they consider to be ethical. But unless we have the right understanding, we are not able to identify the definitiveness of ethical human conduct. It can be understood in the following terms

Values (Mulya)

They give us the Competence of living in accordance with universal human values or the participation of a unit in the larger order- its natural characteristics or svabhava. Values are a part of our ethical conduct. They are the natural outcome of realization and right understanding, which are always definite. Values need not to be imposed through fear, greed or blind belief.

Policy (Niti)

Having been convinced about the values and about the inherent harmony in the existence, we are able to develop an ethical sense in all our actions. We always think, behave and work towards nurturing this harmony. It leads us to adopt policies conducive to human welfare which are conducive to enrichment, protection and right utilization of mind, body and wealth. This is an outcome of the definiteness of our desire and expectation.

The policy has *three* parts :

(*a*) **Economic Policy** (*Artha Niti*). The policy for enrichment of wealth.
(*b*) **Political Policy** (*Rajya Niti*). The policy for protection of body and wealth.
(*c*) **Policy for Universal Human Order** (*Dharma Niti*). The policy for right utilization of mind, body and wealth.

Character (Charitra)

A definite desire, thought and selection gives definiteness to our living. A definite character is the outcome of our definite behavior and work. This can be mainly characterized in terms of the following :

(*a*) Chastity in conjugal relationship *i.e.*, chastity in husband - wife relationship.
(*b*) Rightful production, acquisition and utilization of wealth.
(*c*) Kindness in behavior and work.

This definitiveness of human conduct in terms of values, policies and character is termed as ethics. The ethics in the living of an individual can be imbibed only through inculcation of values, policies and character, and this is possible through the process of ensuring right understanding through self-exploration. In other words ethics addresses questions about morality *i.e.*, concepts such as good *vs.* bad, noble vs. ignoble, right *vs.* wrong, and matters of justice, love, peace and virtue.

A human being with ethical human conduct having professional skills only, can be a good professional, *e.g.*, a good engineer, a good manager, a good teacher and researcher, and a good technocrat, etc.

- Ethical conduct implies that it is naturally acceptable to us and does not give rise to conflict within.
- Ethical conduct implies that it is in consonance with the right understanding of the reality.
- Ethical conduct implies that it leads to mutual fulfillment with other people and mutual enrichment with rest of nature.

Thus, the ethical conduct is self-satisfying, people friendly, eco-friendly and universal.

1.2.6 Engineer as a Role Model for Society

Engineering is an important and learned profession. As members of this profession, engineers are expected to exhibit the highest standards of honesty and integrity. Engineering has a direct and vital impact on the quality of life of all people in the society. Accordingly, the services provided by engineers require honesty, impartiality, fairness, and equity, and must be dedicated to the protection of the public health, safety, and welfare. Engineers must perform under a standard of professional behavior that requires adherence to the highest principles of ethical code of conduct.

(A) Engineers shall hold paramount the safety, health, and welfare of the public

(i) If his/her judgment is overruled under circumstances that endanger life or property, they shall notify their employer or client and such other authority as may be appropriate.

(ii) He/she will approve only those engineering documents that are in conformity with applicable standards.

(iii) He/she will not reveal facts, data, or information without the prior consent of the client or employer except as authorized or required by the law.

(iv) He/she will not permit the use of his/her name or associate in business ventures with any person or firm that they believe is engaged in fraudulent or dishonest enterprise.

(v) He/she will not aid or abet the unlawful practice of engineering by a person or firm.

(vi) Engineers having knowledge of any alleged violation of this code shall report there upon to appropriate authorities and cooperate assistance as may be required.

(B) Engineers shall perform services only in the areas of their competence

(i) Engineers shall undertake assignments only when qualified by education or experience in the specific technical field involved.

(ii) They will neither affix their signatures to any plans or documents dealing with subject matter in which they lack competence, nor to any plan or document not prepared under their direction and control.

(iii) Engineers may accept assignments and assume responsibility for coordination of an entire project, provided that each technical segment is signed by the qualified engineers who prepared the plan.

(C) Engineers shall issue public statements only in an objective and truthful manner

(i) Engineers shall be objective and truthful in professional reports.

(ii) They may express publicly technical opinions that are founded upon knowledge of the facts and competence in the subject matter.

(iii) Engineers shall issue no statements, criticisms, or arguments on technical matters that are inspired or paid for by interested parties.

(iv) They will act for their employer or client as faithful agents or trustees.

(v) Engineers shall not accept compensation, financial or otherwise, from more than one party for services on the same project.

(vi) Engineers shall not solicit or accept financial or other valuable consideration, directly or indirectly, from outside agents in connection with the work for which they are responsible.

(vii) They will not solicit or accept a contract from a governmental body on which an officer of their organization serves as a member.

(D) Engineers shall avoid deceptive acts

(i) Engineers shall not falsify their qualifications or permit misrepresentation of their or their associates' qualifications.

(ii) They shall not misrepresent or exaggerate their responsibility of prior assignments.

(iii) Engineers shall not offer, give, solicit, or receive, either directly or indirectly, any bribe to influence the award of a contract.

(iv) They shall not offer any gift or other valuable consideration in order to secure work.

(v) They shall not pay a commission, percentage, or brokerage fee in order to secure work, except to a bona fide established commercial or marketing agencies retained by them.

(E) Engineers shall be guided in all relations by the highest standards of honesty and integrity

(i) They shall acknowledge their errors and shall not distort or alter the facts.

(ii) They shall advise their client or employers when they believe a project will not be successful.

(iii) Engineers shall not accept outside employment to the detriment of their regular work or interest.

(iv) They shall not attempt to attract an engineer from another employer on false or misleading pretenses.

(v) Engineers shall not promote their own interest at the expense of the dignity and integrity of the profession.

(F) Engineers shall at all times strive to serve the public interest

(i) Engineers should participate in career guidance to their juniors ; and work for the advancement of the safety and well-being of their community.

(ii) Engineers shall not complete and sign specifications that are not in conformity with applicable engineering standards. If the client or employer insists on such unprofessional conduct, they shall notify the proper authorities and withdraw from further service on the project.

(iii) They should encourage to extend knowledge and appreciation of engineering and its achievements to the public.

(iv) They should work to protect the environment for future generations.

(G) Engineers shall avoid all conduct or practice that deceives the public

(i) Engineers shall avoid the use of statements containing a material misrepresentation of fact or omitting a material fact.

(ii) Consistent with the above engineers may advertise and recruit personnel.

(iii) Consistent with the foregoing, engineers may prepare articles for the technical press, but such articles shall not take self credit for work performed by others.

(H) Engineers shall not disclose, without consent, confidential information concerning the business affairs or technical processes of any present or former client or employer, or public body on which they serve

- Engineers should not, participate in proceedings in which the engineer has gained particular specialized knowledge on behalf of a former client or employer.

(I) Engineers shall not be influenced in their professional duties by conflicting interests

(i) Engineers shall not accept financial or other considerations, including free engineering designs, from material or equipment suppliers for preparing specifications of their required product.

(ii) Engineers shall not accept commissions or allowances, directly or indirectly, from contractors or other parties dealing with the work for which the engineer is responsible.

(J) Engineers shall not attempt to obtain professional engagements by untruthfully criticizing other engineers

(i) Engineers shall not request, propose, or accept a commission on a contingent basis under the circumstance in which their judgment may be compromised.

(ii) Engineers in salaried positions shall not accept any part-time engineering work without approval of his employer.

(iii) Engineers shall not, without consent use equipment, supplies, laboratory, or office facilities of an employer to carry on with any outside private practice.

(K) Engineers shall not attempt to injure, directly or indirectly, the professional reputation of other engineers. Engineers who believe others are guilty of unethical or illegal practice shall present such information to the proper authority for action

(i) Engineers in private practice shall not review the work of another engineer for the same client, except with the knowledge of such engineer, or unless the connection of such engineer with the work has been terminated.

(ii) Engineers in governmental, industrial, educational employment are entitled to review and evaluate the work of other engineers when so required by their employment duties.

(iii) Engineers in sales or industrial employment are entitled to make engineering comparisons of their products with products of other suppliers.

(L) Engineers shall accept personal responsibility for their professional activities

(i) They should conform with state registration laws if any, in the practice of engineering.

(ii) They will not use association with a non-engineer, a corporation, or partnership as a "cloak" for unethical acts.

(M) Engineers shall give credit for engineering work to those to whom credit is due, and will recognize the proprietary interests of others

(i) They should name the person or persons who may be individually responsible for designs, inventions, writings, or other accomplishments.

(ii) Engineers using designs supplied by a client should recognize that the designs being the property of the client may not be duplicated.

(iii) Before undertaking any work he/she should enter into a positive agreement regarding ownership/ copyrights/patents.

(iv) Engineers' designs, data, records, and notes referring exclusively to an employer's work are the employer's property. The employer should indemnify the engineer for use of the information for any purpose other than the original purpose.

(v) They should continue their professional development throughout their careers and should keep current in their specialty fields by engaging in professional practice, participating in continuing education courses, reading in the technical literature, and attending professional meetings and seminars.

1.2.7 Four Orders of Living

The *four* different levels of our living in harmony are described below :

(i) ***Living with harmony in myself.*** We all are having thoughts, belief and choices. It indicates the first levels of our living. We should start to study ourselves *i.e.*, to study our own wants, behavior, requirements etc. We are not the same person in every situation at all the time. We could be five different people in one given day in different areas. They all contain fragments of us, hidden beneath. If you could reach the point of acknowledgment that your work is to find harmony with you, then what anybody else thinks about it, has nothing to do with your experience. You would be of much more value to all.

(ii) ***Living with harmony in family.*** All of us have born in a family. Unlike basic physical needs of food, sleep and shelter, a child's mental and emotional needs may not be visible. A child who is mentally and emotionally stable is able to think clearly, learn new skills, is self-confident, and is also able to adapt to new situations easily. To develop into emotionally stable individuals, children need unconditional love and opportunities to develop self-confidence. His mistakes and failures should be expected and accepted. Praise and encourage them to explore. Your attention helps to build their self-confidence and self esteem. Let them know that we all make mistakes and that adults are also not perfect. Playtime helps children to be creative and to learn problem-solving skills. Playing allows for a special bonding and kinship to develop between you and your child. Help your children to understand that while playing, winning is not as important. It is more important for children to participate and enjoy themselves than to have winning as a focus. As members of a family, children need to learn the rules of the family unit. You can offer fair and consistent guidance

and discipline to your children. It is natural for children to feel afraid sometimes. If your children have fears that will not go away and affect his or her behavior, therefore support them.

*(iii) **Living with harmony in society.*** Society is also a broader group of our family where we live. In society we are interdependent of many physical needs life housing, health, medical services, education, transport etc.

To live with harmony in society :

(*a*) Follow your heart,
(*b*) Be responsible for yourself,
(*c*) Be responsible to others,
(*d*) Be open and honest,
(*e*) Respond to others from your heart,
(*f*) Be compassionate,
(*g*) Act inclusively rather than exclusively,
(*h*) Be true to your own feelings,
(*i*) Grow in positive directions and
(*j*) Share your knowledge with others.

*(iv) **Living with harmony in nature or existence.*** We live on this earth with birds, animals, plants in a large eco-system called nature. Nature is giver as well as doer. Nature teaches us humility which is regarded as one of the first step towards self-realization. Man asserts his own needs and this makes him arrogant and selfish. Living in dynamic harmony with nature allows one to find ancient and new wisdom. The capitalist development is a threat to life because it prioritizes consumerism and the generation of profits over common well-being and the satisfaction of basic needs. Accumulation of wealth and maximization of economic growth destroys nature. It is necessary to re-establish harmony with nature. We must respect for human rights and the Right of Mother Earth as an articulated, complementary, and reciprocal processes. Harmony with nature is not possible if, equality does not exist between human beings and the environment.

1.2.8 Holistic Technology (Eco-friendly systems)

Any of the methods used in industry to create goods and services from various resources is called a production system *i.e.*, these are processes that transform resources into useful goods and services. The transformation process typically uses common resources such as labour, capital (for machinery and equipment, materials, etc.), and space (land, buildings, etc.) to effect a change. Economists call these as resources and usually refer to them as labour, capital, and land. Production managers refer to them as the "five M's": men, machines, methods, materials, and money. There are thousands of items developed in the industry using eco-friendly systems.

Environment-friendly (also eco-friendly, nature friendly, and green) production systems are ambiguous terms used to refer to goods and services with laws, guidelines and policies claimed to inflict minimal, or no harm upon eco-systems or the environment. Companies sometimes use these terms to make environmental marketing claims when promoting goods and services, for example with eco-labels

The International Organisation for Standardization has developed ISO 14020 and ISO 14024 to establish principles and procedures for environmental labels and declarations that certifiers and eco-labellers should follow.

An eco-friendly production system should keep the following points into consideration :

(*i*) Evaluating the human health and environmental impacts of its processes and products.
(*ii*) Identifying what information is needed to make human health and environment decisions
(*iii*) Conducting an assessment of alternatives
(*iv*) Considering cross-media impacts and the benefits of substituting chemicals
(*v*) Reducing the use and release of toxic chemicals through the innovation of cleaner technologies that use safer chemicals.
(*vi*) Implementing pollution prevention, energy efficiency, and other resource conservation measures.
(*vii*) Making products that can be reused and recycled
(*viii*) Monitoring the environmental impacts and costs associated with each product or process
(*ix*) Recognizing that although change can be rapid, in many cases a cycle of evaluation and continuous improvement is needed.

There are *four* main concepts of the Design for Environment friendly systems for the Industry :

(*i*) ***Design for environmental processing and manufacturing.*** This ensures that raw material extraction (mining, drilling, etc.), processing (processing reusable materials, metal melting, etc.) and manufacturing are done using materials and processes which are not dangerous to the environment or the employees working on said processes. This includes the minimization of waste and hazardous by-products, air pollution, energy expenditure and other factors.

(*ii*) ***Design for environmental packaging.*** This ensures that the materials used in packaging are environmentally friendly, which can be achieved through the reuse of shipping products, elimination of unnecessary paper and packaging products, efficient use of materials and space, use of recycled and/or recyclable materials.

(*iii*) ***Design for disposal or reuse.*** The end of life cycle of a product is very important, because some products emit dangerous chemicals into the air, ground and water after they are

disposed of in a landfill. Planning for the reuse or refurbishing of a product will change the types of materials that would be used, how they could later be disassembled and reused, and the environmental impacts such materials have.

(iv) ***Design for energy efficiency.*** The design of product to reduce overall energy consumption throughout the product's life.

The following are the few examples of environment and eco-friendly non-conventional sources of energy used in production systems :

S.No	System	Product/use
1.	Solar Energy System (replacement of thermal power)	(*i*) Electricity Generation (*ii*) Pumping of Water (*iii*) Lighting of bulbs (*iv*) Battery Charging (*v*) Pelletier Cooling
2.	Hydel Power System (replacement of thermal power)	(*i*) Electricity Generation
3.	Wind Power System	(*i*) Electricity Generation
4.	Wave Energy System	(*i*) Electricity Generation
5.	Nuclear Power Energy System (replacement of thermal power)	(*i*) Electricity Generation
6.	Different kinds of wastes	(*i*) Heating (*ii*) Electricity Generation
7.	Night soil based biogas plant	(*i*) Electricity Generation
8.	Muscle power	(*i*) Replace use of petrochemicals
9.	Tidal Energy	(*i*) Electricity Generation

CHAPTER 2

Engineers' Responsibility for Safety

2.1 INTRODUCTION

To assure public safety and welfare it is important that Engineers should understand their responsibilities. It is central to professional conduct, but often an individual engineer faces obstacles in the form of other duties which conflict with it. Sometimes an engineer has to sacrifice one safety concern for another. In some cases, an engineer's duty to maintain client confidentiality can come in conflict with his duty to ensure safety *i.e.*, an engineer sometimes has to make a compromise between safety and cost. For example, we might be able to make a vehicle most safer, but only at an incredible cost to the company and consumer. Therefore then the question arises is, how much safe is safe enough ?

Discussion on this topic has to start from the stage of technical education in the professional courses at the college level. Teachers should discuss these obligations faced by the engineers in their professional life *i.e.*, the kinds of conflicts that arise while handling them and should show students how to recognize these conflicts in the course of their work. Have the students learn to identify the people to whom they will likely have to oblige in the course of their work *i.e.*, co-workers, managers, clients, general public, themselves (family), and their profession. To make them understand better students may be asked to list the obligations they believe they have towards each of these groups of people.

2.2 SAFETY ENGINEERING

The primary goal of safety engineering is to manage risk, eliminate or reduce it to acceptable levels. Risk is the combination of the probability of a failure event, and the severity resulting from the failure. For instance, the severity of a particular failure may result in fatalities, injuries, property damage, or nothing more than annoyance. It may be a frequent, occasional, and/or rare occurrence, however the failure depends on any/or the combination of

these two frequencies. Probability is often more difficult to predict than severity due to the many factors that could lead to a failure, such as mechanical failure, environmental effects, and operator error etc.

Safety engineering attempts to reduce the frequency of failures, and to ensure that when failures do occur, the consequences are not life-threatening. For example, bridges are designed to carry loads well in excess of the heaviest truck likely to use them. This reduces the likelihood of being overloaded. Most bridges are designed while multiplying the redundant load with a huge factor of safety, so that if any one structural member fails, the structure will remain standing. This reduces the severity if the bridge is overloaded.

Ideally, safety engineering starts during the early design of a system. Safety engineers consider what undesirable events can occur under what conditions, and project the related accident risk. They may then propose or require safety mitigation requirements in specifications at the start of development or changes to existing CAD designs or in-service products to make a system safer. This may be done by full elimination of any type of hazards or by lowering accident risk. Far too often, rather than actually influencing the design, safety engineers are assigned to prove that an existing or completed design is safe. If the engineer discovers significant safety problems late in the development process, correcting them at that stage can be very expensive. This type of error has the potential to waste large sums of money and likely more important, human lives and environmental damage.

The exception to this conventional approach is the way some large government agencies approach safety engineering from a more proactive and proven process perspective, known as "*system safety*". The system safety philosophy is to be applied to complex and critical systems, such as commercial airliners, complex weapon systems, spacecraft, rail and transportation systems, air traffic control system and other complex and safety-critical industrial systems. The proven system safety methods and techniques are to prevent, eliminate and control hazards and risks through designed influences by a collaboration of key engineering disciplines and product teams. Software safety is a fast growing field since modern systems' functions are increasingly being put under control of software. The whole concept of system safety and software safety, as a subset of systems engineering, is to influence safety-critical systems' designs by conducting several types of hazard analysis to identify hazards, validate hazards and verify design, assess and if needed to specify (new) design safety features and procedures to strategically mitigate risk to acceptable levels before the system is certified.

Additionally, failure mitigation can go beyond design recommendations, particularly in the area of maintenance. There is an entire realm of safety and reliability engineering known as Reliability Centered Maintenance (RCM), which is a discipline that is a direct result of analyzing potential failures within a system and determining maintenance actions that can mitigate the risk of failure. This methodology is used extensively on aircraft and involves understanding the failure modes of the serviceable replaceable assemblies in addition to the means to detect or predict an impending failure. Every automobile owner is familiar with this concept when in their car they recommend to have the oil changed or brakes checked. Even filling up one's car with fuel is a simple example of a failure mode (failure due to fuel exhaustion), a means of detection (fuel gauge), and a maintenance action (filling the car's fuel tank). (The use of a car's odometer to gauge fuel also illustrates the concept of "*redundant sensors*".)

For large scale complex systems, hundreds if not thousands of maintenance actions can result from the failure analysis. These maintenance actions are based on conditions (*e.g.*, gauge reading or leaky valve), hard conditions (*e.g.*, a component is known to fail after 100 hrs of operation with 95% certainty), or require inspection to determine the maintenance action (*e.g.*, metal fatigue). The RCM concept then analyzes each individual maintenance item for its risk contribution to safety, mission, operational readiness, or cost to repair if a failure does occur. Then the sum total of all the maintenance actions are bundled into maintenance intervals so that maintenance is not occurring around the clock, but rather, at regular intervals. This bundling process introduces further complexity, as it might stretch some maintenance cycles, thereby increasing risk, but reduce others, thereby potentially reducing risk, with the end result being a comprehensive maintenance (also called preventive maintenance) schedule, purpose built to reduce operational risk and ensure acceptable levels of operational readiness and availability.

2.3 RISK-BENEFIT ANALYSIS

Risk-benefit analysis, is the comparison of the risk of a situation to its related benefits. Exposure to personal risk is recognized as a normal aspect of everyday life. We accept a certain level of risk in our lives as necessary to achieve certain benefits. With most of these risks we feel we have some sort of control over the situation. For example, driving an automobile is a risk most people take daily. "*The controlling factor appears to be their perception of their individual ability to manage the risk-creating situation.*" Analyzing the risk of a situation is, however, very dependent on the individual doing the analysis. When individuals are exposed to involuntary risk (a risk over which they have no control), they make risk aversion their primary goal. Under these circumstances individuals require the probability of risk to be as much as one thousand times smaller than for the same situation under their perceived control.

2.4 SAFETY ANALYSIS TECHNIQUES

Analysis techniques can be split into two categories: qualitative and quantitative methods. Both approaches share the goal of finding causal dependencies between a hazard on system level and failures of individual components. Qualitative approaches focus on the question "*What must go wrong, such that a system hazard may occur ?*", while quantitative methods aim at providing estimations about probabilities, rates and/or severity of consequences. Safety analysis techniques rely solely on skill and expertise of the safety engineer. In the last decade model-based approaches have become prominent. In contrast to traditional methods, model-based techniques try to derive relationships between causes and consequences.

2.5 TESTING METHODS FOR SAFETY

The *two* most common fault modeling techniques are called :

(*i*) failure mode and effects analysis and

(*ii*) fault tree analysis.

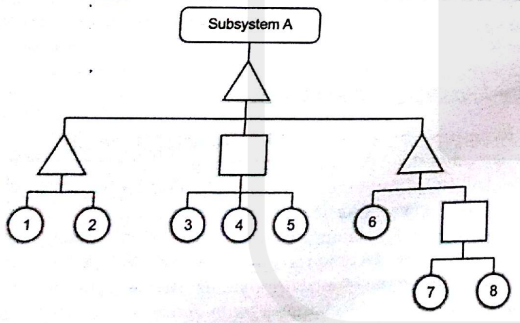
These techniques are just ways of finding problems and for making plans to cope with failures, and the related risk assessment. One of the earliest complete studies (known as Reactor Safety Study) using this technique was carried out on a commercial nuclear plant.

Failure Mode and Effects Analysis (FMEA)

Failure Mode and Effects Analysis (FMEA) is a bottom to top study and inductive analytical method which may be performed at either the functional or piece-part level. For functional FMEA, failure modes are identified for each function in a system or equipment item, usually with the help of a functional block diagram. For piece-part FMEA, failure modes are identified for each piece-part component (such as a valve, connector, resistor and diode etc). The effects of the failure mode are described and assigned a probability, based on the failure rate and failure mode ratio of the function or component. This quantization is difficult for software *i.e.*, a bug exists or not, and the failure models used for hardware components do not apply. Temperature, age and manufacturing variability affect a resistor whereas they do not affect software. Failure modes with identical effects can be combined and summarized in a Failure Mode Effects Summary. When combined with criticality analysis, FMEA is known as Failure Mode, Effects, and Criticality Analysis or FMECA, pronounced *"fuh-MEE-kuh"*.

Fault Tree Analysis (FTA)

Fault tree analysis (FTA) is a top to down study and deductive analytical method. In FTA, initiating primary events such as component failures, human errors, and external events



A typical example of a fault tree diagram

are traced through logic gates to an undesired top event such as an aircraft crash or a nuclear reactor core melt. The intent is to identify ways to make top events less probable, and verify that safety goals have been achieved.

Fault trees are a logical inverse of success trees, and may be obtained by applying de Morgan's theorem to success trees (which are directly related to reliability block diagrams). FTA may be qualitative or quantitative. When failure and event probabilities are unknown, qualitative fault trees may be analyzed for minimal cut sets. For example, if any minimal cut set contains a single base event, then the top event may be caused by a single failure. Quantitative FTA is used to compute top event probability, and usually requires computer software such as CAFTA or SAPHIRE.

Some industries use both fault trees and event trees. An event tree starts from an undesired initiator (loss of critical supply, component failure etc.) and follows further possible system events through and to a series of final consequences. As each new event is considered, a new node on the tree is added with a split of probabilities of taking either branch. The probabilities of a range of "*top events*" arising from the initial event can then be seen.

Usually a failure in *safety-certified systems* is acceptable if, on average, less than one life per 109 hours of continuous operation is lost to failure. Most Western nuclear reactors, medical equipment, and commercial aircraft are certified to this level. The cost versus loss of lives has been considered appropriate at this level (by FAA for aircraft systems under Federal Aviation Regulations).

2.5.1 Containing/Preventing Failure

It is a common practice to plan for the failure of safety systems through containment and isolation methods. The use of isolating valves, also known as the block and bleed manifold, is very common in isolating pumps, tanks, and control valves which may fail or need routine maintenance. In addition, nearly all tanks containing oil or other hazardous chemicals are required to have containment barriers set up around them to contain 100% of the volume of the tank in the event of a catastrophic tank failure. Similarly, in a long pipeline, there are remote-closing valves at regular intervals so that a leak can be isolated. Fault isolation boundaries are similarly designed into critical electronic systems or computer software. The goal of all containment systems is to provide means of mitigating the consequences of failure. Fault isolation might also refer to the extent to which detected failures might be isolated for successful recovery. The isolation level shows the system identity level at which the failure cause can be recovered (often by a replaceable unit).

Once a failure mode is identified, it can usually be mitigated by adding extra or redundant equipment to the system. For example, nuclear reactors contain dangerous radiation, and nuclear reactions can cause so much heat that no substance might contain them. Therefore reactors have emergency core cooling systems to keep the temperature down, shielding to contain the radiation, and engineered barriers (usually several, nested, surmounted by a containment building) to prevent accidental leakage.

Safety-critical systems are commonly required to permit no single event or component failure to result in a catastrophic failure mode. Most biological organisms have a certain amount of redundancy: multiple organs, multiple limbs, etc.

2.5.2 Safety and Reliability

Safety is not reliability. If a medical device fails, it should fail safely ; other alternatives will be available to the surgeon. If an aircraft fly-by-wire control system fails, there is no backup. Electrical power grids are designed for both safety and reliability ; telephone systems are designed for reliability, which becomes a safety issue when emergency calls are to be made.

Probabilistic risk assessment has created a close relationship between safety and reliability. Component reliability, generally defined in terms of component failure rate, and external event probability are both used in quantitative safety assessment methods such as FTA. Related probabilistic methods are used to determine Mean Time Between Failure (MTBF) for the system, system availability and/or probability of mission success or failure. Reliability analysis has a broader scope than safety analysis, wherein non-critical failures are considered. On the other hand, higher failure rates are considered acceptable for non-critical systems.

Safety generally cannot be achieved through component reliability alone. Catastrophic failure probabilities of 10^{-9} per hour correspond to the failure rates of very simple components such as resistors or capacitors. A complex system containing hundreds or thousands of components might be able to achieve a MTBF of 10,000 to 100,000 hours, meaning it would fail at 10^{-4} or 10^{-5} per hour. If a system failure is catastrophic, usually the only practical way to achieve 10^{-9} per hour failure rate is through redundancy. Two redundant systems with independent failure modes, each having an MTBF of 100,000 hours, could achieve a failure rate on the order of 10^{-10} per hour because of the multiplication rule for independent events.

When adding equipment is impractical (usually because of expenses), then the least expensive form of design is often "*inherently fail-safe*" *i.e.*, change the system design so that its failure modes are not catastrophic. Inherent fail-safes are common in medical equipment, traffic and railway signals, communications equipment, and safety equipment.

The typical approach is to arrange the system so that ordinary single failures cause the mechanism to shut down in a safe way (for nuclear power plants, this is termed a passively safe design, although more than ordinary failures are covered). Alternately, if the system contains a hazard source such as a battery or rotor, then it may be possible to remove the hazard from the system so that its failure modes cannot be catastrophic.

One of the most common fail-safe systems is the overflow tube in baths and kitchen sinks. If the valve sticks open, rather than causing an overflow and damage, the tank spills into an overflow. Another common example is, that in an elevator (lift) the cable supporting the car keeps spring-loaded brakes open. If the cable breaks, the brakes grab rails, and the elevator cabin does not fall.

Some systems can never be made fail safe, as continuous availability is needed. For example, loss of engine thrust in flight is dangerous. Redundancy, fault tolerance, or recovery procedures are used for these situations (*e.g.*, multiple independent controlled and fuel fed engines). This also makes the system less sensitive for the reliability prediction errors or quality induced uncertainty for the separate items. On the other hand, failure detection and correction and avoidance of common cause failures becomes here increasingly important to ensure system level reliability.

SUMMARY

- *To assure public safety and welfare it is important that Engineers should understand their responsibilities. It is central to professional conduct, but often an individual engineer faces obstacles in the form of other duties which conflict with it. Safety engineering attempts to reduce the frequency of failures, and to ensure that when failures do occur, the consequences are not life-threatening. The primary goal of safety engineering is to manage risk, eliminate or reduce it to acceptable levels. Safety engineering attempts to reduce the frequency of failures, and to ensure that when failures do occur, the consequences are not life-threatening. Safety engineers consider what undesirable events can occur under what conditions. Failure mitigation can go beyond design recommendations, particularly in the area of maintenance engineering known as Reliability Centered Maintenance (RCM). Risk–benefit analysis, is the comparison of the risk of a situation to its related benefits. The two most common fault modeling techniques are : (i) failure mode and effects analysis (FMEA) is a bottom to top study, and (ii) fault tree analysis (FTA) is a bottom to top study. It is a common practice to plan for the failure of safety systems through containment and isolation methods.*
- *Safety is not reliability, e.g., if a medical device fails, it should fail safely. Component reliability is generally defined in terms of component failure rate.*

Short Question Answers

1. *Write an engineers' responsibility towards society in conduct of his professional duties.*

   Ans. To assure public safety and welfare it is important that Engineers should understand their responsibilities. Sometimes an engineer has to sacrifice one safety concern for another. In some cases, an engineer's duty to maintain client confidentiality can come in conflict with his duty to ensure safety *i.e.*, an engineer sometimes has to make a compromise between safety and cost, but it should not be at the cost of public.

2. *Describe the aspects of safety engineering to manage risks and eliminate/ reduce it.*

   Ans. Safety engineering attempts to reduce the frequency of failures, and to ensure that when failures do occur, the consequences are not life-threatening. Ideally, safety engineering starts during the early design of a system. Safety engineers consider what

undesirable events can occur under what conditions, and project the related accident risk. The exception to this conventional approach is the perspective, known as "system safety". The system safety philosophy is applied to complex and critical systems, such as commercial airliners, complex weapon systems, spacecraft, rail and transportation systems, air traffic control system and other complex and safety-critical industrial systems. There is an entire realm of safety and reliability engineering known as Reliability Centered Maintenance (RCM), which is a discipline that is a direct result of analyzing potential failures within a system and determining maintenance actions that can mitigate the risk of failure.

3. *What is the responsibility of an engineer while designing any system ?*

Ans. Ideally, safety engineering starts during the early design of a system. Safety engineers consider what undesirable events can occur under what conditions, and project the related accident risk. They may then propose or require safety mitigation requirements in specifications at the start of development or changes to existing CAD designs or in-service products to make a system safer. This may be done by full elimination of any type of hazards or by lowering accident risk.

4. *How do you conduct comparison of the risk of a situation to it's related benefits ?*

Ans. Risk–benefit analysis, is the comparison of the risk of a situation to its related benefits. We accept a certain level of risk in our lives as necessary to achieve certain benefits. With most of these risks we feel we have some sort of control over the situation. For example, driving an automobile is a risk most people take daily. "*The controlling factor appears to be their perception of their individual ability to manage the risk-creating situation.*" Analyzing the risk of a situation is, however, very dependent on the individual doing the analysis.

5. *Justify the term "Safety is not reliability".*

Ans. Safety is not reliability because, if a medical device fails, it should fail safely so that, other alternatives can be available to the surgeon. If an aircraft fly-by-wire control system fails, there is no backup. Electrical power grids are designed for both safety and reliability ; telephone systems are designed for reliability, which becomes a safety issue when emergency calls are to be made.

Exercise

1. How can the teachers in the college show students as how to handle conflicts in their profession ?
2. How can proper and reliable maintenance reduce the risks of failure of any system ?
3. Describe in brief traditional methods for safety analysis.
4. In order to contain failure how can we increase safety and reliability of any system ?
5. What are the containment and isolation methods for containing the failure of safety systems ?
6. How is Mean Time Between Failures (MTBF) important for a component, explain ?

2.6 CASE STUDIES OF FAILURE IN SAFETY SYSTEMS

Man has developed science for his comforts and dominance over others and has set up industries, power plants and many other facilities in last few decades. Many industrial accidents /disasters have happened in the world in which lots of lives were lost and there are thousands who are still suffering for years without any respite. Given below are few of the cases which got prominence in news on account of the failure of nuclear plants and equipments and sufferings of mankind at the hands of the installation of industry/facilities.

(*i*) On *December 12, 1952*, a partial meltdown of a reactor's uranium core at the Chalk River plant near Ottawa, Canada, resulted after the accidental removal of four control rods. Millions of gallons of radioactive water poured out of the reactor but, there were no injuries.

(*ii*) In *October, 1957*, fire destroyed the core of a plutonium-producing reactor at Britain's Windscale nuclear complex, sending clouds of radioactivity into the atmosphere. An official report said the leaked radiation caused dozens of cancer deaths in the vicinity of Liverpool.

(*iii*) In *1957-58*, a serious accident occurred near the town of Kyshtym in the Urals. A Russian scientist who first reported the disaster estimated that hundreds died from radiation sickness.

(*iv*) On *January 3, 1961*, three technicians died at a U.S. plant in Idaho Falls in an accident at an experimental reactor.

(*v*) On *July 4, 1961*, radiation spread through the Soviet Union's first nuclear-powered submarine, when a pipe in the control system of one of the two reactors had ruptured. The Captain and seven crew members died.

(*vi*) On October 5, 1966, the core of an experimental reactor near Detroit, Mich., USA melted partially when a sodium cooling system failed.

(*vii*) On *January 21, 1969*, a coolant malfunction from an experimental underground reactor at Lucens Vad, Switzerland, released a large amount of radiation into a cave, which was then sealed.

(*viii*) On *December 7, 1975*, at the Lubmin nuclear power complex on the Baltic coast in the former East Germany, a short-circuit caused by an electrician's mistake started a fire. Some news reports said there was almost a meltdown of the reactor core.

(*ix*) On *March 28, 1979*, near Harrisburg, Pennsylvania, America's worst nuclear accident occurred. A partial meltdown of one of the reactors forced the evacuation of the residents after radioactive gas escaped into the atmosphere. It was later known as Three Mile Island nuclear power plant accident.

(*x*) On *February 11, 1981*, eight workers were contaminated when more than 100,000 gallons of radioactive coolant fluid leaked into the contaminant building of the Tennessee Valley Authority's Sequoyah 1 plant in Tennessee.

(*xi*) On *April 25, 1981*, officials said around 45 workers were exposed to radioactivity during repairs to a plant at Tsuruga, Japan.

(xii) On *April 26, 1986*, the world's worst nuclear accident occurred after an explosion and fire at the Chernobyl nuclear power plant. It released radiation over much of Europe. Thirty-one people died in the immediate aftermath of the explosion. Hundreds of thousands of residents were moved from the area and a similar number are believed to have suffered from the effects of radiation exposure.

(xiii) On *March 24, 1992*, at the Sosnovy Bor station near St. Petersburg, Russia, radioactive iodine escaped into the atmosphere. A loss of pressure in a reactor channel was the source of the accident.

(xiv) In *November 1992*, in France's most serious nuclear accident, three workers were contaminated after entering a nuclear particle accelerator in Forbach without protective clothing. Executives were jailed in 1993 for failing to take proper safety measures.

(xv) In *November 1995*, Japan's Monju prototype fast-breeder nuclear reactor leaked two or three tons of sodium from the reactor's secondary cooling system.

(xvi) In *March 1997*, the state-run Power Reactor and Nuclear Fuel Development Corporation reprocessing plant at Tokaimura, Japan, contaminated at least 35 workers with minor radiation after a fire and explosion occurred.

(xvii) On *September 30, 1999*, an accident at the uranium processing plant at Tokaimura, Japan, exposed fifty-five workers to radiation. More than 300,000 people living near the plant were ordered to stay indoors. Workers had been mixing uranium with nitric acid to make nuclear fuel, but had used too much uranium and set off the accidental uncontrolled reaction.

(xviii) At Fukushima Japan, on *11th March, 2011* following an earthquake of 9 Mw magnitudes, a 15mtrs tsunami disabled the power supply and stopped cooling of three nuclear reactors thus melting all the cores which resulted in release of very high radioactive materials.

2.6.1 The Bhopal Gas Tragedy

(i) Historical Back Ground of the Gas Plant

Union carbide of USA embarked on a mission of devising a product to exterminate a wide range of parasites, which soon came to be known as '*Sevin*'. To manufacture Sevin, phosgene gas was made to react with another gas called monomethylamine. The reaction of these two gases produced a new molecule, MIC, which was one of the most dangerous compounds ever invented in the chemical history. Experiments had shown that animals exposed to MIC vapours would face instantaneous death. MIC was so volatile that as soon as it came into contact with a few drops of water or a few ounces of metal dust, it got off to an uncontrollably violent reaction. No safety system, no matter how sophisticated, would then be able to stop it emitting a fatal cloud into the atmosphere. To prevent explosion, MIC had to be kept permanently at a temperature near zero. Therefore, provision had to be made for the refrigeration of any drums or tanks that were to hold it.

In 1966 the Govt. of India (GOI) granted a license to Union Carbide India Ltd. (UCIL) to produce Sevin and all the required chemical ingredients in India. UCIL's agronomic engineer, felt that manufacturing 5,000 tons of Sevin would require considerable quantities of MIC to be manufactured, but was not in favour of storing huge quantity of MIC. He was also against the proposed site of the factory as it was too close to areas where people lived, as according to municipal planning regulations, no industry likely to give off toxic emissions could be set up on a site where the prevailing wind might carry effluents into densely populated areas. At the plants site wind usually blew toward the slums, the railway station and finally toward the overpopulated parts of the old town. Under such circumstances, the application should have been rejected.

In May 1982, three UCIL engineers came from U.S.A. to Bhopal, to appraise the running of the plant and confirm that everything was functioning according to the laid down standards. The report presented by them revealed that all was not well with the Bhopal plant, so much so, that the surroundings of the site was '*strewn with oily old drums, used piping, pools of used oil and chemical waste likely to cause fire*,' apart from the shoddy workmanship on certain connections, the warping of equipment, the corrosion of several circuits, the absence of automatic sprinklers in the MIC and phosgene production zones. It also reported leaks of phosgene, MIC and chloroform, ruptures in pipework and sealed joints, absence of any earth wire on one of the three MIC tanks and poor adjustment of certain devises where excessive pressure could lead to water entering the circuits. At the same time, the report expressed concern at the inadequately trained staff, unsatisfactory instruction methods and sloppy maintenance reports.

In 1983, the manpower in each shift was cut by half. In the control room, only one man was left to oversee some seventy dials, counters and gauges, which relayed, among other things, the temperature and pressure of the three tanks containing the MIC. According to analysts the plant management did not pay heed to the fact that sixty tons of MIC were stored in the tanks, and violated a fundamental rule, which stipulated that MIC must in all circumstances be kept at a temperature close to zero degree Celsius. In order to save coal and money the flames which in the event of an accident burnt off any toxic gases emitted into the atmosphere day and night at the flare tower were also extinguished. The scrubber cylinder used to decontaminate any gas leaks, was also deactivated.

(ii) The Catastrophe

On the night of December 3rd/4th 1984, forty tons of toxic gases made a poisonous grey cloud from Union Carbide India Limited (UCIL's) pesticide plant at Bhopal which spread throughout the city. It was result of a water carrying catalytic material which entered Methyl Isocyanate (MIC) storage tank. It proved to be a killer gas which spread throughout the city. No alarm from the plant ever sounded a warning and hence no evacuation plan was prepared. When victims arrived at hospitals breathless and blind, doctors did not know how to treat them. Next morning the magnitude of the devastation was observed. Dead bodies of humans and animals blocked the streets, leaves turned black, the smell of burning chilli peppers lingered in the air. As many as 10,000 persons died immediately and 30,000 to 50,000 were critically ill.

(iii) Analysis of the Catastrophe

The catastrophe raised some serious ethical issues. The pesticide factory was built in the midst of densely populated settlements. UCIL chose to store and produce MIC, one of the most deadliest chemicals, in a densely populated Bhopal city. When the uncontrolled reaction started, MIC was flowing through the scrubber (meant to neutralize MIC emissions) at more then 200 times its designed capacity. MIC in the tank was filled to 87% against a maximum permissible limit of 50%. It was not stored at zero degree centigrade as prescribed because due to economic drive all the refrigeration and cooling systems had been shut down five months before the disaster. Vital gauges and indicators in the MIC tank were defective. The flare tower meant to burn off MIC emissions was under repair and the scrubber contained no caustic soda.

The work force for MIC plant in the factory was brought down to half, which had serious consequences on safety and maintenance. Not only the maintenance supervisor's position was eliminated but the period of safety training to workers in the MIC plant was also brought down from 6 months to 15 days. UCIL never provided any information on chemicals like MIC, which caused death of many people due to lack of proper treatment in time.

(iv) Tragedy of Victims

In December 1987, a Bhopal District Court Judge passed an order directing UCIL to pay ₹3.5 billion as interim relief. UCIL challenged this order in the MP high court. The High Court upheld the liability of UCIL for the Bhopal disaster, but reduced the interim compensation to ₹2.5 billion. UCIL appealed to the Supreme Court of India against the High Court order saying, *"No court that we know of in India or elsewhere in the world has previously ordered interim compensation where there is no proof of damages or where liability is strongly contested."* The Supreme Court of India strangely ruled that the $470 million settlement against all claims (*i.e.*, ₹10000 per victim) was just, equitable and reasonable. Thus UCIL escaped with a petty amount as settlement and the lakhs of Indians still continue to suffer the catastrophe heaped upon them by shear deliberate negligence of UCIL management in connivance with the Indian authorities at different levels.

SUMMARY

- *Union carbide (UCIL) of USA embarked on a mission of producing a new molecule "MIC" at Bhopal, which was one of the most dangerous compounds ever invented in the chemical history. Animals exposed to MIC vapours faced instantaneous death. MIC was so volatile that as soon as it came into contact with a few drops of water or a few ounces of metal dust, it got off to an uncontrollably violent reaction. No safety system would then be able to stop it emitting a fatal cloud into the atmosphere. To prevent explosion, MIC had to be kept permanently at a temperature near zero. UCIL engineers came to confirm that everything was functioning according to the laid down standards. The report presented by them revealed that all was not at all well with the Bhopal plant. It also reported leaks of phosgene, MIC and chloroform, ruptures in pipework and sealed joints. The report expressed concern at the inadequately trained staff and sloppy maintenance. In 1983, the manpower in each shift was cut by half. In the control room, only one man was left to*

oversee some seventy dials, counters and gauges, which relayed the temperature and pressure of the three tanks containing the MIC. On the night of December 3rd/4th 1984, forty tons of toxic gases made a poisonous grey cloud from the plant which spread throughout the city. As many as 10,000 persons died immediately and 30,000 to 50,000 were critically ill.

Short Question Answers

1. *How and why the Bhopal Gas Plant set up ?*

   Ans. In 1966 the Govt. of India (GOI) granted a license to Union Carbide India Ltd. (UCIL) to produce Sevin and all the required chemical ingredients in India. Union carbide of USA embarked on a mission of devising a product to exterminate a wide range of parasites, which soon came to be known as 'Sevin'. To manufacture Sevin, phosgene gas was made to react with another gas called monomethylamine. The reaction of these two gases produced a new molecule, MIC, which was one of the most dangerous compounds ever invented in the chemical history.

2. *Describe the accident at the plant and it's after effects.*

   Ans. On the night of December 3rd/4th 1984, forty tons of toxic gases made a poisonous grey cloud from Union Carbide India Limited (UCIL's) pesticide plant at Bhopal. It proved to be a killer gas which spread throughout the city. No alarm from the plant ever sounded a warning and hence no evacuation plan was prepared. When victims arrived at hospitals breathless and blind, doctors did not know how to treat them. Dead bodies of humans and animals blocked the streets, leaves turned black, the smell of burning chilli peppers lingered in the air. As many as 10,000 persons died immediately and 30,000 to 50,000 were critically ill.

3. *How were the gas tragedy victims treated and helped by the administration ?*

   Ans. In December 1987, a Bhopal District Court Judge passed an order directing UCIL to pay ₹3.5 billion as interim relief. UCIL challenged this order first in the MP high court and later in the supreme court.. The High Court reduced the interim compensation to ₹2.5 billion. Later on the Supreme Court of India strangely ruled that the $470 million settlement against all claims (*i.e.*, ₹10000 per victim) was just, equitable and reasonable. Thus UCIL escaped with a petty amount as settlement and the lakhs of Indians still continue to suffer the catastrophe heaped upon them by shear deliberate negligence of UCIL management in connivance with the Indian authorities at different levels.

Exercise

1. What was the UCIL engineers report after the Bhopal Gas Plant in May 1982 ?
2. Mention, which fundamental rules of the plant were broken endangering its safety ?
3. Describe the analysis done after the accident.

2.6.2 Chernobyl Nuclear Power Plant Accident 1986

History of Chernobyl Plant and Site

The Chernobyl Power Complex, consisted of four nuclear reactors of the RBMK-1000 design, units 1 and 2 being constructed between 1970 and 1977, while units 3 and 4 of the same design were completed in 1983. Two more RBMK reactors were under construction at the site at the time of the accident. An artificial lake of some 22 square kilometers, situated beside the river Pripyat, was constructed to provide cooling water for the reactors. At Chernobyl, within a 30 km radius of the power plant, the total population was between 115,000 and 135,000.

The RBMK-1000 is a Soviet-designed and built graphite moderated pressure tube type reactor, using slightly enriched (2% U-235) uranium dioxide fuel. It is a boiling light water reactor, with two loops feeding steam directly to the turbines, without an intervening heat exchanger. Water pumped to the bottom of the fuel channels boils as it progresses up the pressure tubes, producing steam which feeds two 500 MW turbines. The water acts as a coolant and also provides the steam used to drive the turbines. The vertical pressure tubes contain the zirconium alloy clad uranium dioxide fuel, around which the cooling water flows. The moderator, whose function is to slow down neutrons to make them more efficient in producing fission in the fuel, is graphite, surrounding the pressure tubes, A mixture of nitrogen and helium is circulated between the graphite blocks to prevent oxidation of graphite and to improve the transmission of the heat produced by neutron interactions in the graphite to the fuel channel. The core itself is about 7 m high and about 12 m in diameter. In each of the two loops, there are four main coolant circulating pumps, one of which is always on standby. The reactivity or power of the reactor is controlled by raising or lowering 211 control rods, which, when lowered into the moderator, absorb neutrons and reduce the fission rate. The power output of this reactor is 3200 MW. Various safety systems, such as an emergency core cooling system, were incorporated into the reactor design.

The Accident

On 25 April, 1986 prior to a routine shutdown, the reactor crew at Chernobyl 4 began preparing for a test to determine how long turbines would spin and supply power to the main circulating pumps following a loss of main electrical power supply. This test had been carried out at Chernobyl the previous year, but the power from the turbine ran down too rapidly, so new voltage regulator designs were to be tested. A series of operator actions, including the disabling of automatic shutdown mechanisms, preceded the attempted test early on 26 April. By the time that the operator moved to shut down the reactor, the reactor was in an extremely unstable condition.

The interaction of very hot fuel with the cooling water led to fuel fragmentation along with rapid steam production and an increase in pressure. The design characteristics of the reactor were such that substantial damage to even three or four fuel assemblies can – and did - result in the destruction of the reactor. The overpressure caused the 1000 tonnes cover plate of the reactor to become partially detached, rupturing the fuel channels and jamming all the control rods, which by that time were only halfway down. Intense steam generation then spread throughout the whole core (fed by water dumped into the core due to the rupture of the emergency cooling circuit) causing a steam explosion and releasing fission products to the atmosphere. About two to three seconds later, a second explosion threw out fragments from the fuel channels and hot graphite. There is some dispute among experts about the character of this second explosion, but it is likely to have been caused by the production of hydrogen from zirconium-steam reactions.

The graphite (about a quarter of the 1200 tonnes of it was estimated to have been ejected) and fuel became incandescent and started a number of fires, causing the main release of radioactivity into the environment. A total of about 14 EBq (14×10^{18} Bq) of radioactivity was released, over half of it being from biologically-inert noble gases.

About 200-300 tones of water per hour was injected into the intact half of the reactor using the auxiliary feed water pumps but this was stopped after half a day owing to the danger of it flowing into and flooding units 1 and 2. From the second to tenth day after the accident, some 5000 tons of boron, dolomite, sand, clay and lead were dropped on to the burning core by helicopter in an effort to extinguish the blaze and limit the release of radioactive particles.

Impact of the Accident

The accident caused the largest uncontrolled radioactive release into the environment ever recorded for any civilian operation, and large quantities of radioactive substances were released into the air for about 10 days. This caused serious social and economic disruption for large populations in Belarus, Russia and Ukraine. Two radionuclides, the short-lived iodine-131 and the long-lived caesium-137, were particularly significant for the radiation dose they delivered to members of the public.

The next task was cleaning up the radioactivity at the site so that the remaining three reactors could be restarted, and the damaged reactor shielded more permanently. About 200,000 people (*'liquidators'*) from all over the Soviet Union were involved in the recovery and clean-up during 1986 and 1987. They received high doses of radiation, averaging around 100 millisieverts (mSv). Some 20,000 of them received about 250 mSv and a few received 500 mSv. Later, the number of liquidators swelled to over 600,000 but most of these received only low radiation doses.

Effects of the Chernobyl accident on Environment and health. Several organizations have reported on the impacts of the Chernobyl accident, but all have had problems assessing the significance of their observations because of the lack of reliable public health information before 1986. In April 2005, the reports prepared by two expert groups – "*Environment*", coordinated by the IAEA, and "*Health*", coordinated by WHO said that "*apart from this [thyroid cancer] increase, there is no evidence of a major public health impact attributable to radiation exposure even 14 years after the accident*".

Chernobyl today

Chernobyl unit 4 is now enclosed in a large concrete shelter which was erected quickly (by October 1986) to allow continuing operation of the other reactors at the plant. However, the structure is neither strong nor durable. Some 200 tones of highly radioactive material remains deep within it, and this poses an environmental hazard until it is better contained.

The hermetically sealed building will allow engineers to remotely dismantle the 1986 structure that has shielded the remains of the reactor from the weather since the weeks after the accident. It will enable the eventual removal of materials containing nuclear fuel and accommodate their characterization, compaction and packing for disposal. This task represents the most important step in eliminating nuclear hazard at the site – and the real start of decommissioning.

Used Fuel and Wastes

In 1999, a contract was signed for construction of a radioactive waste management facility to store 25,000 used fuel assemblies and other operational wastes, as well as material from units decommissioned anywhere. The contract included a processing facility, able to cut the fuel assemblies and to put the material in canisters, which would be filled with inert gas and welded shut. They would then be transported to dry storage vaults in which the fuel containers would be enclosed for up to 100 years.

The storage area is designed to hold 55,000 m^3 of treated waste which will be subject to radiological monitoring for 300 years, by when the radioactivity will have decayed to such an extent that monitoring is no longer required.

Another contract has been signed for a Liquid Radioactive Waste Treatment Plant, to handle some 35,000 cubic metres of low-and intermediate-level liquid wastes at the site. This will need to be solidified and eventually buried along with solid wastes on site.

Lesson Learned from the Chernobyl Disaster

Leaving aside the verdict of history on its role in melting the Soviet 'Iron Curtain', some very tangible practical benefits have resulted from the Chernobyl accident. The main ones concern reactor safety, notably in Eastern Europe. (The US Three Mile Island accident in 1979 had a significant effect on Western reactor design and operating procedures. While that reactor was destroyed, all radioactivity was contained – as designed – and there were no deaths or injuries.)

While no-one in the West was under any illusion about the safety of early Soviet reactor designs, some lessons learned have also been applicable to Western plants. Certainly the safety of all Soviet-designed reactors has improved vastly. This is due largely to the development of a culture of safety encouraged by increased collaboration between East and West, and substantial investment in improving the reactors.

Modifications have been made to overcome deficiencies in all the RBMK reactors still operating. In these, originally the nuclear chain reaction and power output could increase if cooling water were lost or turned to steam, in contrast to most Western designs. It was this effect which led to the uncontrolled power surge and the destruction of Chernobyl 4. All of the RBMK reactors have now been modified by changes in the control rods, adding neutron absorbers and consequently increasing the fuel enrichment from 1.8 to 2.4% of U-235, making them very much more stable at low power. Automatic shut-down mechanisms now operate faster, and other safety mechanisms have been improved. Automated inspection equipment has also been installed. A repetition of the 1986 Chernobyl accident is now virtually impossible, according to a German nuclear safety agency report.

Many other international programmes were initiated following Chernobyl. The International Atomic Energy Agency (IAEA) safety review projects for each particular type of Soviet reactor are noteworthy, bringing together operators and Western engineers to focus on safety improvements. These initiatives are backed by funding arrangements. The Chernobyl Forum report said that some seven million people or/are now receiving or eligible for benefits as 'Chernobyl victims', which means that resources are not targeting the needy few percent of them.

Conclusion by International Agencies

International Atomic Energy Agency's (IAEA's) International Nuclear Safety Advisory Group (INSAG) accepted the view of the Soviet experts that

> *"the accident was caused by a remarkable range of human errors and violations of operating rules in combination with specific reactor features which compounded and amplified the effects of the errors and led to the reactivity excursion".* In particular, according to the INSAG-1 report: *"The operators deliberately and in violation of rules withdrew most control and safety rods from the core and switched off some important safety systems."*

However, the IAEA's 1992 INSAG-7 report, *The Chernobyl Accident : Updating of INSAG-1*, was less critical of the operators, with the emphasis shifted towards "the contributions of particular design features, including the design of the control rods and safety systems, and arrangements for presenting important safety information to the operators. The accident is now seen to have been the result of the concurrence of the following major factors :

(*i*) specific physical characteristics of the reactor ;

(*ii*) specific design features of the reactor control elements, and

(*iii*) the fact that the reactor was brought to a state not specified by procedures or investigated by an independent safety body.

Most importantly, the physical characteristics of the reactor made possible its unstable behaviour." But the report goes on to say that the International Nuclear Safety Advisory Group remains of the opinion that critical actions of the operators were most ill-judged. As pointed out in INSAG-1, the human factor has still to be considered as a major element in causing the accident.

It is certainly true that the operators placed the reactor in a dangerous condition, in particular by removing too many of the control rods, resulting in the lowering of the reactor's operating reactivity margin (ORM). However, the operating procedures did not emphasise upon the vital safety significance of the ORM but rather treated the ORM as a way of controlling reactor power. It could therefore be argued that the actions of the operators were more a symptom of the prevailing safety culture of the Soviet era rather than the result of recklessness or a lack of competence on the part of the operators.

In what is referred to as his *Testament* – which was published soon after his suicide two years after the accident – Valery Legasov, who had led the Soviet delegation to the IAEA

Post-Accident Review Meeting, wrote: "After I had visited Chernobyl NPP I came to the conclusion that the accident was the inevitable apotheosis of the economic system which had been developed in the USSR over many decades. Neglect by the scientific management and the designers was everywhere with no attention being paid to the condition of instruments or of equipment. When one considers the chain of events leading up to the Chernobyl accident, why one person behaved in such a way and why another person behaved in another etc, it is impossible to find a single culprit, a single initiator of events, because it was like a closed circle."

Although most reports on the Chernobyl accident refer to a number of graphite fires, it is highly unlikely that the graphite itself burned. Numerous tests and calculations have shown that it is virtually impossible to burn high-purity, nuclear-grade graphites. Graphite played little or no role in the progression or consequences of the accident. The red glow observed during the Chernobyl accident was the expected color of luminescence for graphite at 700°C and not a large-scale graphite fire, as some have incorrectly assumed. It is stated : *"The fire teams experienced no unusual problems in using their fire-fighting techniques, except that it took a considerable time to extinguish the graphite fire."*

SUMMARY

- *The April 1986 disaster at the Chernobyl nuclear power plant in Ukraine was the product of a flawed Soviet reactor design coupled with serious mistakes made by the plant operators. The resulting steam explosion and fires released at least 5% of the radioactive reactor core into the atmosphere and downwind. Two Chernobyl plant workers died on the night of the accident, and a further 28 people died within a few weeks as a result of acute radiation poisoning. UNSCEAR says that apart from increased thyroid cancers, "there is no evidence of a major public health impact attributable to radiation exposure 20 years after the accident." Resettlement of areas from which people were relocated is ongoing. The accident destroyed the Chernobyl 4 reactor, killing 30 operators and firemen within three months and several further deaths later. Acute radiation syndrome (ARS) was originally diagnosed in 237 people on-site, of these 28 people died within a few weeks of the accident. Large areas of Belarus, Ukraine, Russia and beyond were contaminated in varying degrees. The Chernobyl disaster was a unique event and the only accident in the history of commercial nuclear power where radiation-related fatalities occurred.*

Short Question Answers

1. *How and where was Chernobyl Nuclear Power Plant set up ?*

Ans. The Chernobyl Power Complex, consisted of four nuclear reactors of the RBMK-1000 design, An artificial lake of some 22 square kilometers, situated beside the river Pripyat, was constructed to provide cooling water for the reactors. At Chernobyl, within a 30 km radius of the power plant, the total population was between 115,000 and 135,000.

2. *Describe briefly it's functional design set up.*

Ans. The RBMK-1000 is a Soviet-designed and built graphite moderated pressure tube type reactor, using slightly enriched (2% U-235) uranium dioxide fuel. It is a boiling light water reactor, with two loops feeding steam directly to the turbines, without an intervening heat exchanger. The water acts as a coolant and also provides the steam used to drive the turbines. The core itself is about 7 m high and about 12 m in diameter. The reactivity or power of the reactor is controlled by raising or lowering 211 control rods. The power output of this reactor is 3200 MW.

3. *What were the impacts/ effects of this accident on the environment ?*

Ans. The accident caused the largest uncontrolled radioactive release into the environment ever recorded for any civilian operation, and large quantities of radioactive substances were released into the air for about 10 days. This caused serious social and economic disruption for large populations in Belarus, Russia and Ukraine. Two radionuclides, the short-lived iodine-131 and the long-lived caesium-137, were particularly significant for the radiation dose they delivered to members of the public.

4. *Describe the steps taken to eliminate nuclear hazard at the accident site.*

Ans. Chernobyl unit 4 is now enclosed in a large concrete shelter which was erected quickly (by October 1986) to allow continuing operation of the other reactors at the plant. However, the structure is neither strong nor durable. Some 200 tones of highly radioactive material remains deep within it, and this poses an environmental hazard until it is better contained. The hermetically sealed building will allow engineers to remotely dismantle the 1986 structure that has shielded the remains of the reactor. It will enable the eventual removal of materials containing nuclear fuel and accommodate their characterization, compaction and packing for disposal.

5. *What steps have been taken to take care of the used fuel and nuclear waste ?*

Ans. In 1999, a contract was signed for construction of a radioactive waste management facility to store 25,000 used fuel assemblies and other operational wastes, as well as material from units decommissioned anywhere. The cut fuel assemblies will be put the material in canisters, which would be filled with inert gas and welded shut and transported to dry storage vaults in which the fuel containers would be enclosed for up to 100 years. The storage area is designed to hold 55,000 m3 of treated waste which will be subject to radiological monitoring for 300 years, by when the radioactivity will have decayed to such an extent that monitoring is no longer required.

Exercise

1. Describe in brief the accident that took place at Chernobyl Nuclear Power Plant in Year 1986.
2. What safety precautions have been taken to stop radiation from the Chernobyl Nuclear Power Plant and the used fuel nuclear waste produced ?
3. Write and describe the conclusion drawn by the International Atomic Energy Agency after the accident review.
4. What lesson did the world learn from the Chernobyl Nuclear Power Plant disaster ?

2.6.3 The Three Mile Island Nuclear Power Plant Accident

The Three Mile Island (TMI) nuclear power plant is located in central Pennsylvania about 10 miles south of Harrisburg in Londonderry Township U.S.A. It was named after the island on which it was situated on the Susquehanna River near Harrisburg. It was constructed between years 1968 to 1970. Before the 1979 accident at Pennsylvania's Three Mile Island, few had heard of the nuclear power plant on the Susquehanna River. But the crisis that began years ago in the early morning of March 28 quickly turned the plant and its giant cooling towers into icons. The accident at Three Mile Island, though minuscule in its health consequences, had widespread and profound effects on the American nuclear power industry. It resulted in the immediate (though temporary) closing of seven operating reactors like those at Three Mile Island. A moratorium on the licensing of all new reactors was also temporarily imposed, and the whole process of approval for new plants by the Nuclear Regulatory Commission was significantly slowed for years after the accident.

The Cause of Accident

The incident began at 4:00 a.m. on March 28, 1979 because due to an unknown reason, the feed pump (in the turbine water loop) stopped operating. Without this pump, the turbine water could not remove heat from the steam generator. When this happened, the control rods automatically dropped into the reactor stopping the fission process. However, the radioactive fission products still produced heat so the temperature and pressure started to rise. To reduce the pressure, the valve on the pressurizer, called the pilot-operated relief valve (PORV), opened. Up to this time, everything operated as designed.

When the pressure in the pressurizer dropped to a prescribed value, the PORV was supposed to close but it did not. The accident was now underway. The control panel had an indicator that showed the valve to have closed, (*i.e.*, power was going to the valve to close it) but there was no way to determine that the valve was actually closed or not. With the valve open, steam and water escaped the pressurizer ; this water flowed into a drain tank.

When the feed pump failed, the emergency feed pump should have automatically turned on to keep the turbine water flowing. That pump was tested 42 hours prior to the incident and was functional. However, to perform the test, workers must close a valve, perform the test, and then open it. Apparently the workers forgot to open the valve so the emergency water did not flow. Now the reactor was losing water and getting hotter. With the loss of water (and no air or steam in the pressurizer) the pressure dropped.

When the pressure dropped, some of the water in the reactor turned to steam. This had two major consequences ; first it forced water into the pressurizer and filled it completely, and second, steam instead of water surrounded the reactor fuel. Steam does not conduct heat as well, as water, so the fuel pellets heated up.

In case of an accident, a nuclear power plant has tanks of water with pumps that can quickly introduce water to cool the reactor. One of these automatically started. This was noted by the operators, but then they looked at the indicators for the pressurizer, these indicators

were showing that the pressurizer was full of water (it was because of the steam and not water in the reactor core area). A full pressurizer means that the operators cannot control the pressure, so they turned off the entering water.

Now the situation went from bad to worse. About 100 minutes after the accident started, steam bubbles appeared in the coolant pumps, causing them to vibrate. Fearing a complete failure of these pumps, the operators turned them off. With no water flowing into the reactor and a mixture of water and steam escaping the reactor, large portions of the reactor core became uncovered. With no water to remove the heat, the fuel pellets started to melt, resulting in a partial meltdown.

Finally, one operator surveyed the data and concluded that the PORV was open, so at 6:18 a.m., they closed the valve and then introduced water into the reactor, thus ending the immediate emergency. However, between the time that the operators shut off the pumps and when the valve was closed, the core was uncovered, enough to cause some fuel to melt. In fact, at the time of the accident, nobody thought that a major portion of the fuel had melted. When the reactor was opened months later, they were surprised to find that about 60% of the core actually melted.

While the reactor core was melting, the hot zirconium (that held the fuel) was reacting with the water. This chemical reaction produced hydrogen gas, which is combustible. Some of the hydrogen gas escaped from the reactor into the containment building. The operators were unaware of the presence of hydrogen until something ignited the hydrogen at about 2:00 p.m. Burning of Hydrogen lasted for six to eight seconds, but did no damage to any systems in the building. Although the reactor vessel still contained hydrogen, yet nobody seemed to address this problem in light of other, more serious, problems. When somebody gave it a thought two days later, the great fear was that the hydrogen might explode causing a breach of the reactor vessel and maybe of the containment building. Once the presence of hydrogen was verified, the hydrogen was sent though neutralizers and by the fourth day most of the hydrogen was gone. Actually the fear of an explosion was unfounded. To burn, hydrogen must combine with oxygen, but no oxygen was present in the reactor vessel. However, the fear of an explosion caused many of the public to evacuate the area around TMI.

During these first few hours of the accident, all the action occurred in the reactor building. However, the water that escaped through the pressurizer valve had filled the drain tank and overflowed onto the floor in the Auxiliary Building. Because the core had been uncovered resulting in some core melt, radioactivity had escaped to the reactor water and some of that water was now in the Auxiliary Building. Some of the radioactivity was in the form of xenon and krypton (noble gases) and iodine. The gasses could not be contained so they soon leaked into the atmosphere, thus exposing the public to radiation from the radioactivity in the air. Although the release stacks on the Auxiliary building contained radiation monitors, they were designed for much smaller releases. Therefore the actual radioactivity that was released was never measured, but from later calculations, the scientific community estimated that about 17 million Curies escaped the reactor and transported to the Auxiliary building. The Auxiliary building served as something like a holding tank which allowed some of the radioactivity to decay before entering the atmosphere. As a result, a little more than half *i.e.*, 9 million Curies, made it to the environment.

As a result of these noble gas releases, the public received some radiation dose. The actual dose received by any one person will never be known, but experts, according to testimony in the TMI Litigation, gave limits in the 25 to 50 mrem range.

Human Factors Responsible

Critical human factors and user interface engineering problems were revealed in the investigation of the reactor control system's user interface. Despite the valve being stuck open, a light on the control panel indicated that the valve was closed. In fact the light did not indicate the actual position of the valve, but only the status of the valve solenoid, thus giving false evidence of a closed value. As a result, the operators did not correctly diagnose the problem for several hours.

The design of the PORV indicator light was fundamentally flawed. The bulb was simply connected in parallel with the valve solenoid, thus implying that the PORV was shut when it went dark, without actually verifying the real position of the valve. When everything was operating correctly, the indication was true and the operators became habituated to rely on it. However, when things went wrong and the main relief valve stuck open, the unlighted lamp was actually misleading the operators by implying that the valve was shut. This caused the operators considerable confusion, because of the pressure, temperature and coolant levels in the primary circuit. If the PORV was shut, operators could have observed it via their instruments which were not functioning as they should have. This confusion contributed to the severity of the accident because the operators were unable to break out of a cycle of assumptions and confusions which conflicted with, what their instruments were telling them. It was not until a fresh shift came in, who did not have the mind-set of the first shift of operators, that the problem was correctly diagnosed. By this time, major damage had occurred.

The operators had not been trained to understand the ambiguous nature of the PORV indicator and to look for alternative confirmation that the main relief valve was closed. There was a temperature indicator downstream of the PORV in the tail pipe between the PORV and the pressurizer that could have told them the valve was stuck open, by showing that the temperature in the tail pipe remained higher than it should have been had the PORV been shut. This temperature indicator, however, was not part of the "safety grade" suite of indicators designed to be used after an incident, and the operators had not been trained to use it. Its location on the back of the desk also meant that it was effectively out of sight of the operators.

Consequences of Stuck Valve

The pressure in the primary system continued to decrease and reactor coolant continued to flow in boiling state inside the core. Small bubbles of steam formed and immediately collapsed, which is known as nucleate boiling. As the system pressure decreased further, steam pockets began to form in the reactor coolant. This departure from nucleate boiling (DNB) caused steam voids in coolant channels, blocking the flow of liquid coolant and greatly increasing the fuel cladding temperature. As the volume of these steam voids

increased much more quickly than coolant was lost, the overall water level inside the pressurizer rose despite the loss of coolant through the open PORV. Because of the lack of a dedicated instrument to measure the level of water in the core, operators judged the level of water in the core solely by the level in the pressurizer. Since it was high, they assumed that the core was properly covered with coolant, unaware that because of steam forming in the reactor vessel, the indicator provided misleading readings. Indications of high water levels contributed to the confusion, as operators were concerned about the primary loop "*going solid*," (*i.e.*, no air pocket buffer existed in the pressurizer) which in training they had been instructed to never allow. This confusion was a key contributor to the initial failure to recognize the accident as a loss-of-coolant accident, and led operators to turn off the emergency core cooling pumps, which had automatically started after the PORV stuck and core coolant loss began, due to fears the system was being overfilled. With the PORV still open, the pressurizer relief tank that collected the discharge from the PORV overfilled, causing the containment building sump to fill and sound an alarm at 4:11 a.m. This alarm, along with higher than normal temperatures on the PORV discharge line and unusually high containment building temperatures and pressures, were clear indications that there was an ongoing loss-of-coolant accident, but these indications were initially ignored by operators. At 4:15 a.m., the relief diaphragm of the pressurizer relief tank ruptured, and radioactive coolant began to leak out into the general containment building. This radioactive coolant was pumped from the containment building sump to an auxiliary building, outside the main containment, until the sump pumps were stopped at 4:39 AM.

After almost 80 minutes of slow temperature rise, the primary loop's four main reactor coolant pumps began to cavitate a steam bubble/water mixture, rather than water. The pumps were shut down, and it was believed that natural circulation would continue the water movement. Steam in the system prevented its flow through the core, and as the water stopped circulating it was converted to steam in increasing amounts. About 130 minutes after the first malfunction, the top of the reactor core was exposed and the intense heat caused a reaction to occur between the steam forming in the reactor core and the Zircaloy nuclear fuel rod cladding, yielding zirconium dioxide, hydrogen, and additional heat. This reaction melted the nuclear fuel rod cladding and damaged the fuel pellets, which released radioactive isotopes to the reactor coolant, and produced hydrogen gas that is believed to have caused a small explosion in the containment building later that afternoon.

At 6 am, there was a shift change in the control room. A new team arrival noticed that the temperature in the PORV tail pipe and the holding tanks was excessive and used a backup valve – called a "*block valve*" – to shut off the coolant venting via the PORV, but around 12000 litres of coolant had already leaked from the primary loop. It was not until 165 minutes after the start of the problem that radiation alarms activated when contaminated water reached detectors. By that time, the radiation levels in the primary coolant water were around 300 times expected levels, and the plant was seriously contaminated.

At 6:56 a.m., station manager announced a general emergency, defining it to have the "*potential for serious radiological consequences to the general public*". The uncertainty of operators at the plant was reflected in fragmentary, ambiguous, or contradictory statements made by

government agencies stating that though there had been a small release of radiation, no increase in normal radiation levels had been detected. In fact, readings from instruments at the plant and off-site detectors had detected radioactivity releases, at levels that were unlikely to threaten public health as long as they were temporary, and providing that containment of the then highly contaminated reactor was maintained.

After receiving word of the accident Nuclear Regulatory Commission (NRC) activated emergency response at headquarters in Bethesda, Maryland and sent staff members to Three Mile Island. Initially it viewed the accident, as a "cause for concern but not with an alarm" and informed the White House staff.

In a 2009 article, it was stated that it took five weeks to learn that "*the reactor operators had measured fuel temperatures near the melting point*" and it was not learnt for years, until the reactor vessel was physically opened that by the time the plant operator called emergency roughly half of the uranium fuel had already melted.

It was still not clear to the control room staff that the primary loop water levels were low and that over half of the core was exposed. A group of workers took manual readings from the thermocouples and obtained a sample of primary loop water. Seven hours into the emergency, new water was pumped into the primary loop and the backup relief valve was opened to reduce pressure so that the loop could be filled with water. After 16 hours, the primary loop pumps were turned on once again, and the core temperature began to fall. A large part of the core had melted, and the system was still dangerously radioactive.

On the third day following the accident, a hydrogen bubble was discovered in the dome of the pressure vessel, and became the focus of concern. A hydrogen explosion might not only breach the pressure vessel, but, depending on its magnitude, might compromise the integrity of the containment vessel leading to large scale release of radioactive material. However, it was determined that there was no oxygen present in the pressure vessel, a prerequisite for hydrogen to burn or explode. Immediate steps were taken to reduce the hydrogen bubble, and by the following day it was significantly smaller. Over the next week, steam and hydrogen were removed from the reactor using a catalytic re-combiner and, controversially, by venting straight to the atmosphere.

Release of Radioactive Material

Once the first line of containment is breached during a reactor plant accident, there is a possibility that the fuel or the fission products held inside may escape into the environment. This was evidenced by the radiation alarms that eventually sounded. However, since very little of the fission products released were solids at room temperature, very little radiological contamination was reported in the environment. No significant level of radiation was attributed to the TMI-2 accident outside of the TMI-2 facility. The vast majority of the radioisotopes released were the noble gases xenon and krypton.

The United States Environmental Protection Agency (EPA) analysis concluded that the accident did not raise radioactivity far above safe levels to cause even one additional cancer death among the people in the area, but measures of beta radiation were not included. The EPA found no contamination in water, soil, sediment or plant samples.

Investigations and report of Nuclear Regulatory Commission

Several state and federal government agencies mounted investigations into the crisis, the most prominent of which was the President's Commission on the Accident at Three Mile Island, created by Jimmy Carter in April 1979. The commission consisted of a panel of twelve people, specifically chosen for their lack of strong pro- or anti-nuclear views. It was instructed to produce a final report within six months, and after public hearings, depositions, and document collection, it released a completed study on October 31, 1979. The investigation strongly criticized for lapses in quality assurance and maintenance, inadequate operator training, lack of communication of important safety information, poor management, and complacency, but avoided drawing conclusions about the future of the nuclear industry. The heaviest criticism from the Commission concluded that "fundamental changes were necessary in the organization, procedures, practices 'and above all – in the attitudes' of the NRC and the nuclear industry. It said that the actions taken by the operators were "*inappropriate*" but that the workers "*were operating under procedures that they were required to follow, and our review and study of those indicates that the procedures were inadequate*" and that the control room "*was greatly inadequate for managing an accident*". The Commission notes that PORV valve had previously failed on 11 occasions, nine of them in the open position, allowing coolant to escape.

SUMMARY

- *On March 28, 1979, the plant experienced a failure in the secondary, section (one of two reactors on the site). The main feed water pumps stopped sending water to the steam generators. Immediately, the pressure in the primary system (the nuclear portion of the plant) began to increase. In order to control that pressure, the pilot-operated relief valve opened. The valve should have closed when the pressure fell to proper levels, but it became stuck open and cooling water started pouring out of the stuck-open valve, whereas instruments in the control room indicated to the plant staff that the valve was closed. There was no instrument that showed how much water covered the core and plant staff assumed that the core was properly covered with water. The water escaping through the stuck valve reduced primary system pressure so much that the reactor coolant pumps had to be turned off to prevent dangerous vibrations. To prevent the pressurizer from filling up completely, the staff reduced emergency cooling water being pumped in to the primary system. These actions starved the reactor core of coolant, causing it to overheat. Without the proper water flow, the nuclear fuel overheated to the point at which the zirconium cladding (the long metal tubes that hold the nuclear fuel pellets) ruptured and the fuel pellets began to melt. Authorities did not know that the core had melted, but they immediately took steps to try to gain control of the reactor and ensure adequate cooling to the core. By the evening of March 28, the core appeared to be adequately cooled and the reactor appeared to be stable. But on March 30, a significant release of radiation from the plant's auxiliary building caused a great deal of confusion. Within a short time, chemical reactions in the melting fuel created a large hydrogen bubble in the dome of the pressure vessel, which could explode and rupture the pressure vessel and cause a breach of containment. However, the crisis ended when experts determined on Sunday, April 1, that the bubble could not burn or explode because of the absence of oxygen in the pressure vessel.*

Short Question Answers

1. *How and why did the Three Mile Island become famous ?*

   Ans. The Three Mile Island (TMI) nuclear power plant was named after the island on which it was situated on the Susquehanna River near Harrisburg, USA. Before the 1979 accident at Pennsylvania's Three Mile Island, few had heard of the nuclear power plant on the Susquehanna River. But the crisis that began years ago in the early morning of March 28 quickly turned the plant and its giant cooling towers into icons.

2. *Describe in brief the main cause of nuclear power plant accident at the Three Mile Island.*

   Ans. Due to an unknown reason, the feed pump (in the turbine water loop) stopped operating. Without this pump, the turbine water could not remove heat from the steam generator. The control rods automatically dropped into the reactor stopping the fission process. However, the radioactive fission products still produced heat so the temperature and pressure started to rise. To reduce the pressure, the valve on the pressurizer, called the pilot-operated relief valve (PORV), opened. When the pressure dropped, the PORV was supposed to close but it did not. The control panel indicated that the valve had closed but the valve was actually not closed. With the valve open, steam and water escaped the pressurizer ; this water flowed into a drain tank. When the feed pump failed, the emergency feed pump should have automatically turned on to keep the turbine water flowing, but it did not, because the workers forgot to open the valve. With the loss of water the pressure dropped, some of the water in the reactor turned to steam. This had two major consequences ; first it forced water into the pressurizer and filled it completely, and second, steam instead of water surrounded the reactor fuel so the fuel pellets heated up. Operators looked at the indicators for the pressurizer, which were showing that the pressurizer was full of water (it was because of the steam and not water in the reactor core area). A full pressurizer means that the operators cannot control the pressure, so they turned off the entering water. About 100 minutes after the accident started, steam bubbles appeared in the coolant pumps, causing them to vibrate. Fearing a complete failure of these pumps, the operators turned them off. With no water flowing into the reactor and a mixture of water and steam escaping the reactor, large portions of the reactor core became uncovered. With no water to remove the heat, the fuel pellets started to melt, resulting in a partial meltdown and release of radiation.

3. *What role could have been played by presence of hydrogen gas ?*

   Ans. While the reactor core was melting, the hot zirconium (that held the fuel) was reacting with the water. This chemical reaction produced hydrogen gas, which is combustible. Some of the hydrogen gas escaped from the reactor into the containment building. The operators were unaware of the presence of hydrogen until something ignited the hydrogen. The great fear was that the hydrogen might explode causing a breach of the reactor vessel and maybe of the containment building. Once the presence of hydrogen was verified, the hydrogen was sent though neutralizers and by the fourth day most of the hydrogen had dissipated.

4. *Describe the effects of this accident on the environment and the people around.*

   Ans. During this accident, all the action occurred in the reactor building. The water that escaped through the pressurizer valve filled the drain tank and over flowed in the Auxiliary Building. Because the core had melted, radioactivity escaped to the reactor water. Some of the radioactivity was in the form of xenon and krypton (noble gases) and iodine. The gasses could not be contained so they soon leaked into the atmosphere, thus exposing the public to radiation from the radioactivity in the air. The Auxiliary building served as something like a holding tank which allowed some of the radioactivity to decay before entering the atmosphere. A little more than half made it to the environment. As a result of these noble gas releases, the public received some radiation dose.

5. *How did the flawed pilot operated relief valve create confusion for the plant operators ?*

   Ans. The design of the PORV indicator light was fundamentally flawed because, the bulb was simply connected in parallel with the valve solenoid, thus implying that the PORV was shut when it went dark, without actually verifying the real position of the valve. When everything was operating correctly, the indication was true and the operators became habituated to rely on it. However, when things went wrong and the main relief valve stuck open, the unlighted lamp was actually misleading the operators by implying that the valve was shut.

6. *What were the findings of Nuclear Regulatory Commission of USA on this accident ?*

   Ans. The commission consisted of a panel of twelve people, specifically chosen for their lack of strong pro- or anti-nuclear views, which released its report on October 31, 1979. The investigation strongly criticized for lapses in quality assurance and maintenance, inadequate operator training, lack of communication of important safety information, poor management, and complacency. It said that the actions taken by the operators were "*inappropriate*" but that the workers "*were operating under procedures which were inadequate*" and that the control room "*was also greatly inadequate for managing an accident.*" The Commission noted that PORV valve had also failed on 11 previous occasions, nine of them in the open position, allowing coolant to escape.

Exercise

1. Analyse the human factors as cause accident at Three Mile Island.
2. What were consequences of water turning into steam when pressure dropped in the reactor ?
3. How did the reactor water contaminate the auxiliary building ?
4. What is the function of the pilot operator relief valve indicator in a nuclear power plant ? How did it matter in the nuclear power plant accident ?
5. Describe the consequences of the stuck valve.
6. What were the findings of the Environmental Regulatory Commission ?

2.6.4 The Space Shuttle "*Challenger*" Disaster

In March 1970, President Nixon made an important political choice. For budgetary reasons, he scrapped the Mars project and the space platform, but he ordered the development of the shuttle vehicle. Thus the reusable space shuttle, earlier considered only the transport element of a broad, multi-objective space plan, becam' the focus of NASA's team for the near future.

This decision forced NASA to put all its eggs in one basket ; it significantly shaped NASA's goals for the future. From this point on, to prove that the shuttle could be used as a universal launch vehicle, NASA tried to create an operational shuttle system by instituting a heavy schedule of flights.

President Ronald Reagan, in an important policy speech on the national space policy on July 5, 1982, increased the pressure on NASA when he declared that the shuttle was "fully operational". The administration was eager for the shuttle system to become operational because it had developed some rather ambitions commercial and military goals for NASA. One of these goals was for NASA to become an economically self-sufficient cargo hauler, primarily of communication satellites. Thus NASA found itself in the business of launching satellites for a wide variety of customers. Thus as a result of it pressures in NASA increased, perhaps at the expenses of engineering considerations.

Pressures developed because of the need to meet customer's commitments, which translated into a requirement to launch a certain number of flights per year and to launch them on time. Such considerations may occasionally have obscured engineering concerns.

It is evident, that NASA was subjected to strong external pressures to accept very ambitious goals. These goals were internalized within the organizational structure of NASA. The agency committed itself to a frenetic pace of launchings in the 1980,s so much so, that at one point proposing 714 flights between 1978 and 1990. This pressure was undoubtedly felt by individuals at NASA and such external pressures were internalized as organizational goals by NASA, zeroing in on individual decision makers and setting the stage for the challenger explosion.

Structural Strains within NASA

As NASA attempted to meet the increasing flight schedule of the space shuttle and achieve the commercial and military goals that had been laid out for it, the agency encountered a number of constraints and operational problems. These constraints made it increasingly difficult for NASA to reach its goals in an acceptable way, *i.e.*, with the high level of safety expected of it and resorting to means which were less safe.

> *"The genesis of the Challenger accident was the failure of the joint of the right solid rocket motor-began with decisions made in the design of the joint and in the failure of both Thiokol and NASA's solid booster project team to understand and respond to facts obtained during testing. The Commission has concluded that neither Thiokol nor NASA responded adequately to internal warnings about the faulty seal design.*

> *Furthermore, Thiokol and NASA did not make a timely attempt to develop and verify a new seal after the initial design was shown to be deficient."* While NASA worked on solving the problem, it continued with determination to fly, and defined the risk as "*acceptable*" and "*unavoidable.*"

It had put the whole future of the space program on the shuttle. There was no way out. Overwhelming problems were just denied. The safety, reliability, and quality-assurance workforce at NASA had been reduced, which seriously limited NASA's capability in these vital functions.

The Space Shuttle Challenger-disaster occurred on January 28, 1986, when Space Shuttle Challenger (mission STS-51-L) broke apart 73 seconds into its flight, leading to the deaths of its seven crew members. The spacecraft disintegrated over the Atlantic Ocean, off the coast of Cape Canaveral, Florida at 11:38 EST (Eastern Standard Time). Disintegration of the vehicle began after an O-ring seal in its right solid rocket booster (SRB) failed at liftoff. The O-ring failure caused a breach in the SRB joint it sealed, allowing pressurized hot gas from within the solid rocket motor to reach outside and impinge upon the adjacent SRB attachment hardware and external fuel tank. This led to the separation of the right-hand SRB's aft attachment and the structural failure of the external tank. Aerodynamic forces broke up the orbiter.

The crew compartment and many other vehicle fragments were eventually recovered from the ocean floor after a lengthy search and recovery operation. The exact timing of the death of the crew is unknown ; several crew members are known to have survived the initial breakup of the spacecraft. The shuttle had no escape system, and the impact of the crew compartment with the ocean surface was too violent for survival.

The disaster resulted in a 32-month halt in the shuttle program and the formation of the Rogers Commission, a special commission appointed by United States President Ronald Reagan to investigate the accident. The Rogers Commission found NASA's organizational culture and decision-making processes to be the key contributing factors to the accident. NASA managers knew that contractor Morton Thiokol's design of the SRBs contained a potentially catastrophic flaw in the O-rings since 1977, but failed to address it properly. They also disregarded warnings from engineers about the dangers posed by the low temperatures on the morning of launching date and failed to adequately report these technical concerns to their superiors.

Challenger was originally set to launch from KSC in Florida at 14:42 Eastern Standard Time (EST) on January 22. Delays in the previous mission, STS-61-C, caused the launch date to be moved to January 23 and then to January 24. Launch was then rescheduled to January 25 due to bad weather at the Transoceanic Abort Landing (TAL) site in Dakar, Senegal. NASA decided to use Casablanca as the TAL site, but because it was not equipped for night landings, the launch had to be moved to the morning (Florida time). Predictions of unacceptable weather at KSC on January 26, caused the launch to be rescheduled for 09:37 EST on January 27.

The launch was delayed the next day, due to problems with the exterior access hatch. First, one of the micro-switch indicators which were used to verify that the hatch was safely locked, malfunctioned. Then, a stripped bolt prevented the crew from removing a closing fixture of the orbiter's hatch. By the time repair personnel had sawed the fixture off, crosswinds at the Shuttle Landing Facility exceeded the limits for a Return to Launch Site (RTLS) and the crew waited for winds to die down, forcing another rescheduling.

Thiokol-NASA Conference Call

Forecasts for January 28 predicted an unusually cold morning, with temperature close to 31°F (–1°C), the minimum temperature permitted for launch. The low temperatures had prompted concerns from Thiokol engineers. At a teleconference on the evening of January 27, Thiokol engineers and managers discussed the whether conditions with NASA managers from Kennedy Space Center and Marshall Space Flight Center. Several engineers re-expressed their concerns about the effect of low temperatures on the resilience of the rubber O-rings that sealed the joints of the SRBs, and recommended a launch postponement. They argued that they did not have enough data to determine whether the joints would properly seal if the O-rings were colder than 53°F (12°C). This was an important consideration, since the SRB O-rings had been designated as a "*Criticality 1*" component, meaning that there was no backup if both the primary and secondary O-rings failed, and their failure would destroy the challenger shuttle and the crew.

Thiokol management initially supported its engineers' recommendation to postpone the launch, but NASA staff opposed a delay. One argument by NASA personnel contesting Thiokol's concerns was that if that primary O-ring failed, the secondary O-ring would still seal. Although this statement was unproven, yet it was placed as an argument which could not be applied to a "*Criticality 1*" component.

NASA did not know of Thiokol's earlier concerns about the effects of the cold on the O-rings, and did not understand that Rockwell International, the shuttle's prime contractor, viewed the large amount of ice present on the pad as a constraint to launch. Due to NASA's opposition, Thiokol management reversed itself and recommended that the launch may proceed as scheduled.

The skies were clear and the sun shone on the cold freezing morning of January 28, 1986. Kennedy Space Center in Florida was busy preparing the launch of the 25th space shuttle into space. Mission STL-51-L was the 10th flight of Orbiter Challenger. This was one of the most publicized launches because it was for the first time that a civilian, a school teacher, was going into space. The launch of challenger had been delayed five times due to bad weather, whereas January 28 was the coldest day that NASA had ever launched a shuttle.

The temperature at ground level at Pad 39B was 36°F, *i.e.*, 15°F cooler than any other previous launch by NASA. The Solid Rocket Boosters (SRB) was ignited, and the thundering noise started. At 0.68 seconds after ignition, videotape showed black smoke coming from the aft (bottom) field joint of the right SRB. The aft field joint is the lower portion of the SRB. The black smoke suggested that grease, joint insulation and rubber O-ring were burning.

The smoke continued to come from the aft field joint facing the Exterior Tank, with a cycle of 3 puffs of smoke per second. The last puff of smoke was seen at 2.7 seconds. The black smoke was an indication that the aft field joint was not sealing correctly. Later in flight, flashes were seen on Challenger. Three bright flashes shot across the challenger's wings, 45 seconds after lift-off. Each of the three flashes lasted only 1/13 of a second. As these flashes had been seen on other shuttle missions, therefore were not considered as problems. These bright flashes were completely unrelated to the flame that was seen later in flight.

At 58.8 seconds into flight, on an enhanced film, a flame was seen coming from the right SRB. The flame was coming from the aft center and aft joint, at 305° around the circumference of the SRB. The flame was burning gas that was escaping from the SRB. A fraction of a second later, at 59.3 seconds, the flame was well defined, and could be seen without enhanced film. As the flame increased in size, it began to push against the External Tank by rushing the air around the Orbiter. The SRB is attached to the External Tank by a series of struts along the side the External Tank. One of these struts is located at 310° of the circumference of the SRB. The flame as it grew pushed against this strut, with an intense heat of 5600°F, making it hot and weak.

The first sight that the flame was hitting the External Tank was at 64.7 seconds, when the color of the flame changed. Change in the flame colour indicated that it was on account of mixing with another substance. This other substance was liquid Hydrogen which is stored in the External Tank. The External Tank stores Hydrogen and oxygen in two tanks. The top tank containing Oxygen and the bottom one containing Hydrogen. Pressure changes in the Hydrogen tank confirmed there was leakage. Forty-five milliseconds after the color change, a small glowing light developed between the External Tank and Challenger's black tiles.

From 72 seconds onwards there was a very sudden chain of events that destroyed Challenger and the seven crew members on board. All of these events happened in less than two seconds. By now the lower strut, connecting the right SRB to the External Tank was extremely hot and very weak. With the amount of force given by the SRB, the lower strut broke away from both the right SRB and the External Tank, allowing the right SRB to rotate freely around the top struts. The SRB was out of control, the bottom of the SRB swung around hitting, burning and denting Challengers wing. At 73.12 seconds into flight a white vapor was seen from the bottom corner of the right SRB. The External Tank had become weak due to the intense heat given by the flame. The dome structure under the External Tank failed and fell. The tank of Hydrogen inside the External Tank ruptured and released the liquid Hydrogen contents. With the sudden absence of Hydrogen, there was an extreme force that shot the Hydrogen tank forward into the Oxygen tank, which too burst.

As the two inter-tanks collided, the top of the right SRB on the outside hit the top of the External Tank, and also broke the Oxygen tank. The white vapour seen was the mixture of Hydrogen and Oxygen. At 73.14 seconds, all the structures failed. Only milliseconds after the white vapour was seen from the right SRB, the glow had turned to a fireball in a huge

explosion. The main explosion was the Hydrogen and Oxygen that come from the External Tank. Challenger was traveling at a speed of Mach 1.92, at a height of 46,000 feet when it blew up. The last recorded transmission from Challenger was at 73.62 seconds after launch, when it truly fell apart.

Just before challenger had blown up, it was engulfed in a cloud of smoke, that grew larger after the explosion. From under the gray smoke of the explosion, a red smoke was spreading. This red smoke was the reaction control system burning from the wreckage from challenger. Debris from challenger was seen falling and racing towards the ocean. Both of the SRBs flew in opposite directions out of the fireball and cloud. The explosives on the SRB were detonated by the United States Air Force Safety Commander, 110.25 seconds after launch. (36.6 seconds after the explosion.) The SRB have parachutes in the top cone so that, they can slowly come back to the ground in a normal way. The parachutes from the blown SRB had come loose and were floating down to the ground. The watching public thought that the crew had escaped from the shuttle using their escape system. What the watchers did not know was that there was no escape system on any of the shuttles. The SRB was seen speeding away from the gulf of smoke caused by the exploding challenger.

The right aft field joint sealing was the prime suspect to be the cause of the accident, because the smoke after ignition and flame during flight came from the region of the aft field joint. There were a few causes that were found which could have lead to the joint seal failure.

These causes are :

(*i*) *Assembly damage/Contamination.* The joint seal could have been damaged or contaminated during assembly of the SRB.

(*ii*) *Gap opening.* The gap between the joints open as the pressures are applied.

(*iii*) *O-ring compression.* This depends on the width of the gap.

(*iv*) *Joint temperature.* The temperature has effects on the sealing ability of the O-ring.

(*v*) *Putty performance.* Putty, Zinc chromate is applied before assembly inside the joint to stop gases to the O-rings.

Rogers Commission Report

The Presidential Commission on the Space Shuttle *Challenger* Accident, also known as the Rogers Commission (after its chairman), was formed to investigate the disaster. The commission members were Chairman William P. Rogers, Vice Chairman Neil Armstrong, David Acheson, Eugene Covert, Richard Feynman, Robert Hotz, Donald Kutyna, Sally Ride, Robert Rummel, Joseph Shtter, Arthur Walker, Albert Wheelon, and Chuck Yeager. The commission worked for several months and published a report of its findings. It found that the *Challenger* accident was caused by a failure in the O-rings used for sealing a joint on the right solid rocket booster, which unluckily allowed pressurized hot gases and eventually flame to *"blow by"* the O-ring and make contact with the adjacent external tank, causing

structural failure. The failure of the O-rings was attributed to a faulty design, whose performance could be too easily compromised by factors including the low temperature on the day of launch.

More broadly, the report also considered the contributing causes of the accident. Most salient was the failure of both NASA and Morton Thiokol to respond adequately to the danger posed by the deficient joint design. Rather than redesigning the joint, they came to define the problem as an acceptable flight risk. The report found that managers at Marshall had known about the flawed design since 1977, but never discussed the problem outside their reporting channels with Thiokol—a flagrant violation of NASA regulations. Even when it became more apparent how serious the flaw was, no one at Marshall considered grounding the shuttles until a remedial measure was implemented. On the contrary, Marshall managers went as far as to issue and waive six launch constraints related to the O-rings. The report also strongly criticized the decision-making process that led to the launch of *Challenger*, stating that it was seriously flawed.

Failures in communication resulted in a decision to launch the shuttle based on :

(*i*) incomplete and sometimes misleading information,

(*ii*) a conflict between engineering data and management judgments, and

(*iii*) a NASA management structure that permitted internal flight safety problems to bypass key Shuttle managers.

One of the commission's best-known members was theoretical physicist Richard Feynman. During a televised hearing, he famously demonstrated how the O-rings became less resilient and subject to seal failures at ice-cold temperatures by immersing a sample of the material in a glass of ice water. He argued that the estimates of reliability offered by NASA management were wildly unrealistic, differing as much as a thousand fold from the estimates of working engineers. *"For a successful technology"*, he concluded, *"reality must take precedence over public relations, because nature cannot be fooled"*.

2.6.4A Use as Case Study

The *Challenger* accident has frequently been used as a case study in the study of subjects such as engineering safety, the ethics of whistle-blowing, communications, group decision-making, and the dangers of groupthink. It is part of the required readings for engineers seeking a professional license in Canada and other countries. Roger Boisjoly, the engineer who had warned about the effect of cold weather on the O-rings, left his job at Morton Thiokol and became a speaker on workplace ethics. He argues that the caucus called by Morton Thiokol managers, which resulted in a recommendation to launch, *"constituted the uncthical decision-making forum resulting from intense customer intimidation."* For his honesty and integrity leading up to and directly following the shuttle disaster, Roger Boisjoly was awarded the Prize for Scientific Freedom and Responsibility from the American Association for the Advancement of Science. Many colleges and universities have also used the accident in classes on the ethics of engineering.

SUMMARY

- *In March 1970, reusable space shuttle became the focus of NASA's team for the multi- objective space plan. This decision significantly shaped NASA's goals for the future and increased the pressure on it perhaps at the expenses of engineering considerations, so much so, that at one point proposing 714 flights between 1978 and 1990, setting the stage for the challenger explosion. The genesis of the Challenger accident was the failure of the joint of the right solid rocket motor. While NASA worked on solving the problem, it continued with determination to fly, and defined the risk as "acceptable" and "unavoidable." The Space Shuttle Challenger-disaster occurred on January 28, 1986, when it broke apart 73 seconds into its flight, leading to the deaths of its seven crew members. Disintegration of the vehicle began after an O-ring seal in its right solid rocket booster (SRB) failed at liftoff. The O-ring failure caused a breach in the SRB joint it sealed, which led to the structural failure of the external tank. Aerodynamic forces broke up the orbiter. NASA managers knew a potentially catastrophic flaw in the O-rings since 1977, but failed to address it properly. They also disregarded warnings from engineers about the dangers posed by the low temperatures on the morning of launching date. Rogers Commission formed to investigate the disaster worked for several months and it found that the Challenger accident was caused by a failure in the O-rings used for sealing a joint on the right solid rocket booster. The Challenger accident has frequently been used as a case study in the study of subjects such as engineering safety, the ethics of whistle-blowing, communications, group decision-making, and the dangers of groupthink.*

Short Question Answers

1. *How was NASA pressurized to develop a space shuttle ?*

   Ans. In March 1970, President Nixon ordered the development of the reusable space shuttle, earlier considered only the transport element of a broad, multi-objective space plan, became the focus of NASA's team for the near future. This decision forced NASA to prove and create an operational shuttle system by instituting a heavy schedule of flights.

   President Ronald Reagan's administration was eager for the shuttle system to become operational because it had developed some rather ambitions commercial and military goals for NASA. Pressures developed because of the need to meet customer's commitments, so much so, that at one point proposing 714 flights between 1978 and 1990, setting the stage for the challenger explosion.

2. *Write the cause which lead to the joint seal failure.*

   Ans. The genesis of the Challenger accident was the failure of the joint of the right solid rocket motor. While NASA worked on solving the problem, it continued with determination to fly, and defined the risk as "*acceptable*" and "*unavoidable.*" An O-ring seal in its right solid rocket booster (SRB) failed at liftoff which caused a breach in the SRB joint it sealed, allowing pressurized hot gas from within the solid rocket motor to reach outside

and impinge upon the adjacent SRB attachment hardware and external fuel tank. This led to the separation of the right-hand SRB's aft attachment and the structural failure of the external tank. Aerodynamic forces broke up the orbiter.

3. *Describe in brief the findings of Rogers Commission on space shuttle disaster.*

   Ans. The Presidential Commission on the Space Shuttle Challenger Accident found that the Challenger accident was caused by a failure in the O-rings used for sealing a joint on the right solid rocket booster, which unluckily allowed pressurized hot gases and eventually flame to "blow by" the O-ring and make contact with the adjacent external tank, causing structural failure. The failure of the O-rings was attributed to a faulty design known since 1977, whose performance was easily compromised by factors including the low temperature on the day of launch. The report also strongly criticized the decision-making process that led to the launch of Challenger, stating that it was seriously flawed. Failures in communication resulted in a decision to launch the shuttle based on (*i*) incomplete and sometimes misleading information, (*ii*) a conflict between engineering data and management judgments, and (*iii*) a NASA management structure that permitted internal flight safety problems to bypass key Shuttle managers.

Exercise

1. Describe the story about challenger accident.
2. How was very low temperature responsible to the space shuttle disaster ?
3. Why and how do you think that space shuttle disaster should be considered for use as a case study by professionals ?

CHAPTER 3

Globalization and MNCs

3.1 GLOBALIZATION

Humans have interacted with one another over long distances for thousands of years. The overland Silk Road that connected Asia, Africa, and Europe is a good example of the transformative power of trans-local exchange that existed in the *"Old World"*. Philosophy, religion, language, arts, and other aspects of culture spread and mixed as nations exchanged products and ideas. In the 15th and 16th centuries, Europeans made important discoveries in their exploration of the oceans, including the start of transatlantic travel to the *"New World"* of the Americas. Global movement of people, goods, and ideas expanded significantly in the following centuries. Early in the 19th century, the development of new forms of transportation (such as the steamship and railroads) and telecommunications that *"compressed"* time and space allowed for increasingly rapid rates of global interchange. In the 20th century, road vehicles, intermodal transport, and airlines made transportation even faster. The advent of electronic communications, most notably mobile phones and the Internet, connected billions of people in new ways by the year 2010.

The term globalisation refers to the process of escalating the connectivity and interdependence of the world's markets and businesses. This term can also be defined as the rising global relationships of culture, people and economic activities, with a worldwide movement toward economic, financial, trade, and communications integration. It is the process of international integration arising from the interchange of world views, products, ideas and other aspects of culture. Advances in transportation and telecommunication infrastructure, including the rise of the telegraph and its posterity in the Internet, are major factors in globalization, generating further interdependence of economic and cultural activities.

Globalization implies the opening of local and nationalistic perspective to a broader outlook of an interconnected and interdependent world with free transfer of capital, goods, and services across national frontiers. However, it does not include unhindered movement of labour and, as suggested by some economist, may hurt smaller or fragile economies if applied indiscriminately. Globalization is the tendency of investment of funds and movement of businesses beyond domestic and national markets to other markets around the globe, thereby increasing the interconnectedness of different markets. It has had the effect of markedly increasing not only international trade, but also cultural exchange.

Globalization approached its modern form as a result of the industrial revolution. Industrialization allowed standardized production of household items using economies of the state, while rapid population growth created sustained demand for commodities. Globalization in this period was decisively shaped by nineteenth-century imperialism. In the 19th century, steamships reduced the cost of international transport significantly and railroads made inland transport cheaper. The transport revolution occurred some time between 1820 and 1850. More nations embraced international trade. Globalization in this period was decisively shaped by nineteenth-century imperialism such as in Africa and Asia. The invention of shipping containers in 1956 helped advance the globalization of commerce.

After the Second World War, work by politicians led to the Bretton Woods conference, an agreement by major governments to lay down the framework for international monetary policy, commerce and finance and the founding of several international institutions intended to facilitate economic growth with opening and simplification of multiple rounds of trade and lowered trade barriers. Initially, the General Agreement on Tariffs and Trade (GATT), led to a series of agreements to remove trade restrictions. GATT's successor was the World Trade Organization (WTO), which created an institution to manage the trading system. Exports nearly doubled from 8.5% of total gross world product in 1970 to 16.2% in 2001. The approach of using global agreements to advance trade stumbled with the failure of the Doha round of trade-negotiation. Many countries then shifted to bilateral or smaller multilateral agreements, such as the 2011 South Korea-United States Free Agreement.

Since the 1970s, aviation has become increasingly affordable to middle classes in developed countries. Open skies policies and low-cost carriers have helped to bring competition to the market. In the 1990s, the growth of low cost communication networks cut the cost of communicating between different countries. More work can be performed using a computer without regard to location. This includes accounting, software development, and engineering design.

In the late 19th century and early 20th century, the connectedness of the world's economies and cultures grew very quickly. This slowed down from the 1910s onward due to the World Wars and the Cold War, but picked up again with the neoliberal policies of the 1980s. Perestroika and the Chinese economic reforms of Deng Xiaoping opened the old Eastern Bloc to western capitalism. Private capital flow to developing countries soared during the 1990s, replacing *"aid"* or *"development assistance"* which fell significantly after the early 1980s. Foreign Direct Investment (FDI) became the most important category. Both portfolio investment and bank credit rose but they have been more volatile, falling sharply in the wake

of the financial crisis of the late 1990s. The migration and movement of people can also be highlighted as a prominent feature of the globalization process. In the period between 1965–90, the proportion of the labour force migrating approximately doubled. Most migration occurred between developing countries and Least Developed Countries.

The growth of international trade is a fundamental component of globalization. An absolute trade advantage exists when countries can produce a commodity with less cost per unit produced than could its trading partner. By the same reasoning, it should import commodities in which it has an absolute advantage. While the trade with absolute advantage is possible but the ability to offer goods and services at a lower marginal and opportunity cost extends the range of possible mutually beneficial exchanges. In a globalized business environment, companies argue that the comparative advantages offered by international trade have become essential to remain competitive.

The advantages and disadvantages of globalization have been heavily scrutinized and debated in recent years. Proponents of globalization say that it helps developing nations "catch up" to industrialized nations much faster through increased employment and technological advances. Critics of globalization say that it weakens national sovereignty and allows rich nations to ship domestic jobs overseas where labour is much cheaper.

3.1.1 Multinational Corporation (MNC)

International business arrangements have led to the formation of multinational enterprises (MNE), companies that have a worldwide approach to markets and production or one with operations in more than one country. A MNE may also be called a multinational corporation (MNC) or transnational company (TNC). Well known MNCs include fast food companies such as McDonald's and Yum Brands, vehicle manufacturers such as General Motors, Ford Motor Company and Toyota, consumer electronics companies like Samsung, LG and Sony, and energy companies such as ExxonMobil, Shell and BP. Most of the largest corporations operate in multiple national markets.

Business companies generally argue that survival in the new global marketplace requires companies to source goods, services, labour and materials overseas to continuously upgrade their products and technology in order to survive increased competition. According to a recent McKinsey Global Institute report, flows of goods, services, and finance reached $26 trillion in 2012, or 36 % of global GDP *i.e.*, 1.5 times the level in 1990.

3.1.2 Overall Effect of Globalisation on Earth

(*i*) ***Trade agreements and Special Economic Zones (SEZ) for international trade.*** The category 'SEZ' covers many areas, including Free Trade Zones (FTZ), Export Processing Zones (EPZ), Free Zones (FZ), Industrial parks or Industrial Estates (IE), Free Ports, Urban Enterprise Zones and others. Usually the goal of a structure is to increase foreign direct investment by foreign investors, typically an international business or a multinational corporation (MNC). These are designated areas in which companies are taxed very lightly or

not at all in order to encourage economic activity. Free ports have historically been endowed with favourable customs regulations, *e.g.*, the free port of Trieste. Very often free ports constitute a part of free economic zones.

A FTZ is an area within which goods may be landed, handled, manufactured or reconfigured, and re-exported without the intervention of the customs authorities. Only when the goods are moved to consumers within the country in which the zone is located do they become subject to the prevailing customs duties.

(*ii*) ***Global Tourism.*** Globalization has made tourism a popular global leisure activity. It is estimated that up to 500,000 people are in flight at any one time. Tourism is travelling for recreational, leisure or business purposes. The World Tourism Organization World Tourism organization defines tourists as people "*travelling to and staying in places outside their usual environment for not more than one consecutive year for leisure, business and other purposes*". There are many forms of tourism such as agritourism, birth tourism, culinary tourism, cultural tourism, eco-tourism, extreme tourism, geo tourism, heritage tourism, LGBT tourism, medical tourism, nautical tourism, pop-culture tourism, religious tourism, slum tourism, war tourism and wildlife tourism etc.

(*iii*) ***Global Sports Activities.*** Globalization has continually increased international competition in sports. International sports events can be big business for as well as influencing the political, economical, and other cultural aspects of countries around the world. Especially with politics and sports, sports can affect countries, their identities, and in consequences. For example, the FIFA World Cup is the world's most widely viewed sporting event. Some economists are sceptical about the economic benefits of hosting the Olympic Games, emphasizing that such "*mega-events*" often have large costs for hosting, however the Olympics appear to increase the host country's exports, as the host or candidate country sends a signal about trade openness when bidding to host the Games.

SUMMARY

- *The term globalization refers to the process of escalating the connectivity and interdependence of the world's markets and businesses. Humans have interacted with one another overland long distance for thousands of years in the old world. Development of new forms of transportation and telecommunications movement of people and goods expanded significantly in the following centuries increasingly rapid rates of global interchange. Globalization approached its modern form as a result of the industrial revolution. Globalization is the tendency of investment of funds and movement of businesses beyond domestic and national markets. General Agreement on Tariffs and Trade (GATT), led to a series of agreements to remove trade restrictions. GATT's successor was the World Trade Organization (WTO), which created an institution to manage the trading system. After the early 1980s, Foreign Direct Investment (FDI) became the most important category. Both portfolio investment and bank credit rose. The growth of international trade is a fundamental component of globalization. An absolute trade advantage exists when countries can produce a commodity with less cost per unit produced than could its trading partner. By the same reasoning, it should import commodities in which it has an absolute advantage. Critics of globalization say that it weakens national sovereignty and allows rich nations to ship domestic jobs overseas where labour is much cheapers.*

- *International business arrangements have led to the formation of Multinational companies / Corporation (MNC) that have a worldwide approach to markets and production or one with operations in more than one country. Most of the largest corporations operate in multiple national markets. Business companies generally argue that survival in the new global marketplace requires companies to source goods, services, labour and materials overseas to continuously upgrade their products and technology in order to survive increased competition.*

Short Question Answers

1. *Describe globalization in the context of "Old World".*

   Ans. The overland Silk Road that connected Asia, Africa, and Europe is a good example of the transformative power of trans-local exchange that existed in the *"Old World"*. The two trading parties were far away and it was very time consuming and difficult to have business trade in old days. In the 20th century development of new forms of transportation like, road vehicles, intermodal transport, and airlines along with the advent of electronic communications has connected billions of people in new ways. The people in the whole globe have come so closer that the earth can be called a big village where accessibility to any trading partner is a job of few minutes.

2. *Describe the modern form of globalization.*

   Ans. Development of new forms of transportation and telecommunications movement of people and goods expanded significantly in the following centuries increasingly rapid rates of global interchange. Globalization approached its modern form as a result of the industrial revolution. Globalization is the tendency of investment of funds and movement of businesses beyond domestic and national markets.

3. *Discuss the advantage and disadvantages of globalization.*

   Ans. Globalization refers to the process of escalating the connectivity and interdependence of the world's markets and businesses. This term can also be defined as the rising global relationships of culture, people and economic activities, with a worldwide movement toward economic, financial, trade, and communications integration. Globalization implies the opening of local and nationalistic perspective to a broader outlook of an interconnected and interdependent world with free transfer of capital, goods, and services across national frontiers. Globalization approached its modern form as a result of the industrial revolution. Industrialization allowed standardized production of household items using economies of the state, while rapid population growth created sustained demand for commodities.

Exercise

1. How has General Agreement on Tariffs and Trade (GATT) and world trade organization (WTO) helped the world trade and economy ?
2. Name few multinational companies and describe impact on world economy.
3. Describe the overall effect of globalization on earth.

3.2 CASE STUDIES

3.2.1 Satyam Computers

History

Satyam Computers Services Ltd. was one of the leading global consulting and IT services company that offered end-to-end IT solutions for a range of key verticals and horizontals. Satyam Computers had domain expertise in verticals such as Automotive, Banking and Financial Service, Insurance and Healthcare, Manufacturing, Telecom, Infrastructure, Media, Entertainment and Semiconductors.

Satyam had nearly 40,000 employees on its rolls, working in development centers in India, USA, UK, UAE, Canada, Hungary, Singapore, Malaysia, China, Japan and Australia. Satyam Computers' network was spread over 55 countries across 6 continents. Satyam served over 558 global companies including over 163 Fortune 500 corporations.

Satyam Computers was founded in June 1977 as a private limited company by RamalingaRaju along with one of his brothers-in-law, D. V. S Raju. In June 1991, Satyam Computers got its first Fortune 500 Client. In the same year in August, Satyam Computers was recognized as a Public Limited Company. Satyam went public in May 1992 and its issue was oversubscribed 17 times. In July 1993, Satyam entered into a joint venture with Dun and Bradstreet. Satyam was awarded ISO 9001 Certification in March 1995. In December 1995, Satyam Infoway was incorporated. In May 1997, Satyam became the first Indian IT Company to get ITAA Certification for Y2K Solutions. In November 1998, Satyam became one of the first companies to enter Indian Internet service market with the launch of Satyam Infoway's ISP Service. In the same year Satyam entered into a joint venture with GE. In 1999, Satyam Infoway became the first Indian Internet company to be listed on NASDAQ. In February 2000 Satyam was declared one of '100 Most Pioneering Technology Companies' by World Economic Forum, Davos. In May 2000 Satyam became the first organization in the world to launch Customer-Oriented training for Global Organizations. In March 2001 Satyam became first ISO 9001:2000 Company certified by BVQI in the world. In May 2001 Satyam was listed on New York Stock Exchange. In 2003, Satyam announced business continuity center in Singapore, the first of its kind outside India. In 2004, Satyam opened new development center in Mississauga, Canada. In 2005 Satyam acquired 100% stake in Singapore based Knowledge Dynamics, a leading Data Warehousing and Business Intelligence solutions provider.

Satyam Computer Services Scandal

In 2009 company chairman RamalingaRaju confessed that the company's accounts had been falsified. The Global corporate community was shocked and scandalised when the chairman of Satyam, RamalingaRaju resigned on 7 January 2009 and confessed that he had manipulated the accounts by US$1.47-Billion. RamalingamRaju along with 2 other accused of the scandal, were arrested two days after he admitted the scandal but later on were granted bail from Supreme court as the investigation agency CBI failed to file the chargesheet even after more than 33 months Raju was arrested.

Raju had appointed a task force to address the Maytas situation in the last few days before revealing the news of the accounting fraud. After the scandal broke, the then-board members elected Ram Mynampati to be Satyam's interim CEO.

On 10th January 2009, the Company Law Board decided to bar the current board of Satyam from functioning and appoint 10 nominal directors. On the same day, the Crime Investigation Department (CID) team arrested VadlamaniSrinivas, Satyam's then-CFO. Chartered accountants regulator ICAI issued show-cause notice to Satyam's auditor PricewaterhouseCoopers (PwC) to reply with in 21 days about the accounts fudging. On 11th January 2009, the government nominated noted banker Deepak Parekh, former NASSCOM chief KiranKarnik and former SEBI member C. Achuthan tos Satyam's board.

PricewaterhouseCoopers was the statutory auditor of Satyam Computer Services when the report of scandal in the account books of Satyam Computer Services broke. The Indian arm of PwC was fined $6 million by the SEC (US Securities and Exchange Commission) for not following the code of conduct and auditing standards in the performance of its duties related to the auditing of the accounts of Satyam Computer Services.

Immediately following the news, Merrill Lynch (now a part of Bank of America) and State Farm Insurance terminated its engagement with the company. Apart from it, Suisse also suspended its coverage of Satyam. It was also reported that Satyam's auditing firm PricewaterhouseCoopers will be scrutinized for complicity in this scandal. SEBI, the stock market regulator, also said that, if found guilty, its license to work in India may be revoked. Satyam was the 2008 winner of the coveted Golden Peacock Award for Corporate Governance under Risk Management and Compliance Issues, which was stripped from them in the aftermath of the scandal. The New York Stock Exchange halted trading in Satyam stock w.e.f. 7th January 2009. India's National Stock Exchange announced that it will remove Satyam from its SandP CNX Nifty 50-share index w.e.f. 12th January. Satyam's shares fell to 11.50 rupees on 10th January 2009, their lowest level since March 1998, compared to a high of 544 rupees in 2008.

On 22nd January 2009, CID informed the court that the actual number of employees in Satyam were only 40,000 and not 53,000 as reported earlier and that Mr.Raju had been allegedly causing fraud by withdrawing ₹200 million (US$3 million) every month for paying these 13,000 non-existent employee.

Acquisition by Mahindra Group

On 13 April 2009, via a formal public auction process, a 46% stake in Satyam was purchased by Tech Mahindra, a Mahindra and Mahindra owned company. Effective July 2009, Satyam rebranded its services under the new Mahindra management as *"Mahindra Satyam"*. After a delay due to tax issues. Mahindra announced its merger with Mahindra Satyam on 21 March 2012, after the board of two companies gave the approval.

SUMMARY

- *Satyam Computers' founded in June 1977 as a private limited company was one of the leading global consulting and IT services company having network spread over 55 countries across 6 continents had nearly 40,000 employees on its rolls. It offered end-to-end IT solutions for a range of key verticals and horizontals, such as Automotive, Banking and Financial Service, Insurance and Healthcare, Manufacturing, Telecom, Infrastructure, Media, Entertainment and Semiconductors. Satyam went public in May 1992 and its issue was oversubscribed 17 times. In December 1995, Satyam Infoway was incorporated which became the first Indian Internet company to be listed on NASDAQ. In February 2000 Satyam was declared one of '**100 Most Pioneering Technology Companies**' by World Economic Forum, Davos. In May 2001 Satyam was listed on New York Stock Exchange. Company chairman RamalingaRaju resigned on 7 January 2009 and confessed that he had manipulated the accounts by US$1.47-Billion. It was reported that Mr.Raju had been allegedly causing fraud by withdrawing ₹200 million (US$3 million) every month for paying these 13,000 non-existent employees.*

Short Question Answers

1. *Write in brief the business domains of Satyam Computers.*

   Ans. Satyam Computers had domain expertise in verticals such as Automotive, Banking and Financial Service, Insurance and Healthcare, Manufacturing, Telecom, Infrastructure, Media, Entertainment and Semiconductors.

2. *From a modest Indian private company Satyam Computers was listed on New York stock exchange in year 2003, explain how ?*

   Ans. Satyam Computers was founded in June 1977 as a private limited company by RamalingaRaju. Satyam went public in May 1992 and its issue was oversubscribed 17 times. In December 1995, Satyam Infoway was incorporated. In December 1995, Satyam Infoway was incorporated which became the first Indian Internet company to be listed on NASDAQ. In February 2000 Satyam was declared one of '100 Most Pioneering Technology Companies' by World Economic Forum, Davos. In May 2001 Satyam was listed on New York Stock Exchange.

3. *Where were the development centers set up by Satyam Computers ?*

   Ans. Satyam, working in development centers in India, USA, UK, UAE, Canada, Hungary, Singapore, Malaysia, China, Japan and Australia. Satyam Computers' network was spread in over 55 countries across 6 continents. Satyam served over 558 global companies including over 163 Fortune 500 corporations.

Exercise

1. Explain the dimensions of financial fraud in Satyam Computers Services.
2. What was modus operandi of M.D. of Satyam Computers to cause fraud of millions of rupees per month ?
3. What is the present status of Satyam Computers ?

3.2.2 Infosys Ltd. and Infosys Foundation

3.2.2A Infosys Ltd.

In 1981 Infosys Ltd. was incorporated as *"Infosys Consultants Pvt. Ltd."* with a capital of ₹10,000 (roughly $250) in Pune. It changed its name to *"Infosys Technologies Private Limited"* in April 1992 and to *"Infosys Technologies Limited"* when it became a public limited company in June 1992. It was later renamed to *"Infosys Limited"* in June 2011.

Infosys Ltd. is an Indian multinational corporation that provides business consulting, information technology, software engineering and outsourcing services. It is headquartered in Bangalore, Karnataka. Infosys is the third-largest India-based IT services company, and the fifth largest employer of professionals in the United States. On 31st March 2014, its market capitalization was ₹188,510 crores ($31.11 billion), making it India's fifth largest publicly traded company.

Infosys made an initial public offer (IPO) in February 1993 with an offer price of ₹98 per share against book value of ₹10 per share. The Infosys IPO was under subscribed but it was *"bailed out"* by US investment bank Morgan Stanley which picked up 13% of equity at the offer price. Its shares were listed in stock exchanges in June 1993 with trading opening at ₹145 per share. In October 1994, it made a private placement of 5,50,000 shares at ₹450 each against book value of ₹10 per share to Foreign Institutional Investors (FIIs), Financial Institutions (FIs) and Corporates. The share price surged to ₹8,100 by 1999 making it the costliest share on the market at the time. At that time, Infosys was among the 20 biggest companies by market capitalization on the NASDAQ. In December 2012, Infosys transferred the listing of its Shares from the NASDAQ to the NYSE (New York Stock Exchange). The credit rating of the company is A- (given by Standard and Poor's in Dec. 2013)

Infosys has a global presence with 72 offices and 94 development centers in the United States, India, China, Australia, Japan, Middle East and Europe. Recently, Infosys has begun shifting operations to the United States and other countries. In 2012, Infosys announced a new office in Milwaukee, Wisconsin to service Harley-Devidson, being the 18th international office in the United States.

Products and Services

It provides software development, maintenance and independent validation services to companies in banking, finance, insurance, manufacturing and other domains. One of its known products is Finacle which is a universal banking solution with various modules for retail and corporate banking.

Academic Relations

Infosys' Global Academic Relations team forges Academic Entente with academic and partner institutions. It explores co-creation opportunities between Infosys and academia through case studies, student trips and speaking engagements. They also collaborate on

technology, emerging economies, globalization, and research. Some initiatives include research collaborations, publications, conferences and speaking sessions, campus visits and campus hiring.

Infosys gives annual awards to scientists, researchers, engineers and social scientists in India. It is given by the Infosys Science Foundation, a not-for-profit trust which was set up in February 2009 by Infosys and some members of its Board. The prize is given under six categories. Each category includes a gold medallion, a citation certificate, and a prize money of ₹55 Lakh.

Infosys has a total of 160,405 employees as on 31 March 2014. Its workforce consists of employees representing 89 nationalities working from 32 countries. Out of its total workforce, 79% are software professionals.

Awards and Recognitions

- Infosys was ranked 15th largest IT services provider in the world by HFS Research in its 2013 ranking.
- Infosys was ranked #19 amongst the world's most innovative companies by Forbes.
- Infosys was ranked number one among the best managed companies in Asia Pacific.
- Infosys was identified as one of the top 25 performers in Caring for Climate Initiative by UN Global Environment Program.
- It won the Oracle Excellence Award for Specialized Partner of the Year, in both Financial Management and Human Capital Management categories.
- Boston Consulting Group has listed it in the list of top ten technology companies.
- Company's corporate governance practices were recognized by The Asset Platinum award and the IR Global Rankings. In 2014 Infosys was also ranked as the most trusted Software Services brand in India by The Brand Trust Report 2014.

3.2.2B Controversies

In 2011, Infosys was accused of committing visa fraud by using B-1 (visitor) for work requiring H-1B (work) visas. The allegations were initially made by an American employee of Infosys in an internal complaint. He subsequently sued the company, claiming that he was harassed and sidelined after speaking out. Although that case was dismissed, it along with another similar case, brought the allegations to the notice of the US authorities and the U.S. Department of Homeland Security and a federal grand jury started investigating.

In October 2013, Infosys agreed to settle the civil suit with US authorities by paying US$34 million. Infosys refused to admit guilt and stressed that it only agreed to pay the fine to avoid the nuisance of 'prolonged litigation'. In its statement the company said "As reflected in the settlement, Infosys denies and disputes any claims of systematic visa fraud, misuse of visas for competitive advantage, or immigration abuse.

In July 2014 Former US employees of Infosys filed a lawsuit against it for alleging discrimination because of their inability to communicate in Hindi. According to the lawsuit filed in the US District Court of Eastern District of Wisconsin, the former employees alleged that they were *"excluded"* from work conversations by their supervisors and co-workers who *"regularly spoke in Hindi"* in front of them. The case has been filed by Layla Bolten, Gregor Handloser and two more employees. Bolten was hired as a tester, while Handloser was hired by Infosys in 2004 as a sales manager.

3.2.2C Infosys Foundation

In 1996, Infosys established the Infosys Foundation, to support the underprivileged sections of society. At the outset, the Infosys foundation implemented programs in Karnataka. It subsequently covered Tamil Nadu, Andhra Pradesh, Maharashtra, Odisha and Punjab in a phased manner. A team at the Foundation identifies programs in the areas of Healthcare, Education, Culture, Destitute Care and Rural Development.

'Infosys Foundation came into being with the objective of supporting the underprivileged in our society. The Foundation Trustees comprise of Ms. Sudha Murty (an educationist, a writer and a computer engineer), Chairperson ; Mr. Sudha Gopalkrishnan and Mr. Srinath Batni (Director, Infosys Technologies Ltd.). The Foundation primarily aims at improving the health, education and basic facilities, benefiting a large number of individuals and institutions.' By March 31, 2004 the foundation has given grants totaling about 40 crore rupees. At the end of 2004, the market value of Infosys was over 56,000 crore rupees. It means that it contributed less than 0.1 percent of its market value wealth to Infosys Foundation over the past 8 years. Murthy family who held about 7.5 percent of Infosys shares during this period, contributed Infosys Foundation about 3 crore rupees (7.5 percent of 40 crores).

Benefits of *'Charity'* to Infosys

(i) ***Investors.*** 'The leading world companies prefer investing in Indian companies that have defined social responsibility cells.'

(ii) ***Branding.*** Helps to attract good employees and keep attrition rate low.

(iii) ***'Purchasing Goodwill'.*** Many customers prefer to do business with companies perceived to have social responsibilities. Government officials are receptive to new requests for more land etc.

(iv) ***Association with the famous.*** They are going to benefit out of associating their names with Tata family or Bill Gates, by mentioning them as often as possible.

SUMMARY

- *Infosys Ltd. is an Indian multinational corporation that provides business consulting, information technology, software engineering and outsourcing services. It was incorporated as "Infosys Consultants Pvt Ltd" in the year 1981 with a capital of ₹10000 only, however with progress and time in December 2012, Infosys transferred the listing of its Shares from the NASDAQ to the NYSE (New York Stock Exchange). It provides software development, maintenance and independent validation services to companies in banking, finance, insurance, manufacturing and other domains. One of its known products is Finacle which is a universal banking solution with various modules for retail and corporate banking.*
- *In 1996, Infosys established the Infosys Foundation, to support the underprivileged sections of society. A team at the Foundation identifies programs in the areas of Healthcare, Education, Culture, Destitute Care and Rural Development in six states in India. The Foundation Trustees comprise of Ms. Sudha Murty (an educationist, a writer and a computer engineer), Chairperson ; Mr. Sudha Gopalkrishnan and Mr. Srinath Batni (Director, Infosys Technologies Ltd.). The Foundation primarily aims at improving the health, education and basic facilities, benefiting a large number of individuals and institutions.' By March 31, 2004 the foundation has given grants totaling about 40 crore rupees. Charity of Infosys Ltd. through Infosys Foundation gave it benefits on account of its impacts on 'investors', 'Branding as good employer', 'Purchasing Goodwill of customers and Govt. officials' and 'Association with the famous names like Tata families and Bill Gates'.*

Short Question Answers

1. *Write the products and services of business of Infosys Ltd. which made it one of India's largest company while traverse from the year 1981 onwards.*

   Ans. It provides software development, maintenance and independent validation services to companies in banking, finance, insurance, manufacturing and other domains. One of its known products is Finacle which is a universal banking solution with various modules for retail and corporate banking.

2. *Describe the academic relations of Infosys Ltd. with other global academic partners.*

   Ans. It explores co-creation opportunities between Infosys and academia through case studies, student trips and speaking engagements. They also collaborate on technology, emerging economies, globalization, and research. Some initiatives include research collaborations, publications, conferences and speaking sessions, campus visits and campus hiring. Infosys gives annual awards to scientists, researchers, engineers and social scientists in India.

Exercise

1. Name the awards and recognitions earned by Infosys Ltd.
2. Describe the activities and programmes of Infosys Foundation.
3. Infosys earned benefits of charity, name them.

3.2.3 Tata Group of Companies

The Tata group comprises of over 100 operating companies in seven business sectors: communications and information technology, engineering, materials, services, energy, consumer products and chemicals. The group has operations in more than 100 countries across six continents, and its companies export products and services to 150 countries.

The Tata name has been respected in India for more than 140 years for its adherence to strong values and business ethics. The group has always believed in returning wealth to the society they serve. Two-thirds of the equity of Tata Sons, the Tata promoter holding company, is held by philanthropic trusts that have created national institutions for science and technology, medical research, social studies and the performing arts.

Tata Group was founded in 1868 by Jamseji Tata as a trading company. Tata Group remains a family-owned business, as the descendants of the founder (from the Tata family) own a majority stake in the company. The current chairman of the Tata group is Cyrus Pallonji Mistry, who took over from Ratan Tata in 2012. The role played by Mr. Ratan Tata and Mr. JRD Tata in making the group truly global has been deservedly recognized all over the world. The Tata Group and its companies and enterprises is perceived to be India's best-known global brand within and outside the country. The national and international recognition of the TATA group of industries can be envisaged from the fact that apart from it only few other Indian companies *e.g.*, Infosys Technologies, Wipro, Mahindra and Mahindra and Aditya Birla Group were the other major Indian corporate houses listed to have made their mark on the global business landscape. The major Tata companies are Tata Steel, Tata Motors, Tata Consultancy Services (TCS), Tata Power, Tata Chemicals, Tata Global Beverages, Tata Teleservices, Titan Industries, Tata Communications and Taj Hotels.

In a 2011 investor poll conducted by equity research firm Equity master, TATA Group was voted as the most trustworthy among the Indian corporate houses. Over 61% of the respondents "*showed their confidence in the Tata Group*". The Tata Group retained its "Most Trustworthy" status in the quality and the popularity of Tata brand products, which is quite evident from the following table :

Year	*Global Rank in top 500 companies*	*Global Rank in top 250 companies*	*India Rank in top 100 companies*	*India Rank in top 50 companies*
2014	34		1	
2013	39			1
2012	45			
2011	50			
2010	53			
2009	51			
2008	57			
2007		100		

India has an old religious tradition of philanthropy, passed on down the ages by kings, noblemen and rich merchants. Jamsetji Tata, the founder of the Tata Group, gave new meaning to this term. In his words : "*There is one kind of charity common enough among us. It is that patchwork philanthropy which clothes the ragged, feeds the poor, and heals the sick. I am far from decrying the noble spirit which seeks to help a poor or suffering fellow being. What advance a nation or a community is not so much to prop up its weakest and most helpless members, but to lift up the best and the most gifted, so as to make them of the greatest service to the country.*" This was the sentiment which led Jamsetji Tata to establish the JN. Tata Endowment Scheme for higher education in 1892. The scheme helped bright Indian students of moderate means to become administrators, scientists, doctors, lawyers and engineers, by funding their education through loans and grants.

The Sir Dorabji Tata Trust is best known for promoting six pioneering institutions of national importance. Four of these were established in Mumbai: the Tata Institute of Social Sciences, in 1936 ; The Tata Memorial Centre for Cancer Research and Treatment, in 1941 ; the Tata Institute of Fundamental Research, in 1945 ; and the National Centre for the Performing Arts, in 1966. The National Institute of Advanced Studies (set up in 1988) and the Sir Dorabji Tata Centre for Research in Tropical Diseases (1999) are in Bangalore. The trusts do not usually encourage or consider supporting projects run by Tata companies. The trustees' are of the view that if a company has started something then it should sustain itself through its own funds, instead of asking the trusts for financial support.

3.2.3A Controversies

The Tata group has also attracted several controversies and criticisms, including the following as mentioned below :

(*i*) The Kerala Government had filed an affidavit in the high court saying that Tata Tea had '*grabbed*' forest land of 3,000 acres (12 km^2) at Munnar. The Tatas, on the other hand, say they prosses 58,741.82 acres (237.7197 km^2) of land, which they are allowed to retain under the Kannan Devan Hill (Resumption of Lands) Act, 1971, and there is still a shortage of 278.23 hectares in that.

(*ii*) Tata Motors were reported to have supplied hardware and automobiles to Burma's oppressive and anti-democratic military junta which has come in for criticism from human rights and democracy activists.

(*iii*) The Singur controversy in West Bengal led to further questions over Tata's social record, with protests by locals and political parties (though the involvement of Mamata Banerjee's party is widely criticized as an act for political gains) over the forced acquisition, eviction and inadequate compensation to those farmers displaced for the Tata Nano plant. As the protests grew, Tata eventually pulled the project out of West Bengal, citing safety concerns.

(*iv*) The Dhamra port, a venture between Tata Steel and Larsen and Toubro, has come in for criticism for its proximity to the Gahirmatha Sanctuary and Bhitarkanika National Park, from Indian and international organizations, including Greenpeace. Gahirmatha Beach is one of the world's largest mass nesting sites for the Olive Ridley Turtle and Bhitarkanikais a designated Ramsar site and India's second largest mangrover forest.

(v) Tata group, along with a Tanzanian company, joined forces to build a soda ash extraction plant in Tanzania. The Tanzania government is all for the project. On the other hand, environmental activists are opposing the plant because it would be near Lake Natron, and it could possibly affect the lake's ecosystem and its neighbouring dwellers.

SUMMARY

- *Tata Group was founded in 1868 by Jamseji Tata as a trading company. It remains a family-owned business, of descendants of the founder. The Tata name has been respected in India for more than 140 years for its adherence to strong values and business ethics. It comprises of over 100 operating companies in seven business sectors i.e., communications and information technology, engineering, materials, services, energy, consumer products and chemicals. The major Tata companies are Tata Steel, Tata Motors, Tata Consultancy Services (TCS), Tata Power, Tata Chemicals, Tata Global Beverages, Tata Teleservices, Titan Industries, Tata Communications and Taj Hotels. The role played by Mr. Ratan Tata and Mr. JRD Tata in making the group truly global has been deservedly recognized all over the world. Jamsetji Tata established the Tata Endowment Scheme for higher education in 1892, which has helped bright Indian students of moderate means to become administrators, scientists, doctors, lawyers and engineers, by funding their education through loans and grants. The Sir Dorabji Tata Trust is best known for promoting six pioneering institutions of national importance. The current chairman of the Tata group is Cyrus Pallonji Mistry, who took over from Ratan Tata in 2012.*

Short Question Answers

1. *Introduce the Tata Group of Companies and list the names of companies.*

   Ans. Tata Group was founded in 1868 by Jamseji Tata as a trading company. It remains a family-owned business, of descendants of the founder. The major Tata companies are Tata Steel, Tata Motors, Tata Consultancy Services (TCS), Tata Power, Tata Chemicals, Tata Global Beverages, Tata Teleservices, Titan Industries, Tata Communications and Taj Hotels.

2. *How do you envisage recognition given to TATA group at national and international level ?*

   Ans. The national and international recognition of the TATA group of industries can be envisaged from the fact that apart from it only few other Indian companies *e.g.*, Infosys Technologies, Wipro, Mahindra and Mahindra and Aditya Birls Group were the other major Indian corporate houses listed to have made their mark on the global business landscape.

Exercise

1. How is Sir Dorabji Tata Trust famous, explain it's achievements ?
2. Tata group has had a very long innings with many controversies, name a few of them.
3. What were the views of founder of the TATA Group, on charity ?

3.3 BUSINESS ETHICS

Business Ethics are essential for the long-term success of an organization. Implementing an ethical programme will foster a successful company culture and increase profitability. Developing a Business Ethics programme takes time and effort, but doing so will do more than improve business, it will change lives. A company's ethics will have an influence on all levels of business. It will influence all who interact with the company including customers, employees, suppliers, competitors, etc. All of these groups will have an effect on the way a company's ethics are developed. It is a two-way street ; the influence goes both ways, which makes understanding ethics a very important part of doing business today. Ethics is very important, as news can now spread faster and farther than ever before. Ethical issues include the rights and duties between a company and its employees, suppliers, customers and neighbours, and its responsibility to its shareholders. Issues concerning relations between different companies include hostile take-overs and industrial espionage. Related issues include corporate governance ; finance and accounting ; Intellectual Property Right (IPR) and the marketing of corporations' ethics policies. The four major areas of public concern regarding business ethics are executive pay, corporate tax avoidance, bribery and corruption.

Ethics are the rules or standards that govern our decisions on a daily basis. Many equate "*ethics*" with conscience or a simplistic sense of "*right*" and "*wrong*". Others would say that ethics is an internal code that governs an individual's conduct, ingrained into each person by family, faith, tradition, community, laws, and personal mores. Corporations and professional organizations, particularly licensing boards, generally will have a written "*Code of Ethics*" that governs standards of professional conduct expected of all in the field. It is important to note that "*law*" and "*ethics*" are not synonymous, nor are the "legal" and "ethical" course of action in a given situation necessarily the same. Statutes and regulations passed by legislative bodies and administrative boards set forth the "*law*".

3.3.1 Business Ethics in Corporate Governance

Corporate governance lies at the very heart of the way businesses are run. Often defined as '*the way businesses are directed and controlled*', it concerns the work of the board as the body which bears ultimate responsibility for the business. Governance relates to how the board is constituted and how it performs its role. It encompasses issues of board composition and structure, the board's remit and how it is carried out and the framework of the board's accountability to its stakeholders. It also concerns how the board delegates authority to manage the business throughout the organization. It does this by cascading down specified limits of authority to committees, the CEO and the executive team, who in turn delegate tasks to management and employees. This authority allows management to carry out, in accordance with specified budgets and timings, the purpose, vision and strategy which the board has agreed to.

The extent to which business decisions reflect ethical values and principles is a key to long term success. The business case for business ethics has been well proven by the costs and impacts of the repeated high profile cases of corporate greed and misconduct, often by senior individuals, crossing ethical boundaries as well as ignoring or circumventing the rules set out in law. Trust is essential in establishing an organisation's licence to operate. Maintaining successful business relationships and operations requires businesses to manage their risks, including their integrity risks, and guard their reputations. Trustworthiness is a valuable asset and guarding that asset is a core remit for those running a company ; it is a core remit of good corporate governance.

Business ethics, defined as the application of ethical values to business behavior, is essentially about the discretionary decision a board takes to deliver on its duties as set down in law, specified by best practice, and demanded by shareholders and other stakeholders. Ethical choices are relevant within the core business strategies that they pursue and the way they direct the business as a whole to achieve them. Boards take decisions which have far-reaching consequences and directly affect the lives of their employees and other stakeholders. Conversely, a lack of decisive action may also have significant consequences.

Business ethics also refer to the way the board conducts itself and the way board members choose to behave in carrying out their role. High levels of competency and skill are required of the board, with directors exercising proper care in their duties, upholding high standards of integrity and acting fairly. The culture of an organization will be strongly influenced by the nature as well as the quality of the leadership shown by the board. A lack of strong and clear leadership from the board will generally result in inconsistencies in the ways of behaving and working, with practices derived from employees' personal preferences and habits continued from previous employment rather than being ethically driven. A board is responsible for determining, articulating and communicating the values and standards of the business, and for ensuring that the policies, procedures and controls in place act to embed, rather than hinder, ethical values throughout the business.

3.3.1A Guidance for Corporate Governance practice

A possible reason for why many boards are still found wanting is the fact that despite rigorous efforts to raise governance standards, insufficient attention has been paid to the behavioural standards as opposed to the technical challenges of the boardrooms, hence *"board evaluation can be an occasion to monitor the behavioural rules"*. This presupposes that board evaluation avoids a *'tick box'* approach and that it is open to discussion on behavioral issues. Both should be the case in any well conducted, open evaluation, and indeed a focus on behavioural issues widely considered to be a key element of a serious board evaluation. With increasing globalization, companies are importing good practices developed elsewhere, for their own legal and governance framework. A number of *'best practices'* adopted and followed in European companies include :

- The creation of a *'lead director'*, where the roles of Chairman and CEO are combined.

- Increased transparency in governance reporting, such as more use of tables and diagrams on board evaluation outcomes.
- The increase in the culture of consensus inspired by the role of employees on the board of companies.
- Greater focus on information on compliance systems such as on fraud prevention and anti-money laundering and risk management.

Accountability

In ethics and governance, accountability is about the board being answerable to stakeholders for performance, both financial and non-financial. Accountability encompasses a two-way process and there are many organizations which exert pressure and influence on corporate practice and demand greater accountability, such as trade unions and campaign organizations. This also includes the investment industry and most recent debate around corporate governance has focused on the relationship between companies and their shareholders.

The following are the few of a Director's integrity requirements :

(*i*) A Director Acts with Integrity.

(*ii*) A director acts ethically and with integrity (base of minimum requirements for moral values) in accordance with the applicable governance codes and company practices. A director is able to describe the behavior and to identify the common values of the company (for example, respect, dialogue, tolerance, diversity or pluralism).

(*iii*) A director has the personal and professional qualities that meet the highest definition and most demanding standards in terms of integrity, honesty and loyalty.

3.3.1B Conflicts of Interest

Conflicts of interest are avoided in order to prevent individuals seeking personal gain from their position within a company which can often be to the company's disadvantage. This is seen as an ethical issue and that fairness and honesty are typically absent when there is a conflict of interest. The accountability to shareholders as stated above includes the conflicts of interest potentially experienced by institutional investors.

The board and its members can be a subject to conflicts of interest in a number of ways. Directors may represent a major shareholder or other key stakeholders or they may be an executive director on a unitary board balancing executive and governance responsibilities. It is essential for the good standing of the organization that such conflicts be recognized and managed in an ethical way, so that the director does not profit from his or her position or suffer from impaired judgement. In essence, directors are in a position of trust and should

exercise their stewardship of the company without regard to any personal gain or avoidance of loss. This presupposes both a clear understanding of their role and responsibilities, including the applicable rules on managing conflicts, and a high degree of integrity.

Directors also have a conflict if they have a personal connection with any part of the business or any proposed transaction. They may also have a conflict of interest because of a position they hold outside the business. They must subordinate this interest to that of the company. In practice this may mean withdrawing from board discussion of a matter, not receiving papers on it, not voting on it or a combination of these or any other steps agreed to, by the board.

Conflict management can be said to begin with the appointment process. Directors should be appointed using a process which is as objective as possible to avoid persons being appointed, who have close connections with the board and who may not therefore act impartially in the best interests of the company as a whole. This requires a "formal, rigorous and transparent" appointments process.

Transparency

Transparency is an ethical issue for boards as they seek to meet stakeholders' expectations and demonstrate fair and honest practices to shareholders and other stakeholders. It enables the stakeholder to gain an informed and accurate view of the organization and the way it is doing business, negative points as well as positive. It reduces the scope for an unscrupulous company to conceal unwelcome facts. It is also important in the context of the ownership structure of the company and the extent to which it is possible for a company to identify its ultimate shareholders, so that, it can communicate effectively with them and they can exercise their full governance rights.

SUMMARY

- *Corporate Governance relates to how the board is constituted and how it performs its role. It encompasses issues of board composition and structure, how it carries out its accountability to its stakeholders and delegates authority to manage the business throughout the organization. Maintaining successful business relationships and operations requires businesses to manage their risks, including their integrity risks, and guard their reputations. Trustworthiness is a valuable asset, and core remit of good corporate governance. Business ethics also refer to the way board members choose to behave in carrying out their role, upholding high standards of integrity and acting fairly.*
- *In ethics and governance, accountability is about the board being answerable to stakeholders for performance, both financial and non-financial. Conflicts of interest are avoided in order to prevent individuals seeking personal gain from their position.*
- *Directors also have a conflict of interest if they have a personal connection with any part of the business. They must subordinate this interest to that of the company. Transparency in work is an ethical issue for boards as they seek to meet stakeholders' expectations.*

Short Question Answers

1. *How will you define corporate Governance ?*

   Ans. Corporate governance is defined as 'the way businesses are directed and controlled', it concerns the work of the board as the body which bears ultimate responsibility for the business. Governance relates to how the board is constituted and how it performs its role. It encompasses issues of board composition and structure, the board's remit and how it is carried out and the framework of the board's accountability to its stakeholders. It also concerns how the board delegates authority to manage the business throughout the organization.

2. *Suggest some "best practices" adopted and followed in big companies.*

   Ans. With increasing globalization, companies are adopting a number of 'best practices' adopted and followed in European companies which include: i) creation of a 'lead director', ii) increased transparency in governance reporting, iii) increase in the culture of consensus, and iv) focus on information on compliance systems.

3. *Write down the requirement in the accountability and integrity of a director to the stake holders.*

   Ans. A Director's integrity requirements include :
   - (*i*) acts with Integrity,
   - (*ii*) acts ethically,
   - (*iii*) able to describe the behaviour and to identify the common values of the company *e.g.*, respect, dialogue, tolerance, diversity etc. and
   - (*iv*) personal and professional qualities that meet the most demanding standards in terms of integrity, honesty and loyalty.

Exercise

1. What is the importance of business ethics in corporate governance and business behaviour ?
2. How is board of director basically guided by business ethics ?
3. How does business ethic prevent conflict of interest in the corporate governance ?
4. Explain transparency as an ethical issue for the board of directors.

3.3.2 Business Ethics in Finance and Accounting

Accounting is a profession that gives rise to moral dilemmas and ethical questions at all levels of an organization. Sometimes, there are timing differences when recording transactions that can mean the difference between managers receiving bonuses or losing their jobs. In these instances, ethics play a key role in accounting decision-making. Without adherence to ethical guidelines, accountants are neither living up to their professional responsibilities, nor are they fulfilling their duties to business owners.

For a company's accounting to truly represent what is going on in its financial arena, its bookkeeping must be honest and accurate. Honesty and accuracy in accounting are ethical as well as financial issues. Bookkeepers and accountants have a responsibility to represent information in the ways which genuinely represent the situation going on in the business. Shareholders, potential shareholders, Partners, investors and other users of the financial statements rely heavily on the yearly financial statements of a company, as they can use this information to make an informed decision about investment. They rely on the opinion of the accountants who prepared the statements, as well as, the auditors who verified it to present a true and fair view of the company. Knowledge of ethics can help accountants and auditors to overcome ethical dilemmas, allowing for the right choice that although may not benefit the company, but will benefit the public who relies on the accountant/ auditor's reporting.

Accountants must follow the code of ethics set out by the professional body (of which they are a member) *i.e.*, ; "*independence, integrity,* and *objectivity*" ; "*competence and technical standards*" ; "*responsibilities to clients*" ; "*responsibilities to colleagues*" ; as well as "*other responsibilities and practices*". Each of these ethics provides guidelines on how a Certified Chartered Accountant (CCA) should act as a professional. Failure to comply with the guidelines could cause an accountant to be barred from practicing.

There has been debate on whether ethics should be taught in a university setting. Supporters point out that ethics are important to the profession, and should be taught to accountants entering the field. In addition, the education would help to reinforce students' ethical values and inspire them to prevent others from making unethical decisions. Critics argue that whether an individual is ethical or not, teaching an ethics course would serve no purpose. Despite opposition, instruction on accounting ethics by universities and conferences, has been encouraged by professional organizations and accounting firms.

3.3.2A Accounting Scandals

Fraud in financial statement can be committed in *five* ways *i.e.*,

(*i*) Fictitious revenue-revenues not actually earned,

(*ii*) Fraudulent timing differences,

(*iii*) Concealed liabilities and expenses,

(*iv*) Fraudulent disclosures or Omissions and

(*v*) Fraudulent assets valuation-false statement of the inventory available.

On the basis of so many of these possible frauds, accounting ethics has been deemed difficult to control. As accountants and auditors must consider the interest of the public (which relies on the information gathered in audits), they must consider how best to apply accounting standards even when faced with issues that could cause a company to face a significant loss and/or even winding up. Due to several accounting scandals within the profession, critics of accountants have stated that when asked by a client "*what does two plus two equal ?*" the accountant would be likely to respond "*what would you like it to be ?*" This thought process along with other criticisms of the profession's issues with conflict of interest, have led to various increased standards of professionalism while stressing ethics in the work environment.

The role of accountants is critical to society. Accountants serve as financial reporters and intermediaries in the capital markets and owe their primary obligation to the public interest. The information they provide is crucial in aiding managers, investors and others in making critical economic decisions. Accordingly, ethical improprieties by accountants can be detrimental to society, resulting in distrust by the public and disruption of efficient capital market operations. There have been multiple accounting scandals that resulted in fraud charge, bankruptcy protection requests, and the closure of companies and accounting firms. The scandals were the result of creating accounting, misleading financial analysis, as well as bribery. Various companies had issues with fraudulent accounting practices. In India, one of the most widely reported violation of accounting ethics involved Satyam Computers (a multinational company) which for several years had shown untrue and unfair financial statements on the advice of its M.D. Their company auditor, a very famous international accounting firm, signed off on the validity of the accounts despite the inaccuracies in the financial statements.

One or more factors responsible for failure/ connivance of the accountants and auditors include: "self-interest, failure to maintain objectivity and independence, inappropriate professional judgment, lack of ethical sensitivity, improper leadership and ill-culture, failure to withstand advocacy threats, lack of competence, lack of organizational and peer support, and lack of professional body support." The main factor, self-interest, is the motivation to an accountant to act in his/ her best interest or when facing a conflict of interest. For example, if an auditor finds any irregularity/ fraud in an account being audited by him/her, but is receiving financial incentives to ignore these issues, the auditor may act unethically.

3.3.2B Ethical Responsibility of the Management

For ethical issues in Finance and importance of financial statement the management of a company may consider acting on the following lines of action:

(*i*) Steps should be taken by the management for true, fair and reliable accounts,

(*ii*) Determining the key elements of the business *e.g.*, the objectives and to see how can they be defined and measured from the financial point of view,

(*iii*) Making sure that the funds are allocated to different activities on the basis of their importance, and

(*iv*) Frame finance rules that have a positive effect on business activities.

SUMMARY

- *Accounting is a profession that gives rise to moral dilemmas and ethical questions at all levels of an organization. Without adherence to ethical guidelines, accountants do not fulfill their professional responsibility to business owners. Honesty and accuracy in accounting are ethical as well as financial issues, as the investors use this information to make an informed decision about investment.*
- *Accountants must follow the code of ethics set out by their professional body. Failure to comply with the guidelines could cause an accountant to be barred from practicing. On the basis of so many frauds in financial statement, accounting ethics has been deemed difficult to control. Ethical improprieties by accountants can be detrimental to society, resulting in distrust by the public and disruption of efficient capital market operations. The main factor, self-interest, is the motivation for an accountant to act in his/ her best interest or when facing a conflict of interest. For ethical issues it is the responsibility of the management of a company to take necessary steps.*

Short Question Answers

1. *Enumerate the code of ethics set out by their professional body for chartered accountants.*

   Ans. Accountants must follow the code of ethics set out by the professional body (of which they are a member) i.e., : "independence, integrity, and objectivity" ; "competence and technical standards" ; "responsibilities to clients" ; "responsibilities to colleagues" ; as well as "other responsibilities and practices".

2. *Describe the many ways of frauds committed in financial statements.*

   Ans. Frauds in financial statement have been committed in five ways i.e., (i) Fictitious revenue-revenues not actually earned, (ii) Fraudulent timing differences, (iii) Concealed liabilities and expenses, (iv) Fraudulent disclosures or Omissions and (v) Fraudulent assets valuation-false statement of the inventory available.

3. *How is the role of accountants critical to society ?*

   Ans. Accountants serve as financial reporters and intermediaries in the capital markets and owe their primary obligation to the public interest. The information they provide is crucial in aiding managers, investors and others in making critical economic decisions. Accordingly, ethical improprieties by accountants can be detrimental to society.

Exercise

1. How accounting as a profession is important for organizations ?
2. Name the factors responsible for connivance of accountants/auditors.
3. What lines of action should be followed by a ethical responsible management ?

3.3.3 Intellectual Property Right (IPR)

According to the definition of intellectual property rights it provides the exclusive rights to the holder/creator of the intellectual property for varying lengths of time. Intellectual property is an idea, invention, or process derived from the work of one's intellect or its application providing right of registration relating to it. It is a generic term which encompasses all expressions of human creativity. Ownership of intellectual property is usually expressed as 'intellectual property rights'. These are individual rights which result from assertion of ownership of intellectual property. In general, these are monopoly rights to use the intellectual property. There are many different ways in which rights may be asserted. Some of these are automatic, some require formal registration to achieve protection. In any case, it is for the owner of these rights to use it, as and when any infringement accurse. Intellectual property rights are subject to limitations in several ways :

(i) Rights exist for a limited period,
(ii) Rights are restricted geographically,
(iii) Rights are limited by subject matter and
(iv) Rights are potentially limited by competition and free movement requirements.

Intellectual property can consist of patents, trade secrets, copyrights and trademarks, or simply ideas. The concept of intellectual property relates to the fact that certain products of human intellect should be afforded the same protective rights that apply to physical property. Most developed economies have legal measures in place to protect both forms of property. In India Controller General of Patents, Designs and Trademark, in the Department of Industrial Policy and Promotion under the Ministry of Commerce and Industry has been entrusted with the job of registration of patents, Trademark and other such related matters filed by the individuals and companies.

Intellectual Property Rights, by providing exclusive rights to the inventor or creator, encourages more and more people to invest time, efforts and money in such innovations and creations. Intellectual property is divided into two categories :

(i) ***Industrial property***, which includes inventions (patents), trademarks, industrial designs, and geographic indications of source ; and

(ii) ***Copyright***, which includes literary and artistic works such as novels, poems and plays, films, musical works, artistic works such as drawings, paintings, photographs and sculptures, and architectural designs. Right related to copyright include those of performing artists in their performance, producers of phonograms in their recordings, and those of broadcasters in their radio and television programs.

The issue of Intellectual Property Rights was brought on an international platform of negotiation by World Trade Organization (WTO) through its Agreement on Trade Related Aspects of Intellectual Property Rights (TPIPS). This agreement narrowed down the difference existing in the extent of protection and enforcement of the Intellectual Property

Rights (IPRS) around the world by bringing them under a common minimum internationally agreed trade standards. The member countries are required to abide by these standards within stipulated time-frame. India, being a signatory of TRIPS has evolved an elaborate administrative and legislative framework for protection of its intellectual property.

Quoting WIPO, (World Intellectual Property Organization), "intellectual property shall include rights relating to :

- Literary, artistic and scientific works,
- Performance of performing artists, phonograms and broadcasts.
- Inventions in all fields of human endeavor.
- Scientific discoveries.
- Industrial designs.
- Trademarks, service marks and commercial names and designations.
- Protection against unfair competition".

(a) Copyright and rights related to copyright

The rights of authors of literary and artistic works (such as books and other writings, musical compositions, paintings, sculpture, computer programs and films) are protected by copyright. Also, protection is granted to related or neighbouring rights like the rights of performers (*e.g.*, actors, singers and musicians), producers of phonograms (sound recordings) and broadcasting organizations. Copyright protects intellectual property of a creative or artistic nature. Copyright often lasts 50 to 70 years after the creator's death. In some countries, your copyright must be registered to become effective, however in U.S.A. a copyright is established as soon as a work is created. In the case of software or a digital drawing it is even established as soon as it is saved to the hard drive. However, registering your copyright gives you additional rights.

(b) Industrial property

Industrial property, which is divided into two main areas :

(*i*) One area can be characterized as the protection of distinctive signs, in particular trademarks (which distinguish the goods or services of one undertaking from those of other undertakings) and geographical indications (which identify a good as originating in a place where a given characteristic of the good is essentially attributable to its geographical origin).

(*ii*) Other types of industrial property are protected primarily to stimulate innovation, design and the creation of technology. This category includes inventions (protected by patents), industrial designs and trade secrets.

(c) Industrial property rights are defined and discussed below

(*i*) ***Patents.*** Patents cover inventions. It is an exclusive right awarded to an inventor of a product or process, which prevents others from making, selling, distributing, importing or using the invention, without licence or authorization, for a fixed period of time. These can be utility patents, design patents, and plant patents. The process of filing for a patent can be time consuming, and somewhat costly.

(*ii*) ***Trademarks.*** Trademarks provide exclusive rights to use distinctive, visible signs, such as brands, symbols, colours, letters, shapes or names to identify the producer of a product. In order to be eligible for protection a mark must be distinctive of the proprietor so as to identify the origin of a proprietor's goods or services. The period of protection varies, but most countries provide for the renewal of registrations, so that, protection can be indefinite. Protection against trade mark counterfeiting and the consequent deception of consumers may also be provided through consumer protection. One area which falls under trademarks is ***trade names.*** A company can own several trademarks in their business. However, they usually have one Trade Name, to distinguish themselves from their competitors. The name is independent of whatever the products are, which the company sells under a particular trademark. Trade Names can be long, and also need to indicate information about the type of enterprise. They need to include words *e.g.*, corporation, or Company, or Ltd. for a limited company. Other areas under the umbrella concept of trademarks are franchises, such as Macdonald's, and famous character names, such as Tarzan, Mickey Mouse, and Charlie Chaplin. These can come from literature, pictorial matter or actual people, and are all used as recognizable figures in merchandising. However, there are protections for live people against unauthorized use of their names, images or other characteristics, which are above the rights to intellectual property. This is generally covered under such rights as those to privacy and protection against libel or defamation. Trade secrets often consist of information which could be patentable, such as the formula for Coca-Cola. However, patents expire, whereas a trade secret, if it is not discovered, can continue to be used exclusively by a company for an indeterminate length of time, so some companies make the decision that it is better for the company not to patent the information. Protection for trade secrets generally falls under the intellectual property rights for Protection Against Unfair Competition. Usually, if a trade secret is independently discovered, its intellectual property rights are lost.

(*iii*) ***Industrial Designs Including Integrated Circuits.*** In the United States, industrial design protection is covered under design patents, but other countries have made explicit provisions for protection of industrial design. The related protection of integrated circuits has been handled explicitly under the Treaty on Intellectual Property in Respect of Integrated Circuits (IPIC Treaty) which was passed at a meeting in Washington DC. The world Trade Organization also covers integrated circuits in the TRIPS agreement. The designs for specific circuits are covered, as it is considered that they are products of the mind, and often embody large investment of time, resources and money. Reverse engineering of the principle of the design is allowed, as long as the end result is a different design, even if it does the same thing.

(*iv*) ***Geographical Indications.*** Geographical Indications is probably the newest term covered by the intellectual property right definition used in international negotiation, and refers to the value of such names as Champagne, Chianti, and Darjeeling, which are actual place names, but are thought of generally in terms of the products they are associated with.

Geographical Indications is meant to embody the widest possible coverage of this sort of intellectual property. It differs from trademark because it is not associated with a single company's products, but with products of a particular nature that come from that geographic location. An earlier term, still used in WIPO documents, is appellation or origin, which is a geographical location used to designate a product from the region.

(v) ***Protection Against Unfair Competition.*** Protection Against Unfair Competition is another area of Intellectual property that is not as well known as copyright or patent. This area has been under some sorts of protection in treaties and agreements for over a century, but the reasoning for it being part of intellectual property is generally not as obvious to people as other types of intellectual property. However, an example which shows the reasoning behind this protection is in situations where companies sell products packaged exactly like those of another company, but the product is of inferior quality or actually does not work. Consumer can be hurt economically by the poor quality of products passed off as being manufactured by the well known company. Protection of intellectual property falls under main two areas: Piracy and counterfeiting. Counterfeiting is the illicit copying of products (fakes). Piracy refers to the illicit copying of material that is copyrighted.

SUMMARY

- *Intellectual property is an idea, invention, or process derived from the work of one's intellect or its application providing right of intellectual property registration relating to it, for varying lengths of time. Ownership of intellectual property is usually expressed as 'intellectual property rights'. Intellectual property rights are subject to limitations in several ways and it relates to the fact that certain products of human intellect should be afforded the same protective rights that apply to physical property. Controller General of Patents, Designs and Trademark, in the Department of Industrial Policy and Promotion has been entrusted with the job of registration filed by the individuals and companies. Intellectual property is divided into two categories, i.e., (i) Industrial property, which includes inventions (patents), trademarks, industrial designs, and geographic indications of source ; and (ii)* **Copyright,** *which includes literary and artistic works.*

Short Question Answers

1. *Define the term "Intellectual Property Right" and write its categories.*

Ans. Intellectual property is an idea, invention, or process derived from the work of one's intellect or its application providing right of registration relating to it. Intellectual property rights provide the exclusive rights to the holder/creator of the intellectual property for varying lengths of time. Intellectual property is divided into two categories, *i.e.*, (i) Industrial property, which includes inventions (patents), trademarks, industrial designs, and geographic indications of source ; and (ii) Copyright, which includes literary and artistic works.

2. *What are the dimensions and limitations of Intellectual Property Rights ?*

Ans. Intellectual property rights are subject to limitations in several ways, *i.e.*,

(i) Rights exist for a limited period,
(ii) Rights are restricted geographically,
(iii) Rights are limited by subject matter and
(iv) Rights are potentially limited by competition and free movement requirements.

3. *Write the intellectual property rights agreed upon by world Intellectual Property organisation.*

Ans. According to the World Intellectual Property Organization (WIPO), intellectual property shall include rights relating to :

(i) Literary, artistic and scientific works,
(ii) Performance of performing artists, phonograms and broadcasts,
(iii) Inventions in all fields of human endeavor,
(iv) Scientific discoveries,
(v) Industrial designs,
(vi) Trademarks, service marks and commercial names and designations, and
(vii) Protection against unfair competition.

Exercise

1. Explain in brief the right related to copyright.
2. Write the main areas covered under industrial property.
3. Define and discuss the Industrial Property Rights.

3.4 CORPORATE SOCIAL RESPONSIBILITY (CSR)

3.4.1 Definition

The term *"corporate social responsibility"* became popular in the 1960s. It can be defined as *"corporate citizenship"* and can involve incurring short-term costs that do not provide an immediate financial benefit to the company, but instead promote positive social and environmental change. Companies express the citizenship through their waste and pollution reduction processes, by contributing educational and social programs and by earning adequate returns on the employed resources.

CSR policy functions as a self-regulatory mechanism whereby a business monitors and ensures its active compliance with the spirit of the law, ethical standards and international norms. CSR is titled to aid an organization's mission as well as a guide to what the company stands for to its consumers.

Many large corporations have a lot of power in the community and in the national economy who devote real time and money to environmental sustainability programs, alternative energy/clean technology, and various social welfare initiatives to benefit employees, customers, and the community at large. The term generally applies to company efforts that go beyond what may be required by regulators or environmental protection groups.

CSR policy functions as a self-regulatory mechanism whereby a business monitors and ensures its active compliance with the spirit of the law, ethical standards and international norms. CSR is titled to aid an organization's mission as well as a guide to what the company stands for to its consumers.

Most consumers believe companies doing charity will receive a positive response. It has also been found that consumers are loyal and willing to spend more on retailers that support charity. Consumers also believe that retailers selling local products will gain loyalty. Some believe that marketing local products will gain consumer trust. All CSR activities do not become popular. Environmental efforts are receiving negative views on account of the belief that this would affect customer service.

Philanthropy is a very common approach to CSR in the corporate sector which includes monetary donations and other kind of aid given to non-profit/ government organizations *e.g.*, in India donations are made by TATA group of industries in the areas such as the arts, education, housing, health, social welfare and the environment etc. Political contributions and commercial event sponsorship are not included in this approach to CSR.

Few companies have provided examples of the Link between Competitive Advantage and Corporate Social Responsibility by developing deep linkages between their business strategies and CSR. It acknowledges trade-offs between short-term profitability and social/environmental goals, but emphasizes the opportunities for competitive advantage from building a social value proposition into corporate strategy.

3.4.2 Concepts of CSR

(*i*) ***Environmental sustainability.*** Recycling, waste management, water management, renewable energy, reusable materials, *'greener'* supply chains and reducing paper use etc.

(*ii*) ***Community involvement.*** This can include raising money for local charities, providing volunteers, sponsoring local events, employing local workers, supporting local economic growth, and engaging in fair trade practices, etc.

(*iii*) ***Ethical marketing.*** Companies that ethically market to consumers are placing a higher value on their customers and respecting them as people who are end consumers. It is important for the companies who want to be viewed as ethical that they do not manipulate and/or falsely advertise to potential consumers.

Strategy of big industrial houses to draw benefits by spending their resources in CSR and its Cost benefit analysis.

CSR activity	*Action*	*Strategic Impact*	*Benefits*
Corporate Philanthropy	Providing funds and skills	Less strategic and operational impact	○ Corporate Philanthropy and sponsorships ○ Short-term benefits/not always sustainable ○ Limited funds available ○ Impact diluted because limited budget is allocated to many charities ○ Corporate competencies and other business assets not fully utilized. ○ Misalignment between business and social responsibility strategies and functions. ○ Results in minimal social and business impact on account of social programmes.
Value Creation	Innovation and promotion of sustainable business model	Fundamental strategic and operational impact	○ Shares value (business- Institutions and communities ○ Promotes competitiveness and innovation ○ Promotes a sustainable business model ○ Integrates business into the community ○ Develops Human Capital (key in developing countries) ○ Incorporates into the Business Strategy
Risk Management	Compliance	Medium to high strategic and operational impact	○ Mitigates operational impact ○ Mitigates operational risks ○ Supports external relationships

Various countries are actively engaged in CSR regulation and its related public policy development. CSR efforts and policies are different among countries, responding to the complexity and diversity of governmental, corporate and social roles.

The Companies Act, 2013 passed by the Indian Parliament in August, 2013 mandates companies of a particular size to invest 2% of their Net Profit in CSR activities. As per this Act, more than 22,000 companies were to spend about USD 3 billion annually on CSR activities, starting 1st April, 2014. The guidelines, which have replaced two existing separate guidelines on CSR and sustainable development, issued in 2010 and 2011 respectively, mentions the following :

> *"Since corporate social responsibility and sustainability are so closely entwined, it can be said that corporate social responsibility and sustainability is a company's commitment to its stakeholders to conduct business in an economically, socially and environmentally sustainable manner which appears transparent and ethical."*

By requiring companies, with a minimum net profit of 5 crore INR, to spend on CSR activities, the Companies Act, 2013 is likely to bring in many self-managed companies into the CSR fold. This will usher in a fresh set of challenges to a sector that is increasingly being asked by its business customers to comply with environmental and social standards, while remaining competitive in terms of price and quality.

The industry has responded positively to the reform measures undertaken by the government with a wide interest across the Indian and multinational companies in the public and private sector.

3.4.2A Controversies

Industries such as tobacco, alcohol or munitions firms make products that damage their consumers and/or the environment. Such firms may engage in the same philanthropic activities as those in other industries. This duality complicates assessments of such firms with respect to CSR.

3.4.3 ISO 26000 (Social Responsibility)

It is the recognized international standard for CSR. This is a guidance tool provided by the International Standards organization (ISO) which enables the corporate sector to understand the meaning and significance of social responsibility. It is important to note that it is not a certification but only a guiding tool. Hence, organizations which comply with these standards are self-certified.

It covers *six* core areas of social responsibility, including :

(*i*) **Human rights**
(*ii*) **Labour practices**
(*iii*) **Environment**

(*iv*) Fair operating practices
(*v*) Consumer issues and
(*vi*) Community involvement and development.

This ensures a holistic approach to the concept of social responsibility and sustainable development in the corporate sector.

SUMMARY

- *The term "corporate social responsibility" can be defined as "corporate citizenship" and can involve incurring short-term costs that do not provide an immediate financial benefit to the company, but instead promote positive social and environmental change. CSR is titled to aid an organization's mission as well as a guide to what the company stands for to its consumers. The term generally applies to company efforts that go beyond what may be required by regulators or environmental protection groups. It has also been found that consumers are loyal and willing to spend more on retailers that support charity. Common CSR actions include :*
  - (*i*) *Environmental sustainability,*
  - (*ii*) *Community involvement, and*
  - (*iii*) *Ethical marketing.*
- *The Companies Act, 2013 passed by the Indian Parliament in August, 2013 mandates companies of a particular size to invest 2% of their Net Profit in CSR activities. In order to draw benefits the industrial houses indulge in CSR activities like ; corporate Philanthropy, Value creation and Risk Management. ISO 26000 provides guidance by the International Standards organization (ISO) to enable the corporate sector to understand the meaning and significance of social responsibility.*

Short question answers

1. *Explain the term "corporate Social Responsibility".*

Ans. The term "*corporate social responsibility*" defined as "*corporate citizenship*" can involve incurring short-term costs that do not provide an immediate financial benefit to the company, but instead promote positive social and environmental change. CSR policy functions as a self-regulatory mechanism whereby a business monitors and ensures its active compliance with the spirit of the law, ethical standards and international norms. Many large corporations have a lot of power in the community and in the national economy who devote real time and money to environmental sustainability programs, alternative energy/clean technology, and various social welfare initiatives to benefit employees, customers, and the community at large. Philanthropy is a very common approach to CSR in the corporate sector which includes monetary donations and other kind of aid given to non-profit/government organizations.

2. *Describe the common CSR actions.*

Ans. Common CSR actions include :

(*i*) Environmental sustainability *i.e.*, recycling, waste management, water management, renewable energy, reusable materials, 'greener' supply chains and reducing paper use etc.,

(*ii*) Community involvement *i.e.*, this can include raising money for local charities, providing volunteers, sponsoring local events, employing local workers, supporting local economic growth, and engaging in fair trade practices, etc.

(*iii*) Ethical marketing *i.e.*, Companies that ethically market to consumers are placing a higher value on their customers and respecting them as people who are end consumers. It is important for the companies who want to be viewed as ethical that they do not manipulate and/or falsely advertise to potential consumers.

3. *Explain the companies act 2013 passed by the Indian parliament as a mandate for companies.*

Ans. The Companies Act, 2013 passed by the Indian Parliament in August, 2013 mandates companies of a particular size to invest 2% of their Net Profit in CSR activities. The guidelines mention, "Since corporate social responsibility and sustainability are so closely entwined, it can be said that corporate social responsibility and sustainability is a company's commitment to its stakeholders to conduct business in an economically, socially and environmentally sustainable manner which appears transparent and ethical".

Exercise

1. Explain the actions of industrial houses benefits and strategic impact in public.
2. State and explain the international standards organization (ISO 26000) as a guidance tool for corporate sector.
3. Explain the guidance tool provided for social responsibility in ISO 26000.

3.5 ENVIRONMENTAL ETHICS

Environmental Ethics are related to those aspects of human health including quality of life that are determined by physical, biological, social and psychological factors in the environment. The relationship between the environment and its impact on human health is highly complex. Each of the effects is associated with a variety of aspects of economic and social development. Moreover, there is no single best way of organizing and viewing the development-environment-health relationship that reveals all important interactions and possible entry points for public health interventions. Human beings are exposed to a variety of chemicals including industrial chemicals, pesticides, air pollutants, natural and man-made toxicants etc. in the environment through the skin, respiratory system and gastrointestinal tract that can affect vital body systems such as pulmonary, reproductive and nervous and immune system. Dysfunction of these systems could have far-reaching consequences, which affect individuals and even their progeny from serious health ailments.

To investigate possible effects of environmental pollutants on human health it is of prime importance that accurate exposure assessment techniques and validated biomarkers are available. It is, therefore, essential to have full fledged and accurate Environmental Health Impact Assessment procedures in place, undertake application-oriented research such as occupational and environmental cohort studies to define single or mixture of pollutants and their impacts on health. This would help the implementing agencies to revise the environmental and industry specific actions. It is also very important to have collaborative approach among the industries and various technical/research centers together with the implementing agencies of the pollution control so as to deal with the Environment and Health issues properly.

In the year 1986, the Govt. of India enacted the Environment Protection Act with an objective to plan, promote, coordinate and oversee the implementation of environmental and forestry programmes in order to protect the environment and maintain a balance between conservation and development activities.

3.5.1 Sustainable Development

Sustainable development ties together concern for the carrying capacity of natural systems with the social, political and economic challenges faced by humanity. It is the organizing principle for sustaining finite resources necessary to provide for the needs of future generations of life on the planet. It is a process that envisions a desirable future state for human societies in which living conditions and resource-use continue to meet human needs without undermining the "*integrity, stability and beauty*" of natural biotic systems. The concept of "*sustainable development*" has its roots in forest management. Sustainable development is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Sustainable development also contains within it two key concepts :

(*i*) The concept of "*needs*", in particular, the essential needs of the world's poor, to which overriding priority should be given ; and

(*ii*) The idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs.

UN Conference on Environment and Development in 1992, published the Earth Charter, which outlines the building of a just, sustainable, and peaceful global society in the 21st century. Sustainable development identifies information, integration, and participation as key building blocks to help countries achieve development. It emphasizes that in sustainable development everyone is a user and provider of information. It stresses the need to change from old sector-centered ways of doing business to new approaches that involve cross-sectorial co-ordination and integration of environmental and social concerns into all development processes. Different domains have been identified for research and analysis of sustainable development. Broadly defined, these include ecology, economics, politics and culture.

The ecological sustainability of human settlements is part of the relationship between humans and their natural, social and built environments. Also termed human ecology, this broadens the focus of sustainable development to include the domain of human health. Fundamental human needs such as the availability and quality of air, water, food and shelter are also the ecological foundations for sustainable development. Addressing public health risk through investments in ecosystem services can be a powerful and transformative force for sustainable development which, in this sense, extends to all species. Ecological sustainability is affected by man due to his activities in farming, energy production, environment and transportation etc discussed in brief below.

Farming

Environmental-friendly methods of farming are that which allow the production of crops or livestock without damage to human or natural systems. More specifically, it might be said to include preventing of adverse effects on soil, water, biodiversity, surrounding or downstream resources, as well as, to those working or living on the farm or in the neighbouring areas.

Energy

The Provision of energy which is clean and lasts for a longer period of time is sustainable energy. Unlike the fossil fuel that most of the countries are using, renewable sources of energy *i.e.*, solar energy, wind energy, water energy and nuclear energy produce little or even no pollution. Dirty energy projects (*e.g.*, coal based energy) poison the air and harm the area. These toxins are major contributors to significant health problems in the communities. Due to this reason the renewable energy is becoming more common now with

the Government. At present solar energy is commonly installed and used on street lights and the roofs of buildings. On the other hand, wind energy is also expanding quickly in recent years.

Environment

Since Natural resources are derived from the environment, the state of air, water, and the climate are of particular concern to us. Environmental sustainability requires society to design activities to meet human needs while preserving the life support systems of the planet. For example, this entails using water sustainably, utilizing renewable energy, and sustainable material supplies. Sustainability requires that human activity only uses nature's resources at a rate at which they can be replenished naturally. An unsustainable situation occurs when the sum total of nature's resources are used up faster than it can be replenished by the nature.

Transportation

Transportation is a large contributor to greenhouse gases. It is said that one-third of all harmful gasses produced are due to transportation. To lower greenhouse gases emission, the government is considering some plans to reduce the total number of vehicle trips, by ;

(*i*) Improving public transit and covering larger area by providing more mobility and accessibility to general public, *e.g.*, Delhi Metro Rail.

(*ii*) Providing wider bike and pedestrian pathways to encourage walking and biking.

(*iii*) Increasing the cost of car ownership and related taxes to discourage use of vehicles.

A United Nations conference on Sustainable Development (UNCSD), also known as Rio 2012, Rio+20, or Earth Summit 2012, was held to discuss the sustainable development, which aimed at reconciling the economic and environment goals of the global community.

SUMMARY

- *Environmental Ethics are related to those aspects of human health including quality of life that are determined by physical, biological, social and psychological factors in the environment. Human beings are exposed to a variety of chemicals including industrial chemicals, pesticides, air pollutants, natural and man-made toxicants affect vital body systems. It is essential to have full-fledged and accurate Environmental Health Impact Assessment procedures in place. Environmental-friendly methods of farming may be included to prevent adverse effects on soil, water, biodiversity and surrounding. We should encourage use of renewable sources of energy i.e., solar energy, wind energy, water energy and nuclear energy produce little or even no pollution. We can lower greenhouse gases emission, by reducing the total number of vehicle trips.*

Short question answers

1. *Explain the relationship between the environment and the human health.*

Ans. Human health and quality of life are determined by physical, biological, social and psychological factors in the environment. Human beings are exposed to a variety of chemicals including industrial chemicals, pesticides, air pollutants, natural and man-made toxicants etc. in the environment through the skin, respiratory system and gastrointestinal tract that can affect vital body systems.

2. *How is sustainable development important for humanity, explain it's concepts ?*

Ans. Sustainable development is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs Sustainable development identifies information, integration, and participation as key building blocks to help countries achieve development.

3. *Explain how is ecological sustainability affected by farming, energy and environment ?*

Ans. Ecological sustainability is affected by man due to his activities in farming, energy production, environment and transportation. Environmental-friendly methods of farming may be said to include prevention of adverse effects on soil, water, biodiversity and surrounding. Dirty energy projects (*e.g.*, coal based energy) poison the air. We should encourage use of renewable sources of energy *i.e.*, solar energy, wind energy, water energy and nuclear energy produce little or even no pollution. Natural resources are derived from the environment. Sustainability requires that human activity only uses nature's resources at a rate at which they can be replenished naturally. An unsustainable situation occurs when the sum total of nature's resources are used up faster than it can be replenished by the nature. Transportation is a large contributor to greenhouse gases. To lower greenhouse gases emission, we should reduce the total number of vehicle trips by, i) Improving public transit and covering larger area, ii) encouraging walking and biking, and iii) discouraging use of vehicles.

Exercise

1. What are the possible points for toxicants to enter in human body ?
2. Describe the relation between the ecological sustainability and human settlements.
3. What steps are being taken by the Government to reduce the greenhouse gases released by transport ?

3.5.2 The Eco-System

The eco-system is a core concept in Biology and Ecology, serving as the biological organization in which organisms interact simultaneously with each other and with their environment. As such, ecosystems are a level above that of the ecological community (organisms of different species interacting with each other) but are at a level below, or equal to, biomes and the biosphere. Essentially, biomes are regional ecosystem, and the biosphere is the largest of all possible ecosystems. An ecosystem in a given area includes all of the living things (plants, animals and organisms) interacting with each other, and also with their non-living environments (weather, earth, sun, soil, climate, atmosphere). In an ecosystem, each organism has its' own niche, or role to play.

Every living organism on earth needs some basic things to survive. The amount, way, form or kind of these needs vary from organism to organism. For example, water is a basic need for survival. The amount of water a frog needs to survive is not the same as the amount of water a desert cactus plant needs to survive. They all need water, but because they are different living organisms, their water needs will be different, even though they both need water to live.

There are *six* basic needs/factors of all living things.

(*i*) ***Sunlight.*** This is probably the most important need for all living organisms, because it is the source of all energy. It also provides heat to plants and animals.

(*ii*) ***Water.*** Water is the medium in which living cells and tissue work. Water is also a living environment for many plants and animals.

(*iii*) ***Air.*** Air is made up of several gases, but the two most important gases are Oxygen and Carbon dioxide. Without oxygen, animals will die, and without carbon dioxide, plants cannot survive.

(*iv*) ***Food (nutrients).*** Living things need energy for function. Energy is needed to grow, reproduce, move, and to work. Think of what will happen if you stayed for few days without food.

(*v*) ***A Habitat with the Right Temperature.*** Whether too cold or too hot, every living organism needs the ideal temperature to survive either on land or in water.

(*vi*) ***Limiting Factors.*** Certain factors in a living organism's environment can prevent it from surviving there. Those factors are called 'limiting factors'. They include soils, temperature, water, sunlight and physical barriers. Physical barriers may include landforms and water bodies. They often prevent a living organism from moving to another place when conditions get bad in their regular habitat.

Consider a small puddle at the back of your home. In it, you may find all sorts of living things, from microorganisms, to insects and plants. These may depend on non-living things like water, sunlight, turbulence in the puddle, temperature, atmospheric pressure and even

nutrients in the water for life. This very complex, wonderful interaction of living things and their environment, has been the foundation of energy flow and recycling of carbon and nitrogen. Anytime a '*stranger*' (living things or an external factor such as rise in temperature) is introduced to an ecosystem, it can be disastrous to that ecosystem. This is because the new organism (or factor) can distort the natural balance of the interaction and potentially harm or destroy the ecosystem. Usually, biotic members of an ecosystem, together with their abiotic factors depend on each other. This means the absence of one member, or one abiotic factor can affect all parties of the ecosystem. Unfortunately ecosystems have been disrupted, and even destroyed by natural disasters such as fires, floods, storms and volcanic eruptions. Human activities have also contributed to the disturbance of many ecosystem and biomes.

Ecosystems come in indefinite sizes. It can exist in a small area such as underneath a rock, a decaying tree-trunk, or a pond in a village, or it can exist in large forms such as an entire rain forest. Technically, the Earth can be called a huge ecosystem. To make things simple, let us classify ecosystems into *three* main scales.

(*i*) ***Micro.*** A small scale ecosystem such as a pond, puddle, tree trunk, under a rock etc.

(*ii*) ***Messo.*** A medium scale ecosystem such as a forest or a large lake.

(*iii*) ***Biome.*** A very large ecosystem or collection of ecosystems with similar biotic and abiotic factors such as, an entire Rain forest with millions of animals and trees, with many different water bodies running through them.

Ecosystem boundaries are not separated by any rigid lines. They are often separated by geographical barriers such as deserts, mountains, oceans, lakes and rivers. Ecosystems can be put into 2 groups. If the ecosystem exists in a water body, like an ocean, freshwater or puddle, it is called an *aquatic ecosystem* whereas those which exist outside of water bodies are called *terrestrial ecosystems*.

3.5.2A Carbon Cycle in the Ecosystem

The carbon cycle is very important to all ecosystems, and ultimately life on earth. The carbon cycle is critical to the food chain. Living tissues contain carbon, because they contain proteins, fats and carbohydrates. The carbon in these (living or dead) tissues is recycled in various processes. Human activities like heating homes and cars burning fuels (combustion) give off carbon into the atmosphere. During respiration, animals also introduce carbon into the atmosphere in the form of carbon dioxide. The Carbon dioxide in the atmosphere is absorbed by green plants (producers) to make food by photosynthesis process.

When animals feed on green plants, they pass on carbon compounds into other animals in the upper levels of their food chains. Animals give off carbon dioxide into the atmosphere during respiration. Carbon dioxide is also given off when plant and animals die. This occurs when decomposers (bacteria and fungi) break down dead plants and animals (decomposition) and release the carbon compounds stored in them.

3.5.2B The Nitrogen Cycle in the Ecosystem

Nitrogen is also a key factor in the existence of ecosystems and food chains. Nitrogen forms about 78% of the air on earth. But plants do not use nitrogen directly form the air. This is because nitrogen itself is unreactive, and cannot be used by green plants to make protein. Nitrogen gas therefore needs to be converted into nitrate compound in the soil by nitrogen-fixing bacteria in soil, root nodules or lightning.

SUMMARY

- *Eco-System in a given area includes all living things (plants, animals and organisms) in the area. There are six basic needs/factors of all living things for survival i.e., Sunlight, Water, Air, Food (nutrients), a Habitat with the Right Temperature and other Limiting Factors. Technically, the Earth can be called a huge ecosystem. We can classify ecosystems into three main scales i.e.,*
  - (*i*) **Micro.** A small scale ecosystem,
  - (*ii*) **Messo.** A medium scale ecosystem, and
  - (*iii*) **Biome.** A very large ecosystem or collection of ecosystems.
- *If the ecosystem exists in a water body, it is called an aquatic ecosystem whereas those which exist outside of water bodies are called terrestrial ecosystems. For existence of an eco-system carbon and nitrogen cycles are very important. The carbon cycle is critical to the food chain. Living tissues contain carbon, because they contain proteins, fats and carbohydrates. The carbon in these (living or dead) tissues is recycled in various processes. Nitrogen gas cycle is also a key factor in the existence of ecosystems and food chains. Nitrogen forms about 78% of the air on earth.*

Short Question Answers

1. *Explain eco-system concept vis-a-vis all of living things.*

   Ans. Every living organism on earth needs some basic things to survive. The amount, way, form or kind of these needs vary from organism to organism. For example, water is a basic need for survival.

Exercise

1. Explain the basic needs/ factors of all living things.
2. Describe the nitrogen cycle and carbon cycle in the eco-system.

3.5.3 Depletion of Ozone in the Environment

Ozone layer depletion, is simply the wearing out (reduction) of the amount of ozone in the stratosphere. Unlike pollution, which has many types and causes, ozone depletion has been pinned down to human activity *i.e.*, industries that manufacture things like insulating foams, solvents, soaps, cooling equipments like Air Conditioners and Refrigerators which use substances called chlorofluorocarbons (CFCs). These substances are heavier than air, but over time, (2-5 years) they are carried high into the stratosphere by wind action. But let us first study what is Ozone ?

Ozone is a natural gas composed of three atoms of oxygen. Its chemical symbol is O_3. It is blue in colour and has a strong odour. Normal oxygen (O_2), which we breathe, has two oxygen atoms and is colourless and odourless. Environmental scientists have classified O_3 into *two* categories : *Good Ozone* and *Bad Ozone*.

Good Ozone (also called Stratospheric Ozone) occurs naturally in the upper Stratosphere. The stratosphere is the layer of space 6 to 30 miles above the earth's surface. The air is full of gases reacting with each other, even though our eyes do not see. When UV light strikes (Oxygen) O_2 molecules, they are split into two individual O atoms - O and O. When one of the O atoms combine with O_2 molecule, ozone (O_3) is created. Even though Ozone is only a small part of the gases in this layer, it plays a vital role because it shields us from the sun's harmful UV rays. It is called Good Ozone, because it protects humans, life and animals on earth.

Bad Ozone is also known as Tropospheric Ozone, or ground level ozone. This gas is found in the troposphere, the first layer about 10 Km from earth's surface forms the immediate atmosphere. Bad Ozone does not exist naturally. Human actions cause chemical reactions between oxides of nitrogen (NOX) and volatile organic compounds (VOC). Each time there is a reaction of chemicals such as those found in cars, power plants and factory emissions, in the presence of sunlight (UV light), Bad Ozone is created. Bad ozone contaminates (dirties) the air and contributes to what we typically experience as "*smog*" or haze. Smog from bad ozone is usually caused by the action of sunlight on a mixture of hydrocarbons and oxides of nitrogen. It is also known as Photochemical.

The earth's atmosphere is divided into several layers, and each layer plays an important role. The first region extending about 10 km upwards from the earth's surface is called the troposphere. Many human activities like mountain dimbing, gas balloons and smaller aircrafts operate within this region. The next layer, extending about 15-60 km is called the stratosphere. The ozone layer is mainly found in the lower protion of the stratosphere from approximately 20 to 30 kilometres above earth, though the thickness varies seasonally and geographically. The ozone layer protects the earth from the suns UV Rays. If the ozone layer is depleted by human action, the effects on the planet could be catastrophic.

3.5.3A Factors Responsible for Ozone Depletion

(*i*) Depletion begins when CFC's get into the stratosphere. Ultra violet radiation from the sun breaks up these CFCs. The breaking up action releases Chlorine atoms. Chlorine atoms react with ozone, starting a chemical cycle that destroys the good ozone in that area. One chlorine atom can break apart more than 100,000 ozone molecules.

(*ii*) There are other Ozone Depleting Substance (ODS) such as methyl bromide used in pesticides, halons used in fire extinguishers, and methyl chloroform used in making industrial solvents. Other chemicals that naturally destroy Ozone are Nox, Hox, Clx, which belong to the Nitrogen, Hydrogen and Chlorine families. Measurements of CFCs in the stratosphere are made from gas balloons, aircraft and satellites. Sadly, there isn't much which humans can do to replenish the depleted Ozone, as it tends to recover slowly by itself. All we can do is to be more responsible with our manufacturing needs so that we do not introduce more CFCs into the air.

(*iii*) Eruption of volcanoes is also responsible for depletion of Ozone. When volcanoes erupt, they produce massive clouds of ashes into the troposphere, and then they drift upward into the stratosphere (the upper atmosphere layer where ozone gas protects humans from UV radiation). These ashes contain high concentration of bromine and chlorine. Ashes can stay in the stratosphere for about two to five years, and within this period, there are chemical reactions that destroy the stratospheric ozone molecules.

(*iv*) Human activities like pollution and emissions already send lots of halogen gases into the stratosphere. Scientists have noted that halogens from volcanoes contain twice to thrice as much halogens that human activities can even produce. This means the potential of depleting the ozone layer is higher with volcanic 'smoke'. All in all, it is known that volcanoes contribute about 18%-20% of Chlorine entering the atmosphere, and human activities contribute about 80%-82%.

3.5.3B Effects of Ozone Depletion

Depletion of the ozone layer has consequences on humans, animals and plants. This typically results from higher UV rays reaching us on earth.

(*i*) ***Humans.*** Research confirms that high levels of UV Rays cause non-melanoma skin cancer. Additionally, it plays a major role in malignant melanoma development. UV is also linked to cataracts (a disease of the eye which clouds the eye's lens).

(*ii*) ***Plants.*** The damage that extreme UV levels have on plants is one that our eyes do not see much, but humans can feel the impact. Plant growths, as well as its physiological and developmental processes are all affected negatively. These include the way plants form, timing of development and growth, distribution of plant nutrients and metabolism, etc. These changes can have important implications for plant competitive balance, animals that feed on these plants, plant diseases, and biogeochemical cycles.

(*iii*) ***Marine (or water) Ecosystems.*** Phytoplankton form the foundation of aquatic food webs. These usually grow closer to the surface of water, where there is enough sunlight. Change in UV levels is known to affect the development and growth of phytoplankton, and naturally, the fish that feed on them. UV radiation is also know to affect the development stages of fish, shrimp, crab, amphibians and other animals. When this happens, animals in the upper food chain that feed on these tiny fishes are all affected.

(iv) ***Effects on Biogeochemical Cycles.*** The power of higher UV levels affect the natural balance of gasses (and greenhouse gases) in the biosphere : *i.e.*, carbon dioxide (CO_2), carbon monoxide (CO), carbonyl sulphide (COS) and ozone. Changes in UV levels can cause biosphere-atmosphere feedback resulting from the atmospheric buildup of these gases.

(v) Top atmospheric researchers confirm that Ozone levels vary by season and latitude. Sometime in 1979, it was observed that there was considerable Ozone depletion in the upper latitudes in Arctic and Antarctic. This massive stretch of ozone depletion (hole) is estimated to be about the size of America. Particularly in the antarctic, satellite images were released showing a disturbing thinning of the ozone layer. The phenomenon is what we usually call the Ozone hole, and it was most observed over Australia (Antarctic) every year during the spring. In the winter, temperature drops below –78°C (–109°F) in the Poles (Antarctic). Thin clouds form a mixture of ice, nitric acid, and sulphuric acid. Chemical reactions on the surface of ice crystals in the clouds releases active forms of CFCs. This sets the ozone depletion and by the spring season, a lot of depletion occurs.

3.5.3C How can we Reduce Ozone Depletion ?

Ozone is a natural gas and is naturally replenished over time. This means if we can do something to balance the natural production with its depletion, there should not be a problem. Unfortunately, it does not quiet work like that. People ask if we cannot produce our own ozone gas to replenish what is lost in the stratosphere. The sun naturally produces ozone with immense energy during a long period of time. To do the same, we will be looking at using immense energy too, *i.e.*, approximately equal to the energy used in the world which is practically not possible.

The only way out with us is, to remove the excess chlorine and bromine from the stratosphere. And the only way to do that is to stop making CFCs and several other afore said chemicals. That's why in the 1990s, during a meeting of the world's big nations in the Montreal Protocol, it was agreed to reduce the usage of CFCs and also to encourage other nations to do the same.

SUMMARY

Ozone layer depletion, is simply the wearing out (reduction) of the amount of ozone in the stratosphere. Good Ozone plays a vital role because it shields humans, life and animals from the sun's harmful UV rays. Bad ozone produced by reaction of gases and chemicals in the presence of sunlight (UV light), contaminates (dirties) the air and contributes to formation of "smog" or haze. Several factors responsible for depletion of Ozone are :

(i) Chlorine atoms released from CFCs react with ozone molecule, starting a chemical cycle that destroys the good ozone in that area,

(ii) Chemicals that naturally destroy Ozone are Nox, Hox, Clx, which belong to the Nitrogen, Hydrogen and Chlorine families,

(iii) Eruption of volcanoes produces massive clouds of ashes, containing high concentration of bromine and chlorine, they are also responsible for depletion of Ozone, and

(iv) Human activities like pollution and emissions send lots of halogen gases into the stratosphere to break up Ozone. Depletion of the ozone layer has consequences on humans (cancer), animals and plants. This typically results from higher UV rays reaching us on earth. Apart from it it also affects the marine ecosystem and biogeochemical cycles. The only way out with us to reduce depletion of Ozone is to remove the excess chlorine and bromine from the stratosphere and stop making CFCs and several other afore said chemicals.

Short question answers

1. *Explain the depletion of Ozone gas.*

Ans. When UV light strikes (Oxygen) O_2 molecules, they are split into two individual O atoms *i.e.*, O and O. When one of the O atoms combines with O_2 molecule, ozone (O_3) is created. Ozone layer depletion, is simply the wearing out (reduction) of the amount of ozone in the stratosphere on account of human activities *i.e.*, industries that manufacture things like insulating foams, solvents, soaps and the cooling equipments like Air Conditioners and Refrigerators which use substances called chlorofluorocarbons (CFCs). These substances react with Ozone and break it up in the stratosphere.

2. *Write down the classified categories of ozone gas.*

Ans. Ozone has been classified into two categories *i.e.*,

(i) Good Ozone, because it protects the life of humans and animals on earth, and

(ii) Bad Ozone, because it contaminates (dirties) the air and contributes to what we typically experience as "smog" or haze.

3. *How can we reduce ozone depletion ?*

Ans. The only way out with us to reduce depletion of Ozone is to remove the excess chlorine and bromine from the stratosphere and stop making CFCs and several other chemicals like Nox, Hox, Clx, which belong to the Nitrogen, Hydrogen and Chlorine families.

Exercise

1. Describe the functions of various layers of earth's atmosphere.
2. Describe factors responsible for ozone depletion.
3. What are effects of ozone depletion ?

3.5.4 Pollution

There are several kinds of pollutions in our lives ; namely

(*i*) Air pollution,
(*ii*) Water pollution, and
(*iii*) Soil/Land pollution.

We will discuss them one by one below :

3.5.4A Air Pollution

The Earth is surrounded by a blanket of air (made up a various gases) called the atmosphere. The atmosphere helps protect the Earth and allows life to exist. Without it, we would be burnt by the intense heat of the sun during the day or frozen by the very low temperatures at night.

Air pollution occurs when gases, dust particles, fumes (or smoke) or odour are introduced in such a way that by reducing quantity of oxygen in the atmosphere that it becomes harmful to humans, animals and plant. This is because the air becomes dirty (contaminated or unclean). When pollution occurs in the air, it can easily travel and spread, and because we breathe in air, we cannot easily avoid it. Any additional gas, particles or odours that are introduced into the air (either by nature or human activity) to distort this natural balance and cause harm to living things can be called air pollution. Things that pollute the air are called pollutants. Examples of pollutants include nitrogen oxides, carbon monoxides, hydrocarbons, sulphur oxides (usually from factories), sand or dust particles, and organic compounds that can evaporate and enter the atmosphere.

There are *two* types of pollutants :

(*i*) ***Primary pollutants*** are those gases or particles that are pumped into the air to make it unclean. They include carbon monoxide from automobile (cars) exhausts and sulphur dioxide from the combustion of coal.

(*ii*) ***Secondary pollutants***. when pollutants in the air mix up during a chemical reaction, they form an even more dangerous chemical. Photochemical smog is an example of this, and is a secondary pollutant.

Causes of air pollution

Air pollution can result from both human and natural actions. Natural events that pollute the air include forest fires, volcanic eruptions, wind erosion, pollen dispersal, evaporation or organic compounds and natural radioactivity. Pollution from natural occurrences are not very often.

Human activities that result in air pollution include :

(*i*) ***Emissions from Industries and Manufacturing activities.*** Consider a typical manufacturing plant : You will notice that there are long tubes (called chimneys) erected high into the air, with lots of smoke and fumes coming out of it. Waste incinerators, manufacturing industries and power plants emit high levels of carbon monoxide, organic compounds, and chemicals into the air. This happens almost everywhere people live. Petroleum refineries also release lots of hydrocarbons into the air.

(*ii*) ***Burning of Fossil Fuels.*** After the industrial age, transportation has become a key part of our lives. Cars and heavy duty trucks, trains, shipping vessels and airplanes all burn lots of fossil fuels to work. Emissions from automobile engines contain both primary and secondary pollutants. This is a major cause of pollution, and the one that is very difficult to manage. This is because humans rely heavily on vehicles and engines for transporting people, goods and services. Fumes from car exhaust contain dangerous gases such as carbon monoxide, oxides of nitrogen, hydrocarbons and particulates. On their own, they cause great harm to people who breath them. Additionally, they react with environmental gases to create further toxic gases.

(*iii*) ***Household and Farming Chemicals.*** Crop dusting, fumigating homes, household cleaning or painting products, over the counter insect/pest killers and fertilizer dust emit harmful chemicals into the air and cause pollution. In many cases, when we use these chemicals at home or offices with no or little ventilation, we may fall ill if we breathe them.

Effects of Air Pollutions on Humans

(*i*) ***Carbon Monoxide (CO).*** Fuel combustion from vehicles and engines:- Reduces the amount of oxygen reaching the body's organs and tissues ; aggravates heart disease, resulting in chest pain and other symptoms.

(*ii*) ***Ground-level Ozone (O_3).*** Secondary pollutant formed by chemical reaction of volatile organic compounds (VOCs) and NO (Nitrous oxide) in the presence of sunlight. Decreases lung function and causes respiratory symptoms, such as coughing and shortness of breath, and also makes asthma and other lung diseases get worse.

(*iii*) ***Lead (Pb).*** Smelters (metal refineries) and other metal industries ; combustion of leaded gasoline in piston engine aircraft, waste incinerators (waste burners) and battery manufacturing - Damages the developing nervous system, resulting in IQ loss and impacts on learning, memory, and behavior in children. Cardiovascular and renal effects in adults and early effects related to anaemia.

(*iv*) ***Nitrogen Dioxide (NO_2).*** Fuel combustion (electric utilities, big industrial boilers, vehicles) and wood burning:-Worsens lung diseases leading to respiratory symptoms, increased susceptibility to respiratory infection.

(*v*) ***Particulate matter (PM).*** Air pollutants can be in the form of particulate matter which can be very harmful to our health. The level of effect usually depends on the length of time of exposure, as well the kind and concentration of chemicals and particles exposed to. Short-term effects include irritation to the eyes, nose and throat, and upper respiratory infections such as bronchitis and pneumonia. Others include headaches, nausea, and allergic reactions. Short-term air pollution can aggravate the medical conditions of individuals with

asthma and emphysema. Long-term health effects can include chronic respiratory disease, lung cancer, heart disease, and even damage to the brain, nerves, liver, or kidneys. Continual exposure to air pollution affects the lungs of growing children and may aggravate or complicate medical conditions in the elderly.

(vi) ***Sulphur Dioxide*** **(SO_2).** SO_2 comes from fuel combustion (especially high-sulphur coal) ; electric utilities and industrial processes as well as natural occurrences like volcanoes. Aggravates asthma and makes breathing difficult. It also contributes to particle formation with associated health effects.

Effects of Air Pollution on environment

(i) ***Acidification.*** Chemical reactions involving air pollutants can create acidic compounds and rain which can cause harm to vegetation and buildings. Sometimes, when an air pollutant, such as sulphuric acid combines with the water droplets that make up clouds, the water droplets become acidic, forming acid rain. When acid rain falls over an area, it can kill trees and harm animals, fish, and other wildlife. Acid rain destroys the leaves of plants. When acid rain infiltrates into soils, it changes the chemistry of the soil, making it unfit for many living things that rely on soil as a habitat or for nutrition. Acid rain also changes the chemistry of the lakes and streams that the rainwater flows into, harming fish and other aquatic life.

(ii) ***Eutrophication.*** Rain can carry and deposit the Nitrogen in some pollutants on rivers and soils. This will adversely affect the nutrients in the soil and water bodies. This can result in algae growth in lakes and water bodies, and make conditions for other living organism harmful.

(iii) ***Ground-level ozone.*** Chemical reactions involving air pollutants create a poisonous gas (bad) ozone (O3). Gas Ozone can affect people's health and can damage vegetation types and some animal life too.

Prevention, monitoring and solution for air pollution

Solution efforts on pollution are always a big problem, that is why preventions/ interventions are always a better way of controlling air pollution. These preventive methods can either come from government (laws) or by individual actions. In many big cities, monitoring equipments have been installed at many points. Authorities read them regularly to check the quality of air. Let's see more below :

(i) Government (or community) level prevention :

(a) Governments throughout the world have already taken action against air pollution by introducing green energy. Some governments are investing in wind energy and solar energy, as well as other renewable energy sources, to minimize burning of fossil fuels which cause heavy air pollution.

(b) Governments are also forcing companies to be more responsible with their manufacturing processes, so that even though they will still cause pollution, yet will be a lot controlled.

(c) Companies are also building more energy efficient cars (e.g., Euro V and VI), which pollute less than before.

(ii) Individual Level Prevention :

(a) Encourage your family to use the bus, train or bike while commuting. If we all do this, there will be less cars on road and less fumes.

(b) Use energy (light, water, boiler, kettle and fire woods) wisely. Lots of fossil fuels are burned to generate electricity, and if we can cut down the use, we will also cut down the amount of pollution created.

(c) Recycle and re-use things. This will minimize the production process of new things. Remember manufacturing industries create a lot of pollution, so if we can re-use things like shopping plastic bags, clothing, paper and bottles, it can help.

SUMMARY

- *Any additional gas, particles or odours that are introduced into the air (either by nature or human activity) to reduce the natural balance of Oxygen and making it harmful for living things can be called air pollution. Things like nitrogen oxides, carbon monoxides, hydrocarbons, sulphur oxides, sand or dust particles which pollute the air are called pollutants. Human industrial activities like Waste incinerators, manufacturing industries and power plants emit high levels of carbon monoxide, organic compounds, and chemicals into the air. Emissions from automobile engines contain both primary and secondary pollutants. This is a major cause of pollution, and the one that is very difficult to manage. Crop dusting, fumigating homes, household cleaning or painting products, over the counter insect/pest killers and fertilizer dust emit harmful chemicals into the air and cause pollution. Air pollution affects humans in many ways i.e.,*
  - (i) Carbon Monoxide aggravates heart disease,
  - (ii) Ground-level Ozone decreases lung function and causes respiratory symptoms,
  - (iii) Combustion of leaded damages the developing nervous system, resulting in IQ loss,
  - (iv) Wood burning worsens lung diseases,
  - (v) exposure to particulate matter can cause heart or lung disease and sometimes premature deaths, and
  - (vi) Sulphur dioxide, aggravates asthma and makes breathing difficult.
- *Air pollution affects environment badly in the ways like,*
  - (i) Chemical reactions involving air pollutants can create acidic compounds and rain which can cause harm to vegetation and buildings,
  - (ii) Rain can result in algae growth in lakes and water bodies, and make conditions for other living organism harmful, and
  - (iii) Chemical reactions involving air pollutants create a poisonous gas (bad) ozone.
- *Air Pollution can be prevented/controlled at the govt. level or at the individual level by*
  - (i) using in wind energy and solar energy, as well as other renewable energy sources,
  - (ii) companies building more energy efficient cars,

(iii) less use of cars on road,
(iv) recycle and re-use things and
(v) less Use of electrical energy.

Short question answers

1. *How does air pollution occur ?*

Ans. Air pollution can result from both human and natural actions. Natural events that pollute the air include forest fires, volcanic eruptions, wind erosion, pollen dispersal, evaporation or organic compounds and natural radioactivity. Pollution from natural occurrences are not very often.

2. *Write the types of air pollutants.*

Ans. There are two types of air pollutants *i.e.,*

(i) Primary pollutants are those gases or particles that are pumped into the air to make it unclean. They include carbon monoxide from automobile (cars) exhausts and sulphur dioxide from the combustion of coal.

(ii) Secondary pollutants: when pollutants in the air mix up during a chemical reaction, they form an even more dangerous chemical. Photochemical smog is an example of this, and is a secondary pollutant.

3. *How can we prevent air pollution ?*

Ans. These preventive methods can either come from government (laws) or by individual actions. Governments are

(i) investing in wind energy and solar energy, as well as other renewable energy sources, to minimize burning of fossil fuels which cause heavy air pollution,
(ii) forcing companies to be more responsible with their manufacturing processes and,
(iii) forcing companies to build more energy efficient cars.

At the individual level by,

(i) Using less cars on road and release less fumes,
(ii) Using energy (light, water, boiler, kettle and fire woods) wisely and
(iii) Recycle and re-use of things.

Exercise

1. How is air pollution increased by human activities ?
2. Explain the effects of air pollution on humans.
3. Describe the effects of air pollution on environment.

3.5.4B Water Pollution

Any change or modification in the physical, chemical and biological properties of water that will have a detrimental consequence on living things is called water pollution. Water pollution occurs when pollutants (particles, chemicals or substances that make water contaminated) are discharged directly or indirectly into water bodies without enough treatment to get rid of harmful compounds. Pollutants get into water mainly by human causes or factors. Water pollution can be a point-source, Non Point-source, or Trans-boundary in nature.

Usually, if pollutants come from one source into that water body, (such as a factory disposal) it is called point source pollution. If the pollution comes from many sources, it is called non-point-sources pollution. Pollution can also affect only one area in which the pollution happened. But in many cases, especially for flowing water, the contamination spreads to many other places. This is called trans-boundary pollution.

Non-point source of pollution can include :

(i) Excess fertilizers, herbicides and insecticides from agricultural lands and residential areas.
(ii) Oil, grease and toxic chemicals from urban runoff and energy production.
(iii) Sediment from improperly managed construction sites, crops and forest lands and eroding stream banks.
(iv) Salt from irrigation practices and acid drainage from abandoned mines.
(v) Bacteria and nutrients from livestock, pet wastes and faulty septic systems.
(vi) Atmospheric deposition and hydro-modification.

Types of water pollution :

There are many types of water pollution because water comes from many sources. Here are a few types of water pollution :

(i) ***Nutrients Pollution.*** Some wastewater, fertilizers and sewage contain high levels of nutrients. If they end up in water bodies, they encourage algae and weed growth in the water. This makes the water undrinkable, and even clogs filters. Too much algae will also use up all the oxygen in the water, as a result all other water organisms in the water will die out of oxygen starvation.

(ii) ***Surface Water Pollution.*** Surface water includes natural water found on the earth's surface, like rivers, lakes, lagoons and oceans. Hazardous substances coming into contact with this surface water and dissolving or mixing physically with the water can be called surface water pollution.

(iii) ***Oxygen Depleting.*** Water bodies have micro-organisms. These include aerobic and anaerobic organisms. When too much biodegradable matter (things that easily decay) ends up

in water, it encourages more microorganism growth, and they use up more oxygen in the water. If oxygen is depleted, aerobic organisms die, and anaerobic organism grow more to produce harmful toxins such as ammonia and sulphides.

(*iv*) ***Ground Water Pollution.*** When humans apply pesticides and chemicals to soils, they are washed deep into the ground by rain water. This reaches underground water, causing pollution underground. This means that when ever we dig wells and bore holes to get water from underground, it needs to be checked for ground water pollution.

(*v*) ***Microbiological.*** In many communities in the world, people drink untreated water (straight from a river or stream). Sometimes there is natural pollution caused by micro-organisms like viruses, bacteria and protozoa. This natural pollution can cause fishes and other water life to die. They can also cause serious illness to humans who drink from such waters.

(*vi*) ***Suspended Matter.*** Some pollutants (substances, particles and chemicals) do not easily dissolve in water. This kind of material is called particulate matter. Some suspended pollutants later on settle under the water body. This can harm and even kill aquatic life that live at the floor of water bodies.

(*vii*) ***Chemical Water Pollution.*** Many industries and farmers work with chemicals that end up in water. This is common with Point-source Pollution. These include chemicals that are used to control weeds, insects and pests. Metals and solvents from industries can pollute water bodies. These are poisonous to many forms of aquatic life and may slow their development, make them infertile and kill them.

(*viii*) ***Oil Spillage.*** Oil spills usually have only a localized effect on wildlife but can spread for miles. The oil can cause the death to many fish and get stuck to the feathers of seabirds causing them to lose their ability to fly.

Causes of Water Pollution

Industrial Waste. Industries cause huge water pollution with their activities. These come mainly from :

(*i*) ***Sulphur.*** This is a non-metallic substance that is harmful for marine life.

(*ii*) ***Asbestos.*** This pollutant has cancer-causing properties. When inhaled, it can cause illnesses such as asbestosis and some types of cancer.

(*iii*) ***Lead and Mercury.*** These are metallic elements and can cause environmental and health problems for humans and animals. It is also poisonous. It is usually very hard to clean up from the environment once it gets into it, because it is non-biodegradable.

(*iv*) ***Nitrates and Phosphates.*** These are found in fertilizers, and are often washed from the soils to nearby water bodies. They can cause eutrophication, which can be very problematic to marine environments.

(*v*) ***Oils.*** Oils form a thick layer on the water surface because they do not dissolve in water. This can stop marine plants receiving enough light for photosynthesis. It is also harmful for fish and marine birds. A classic example is the BP oil spill in 2012 which killed thousands of animal species.

(*vi*) ***Oil Pollution by Oil Industries.*** Routine shipping, run-offs and dumping of oils on the ocean surfaces happen everyday. Oil spills make up about 12% of the oil that enters the ocean. Oil spills cause major problems, and can be extremely harmful to local marine wildlife such as fish, birds and sea otters and other aquatic life. Because oil does not dissolve, it stays on the water surface and suffocates fish. Oil also gets caught in the feathers of sea birds, making it difficult for them to fly, as a result some animals die.

(*vii*) ***Sewage and Waste Water.*** Every day, we cook, do laundry, flush the toilet, wash our cars, shower and do many things which use water. Think about how we use water in schools, hospitals and public places. Where does all the water, liquid waste, toilet and urine end up ? In many developed countries, this waste water and soluble waste (called sewage) is treated, cleaned and dumped into the sea or river. Even though it is treated, but is never the same as fresh water. In some not-so-developed countries, the sewage is not treated, but is dumped into the sea or water bodies. This is VERY dangerous because they contaminate the environment and water bodies and bring many deadly diseases to humans.

(*viii*) ***Septic Tanks.*** In many cases, domestic (home) toilet is connected to septic tank usually located outside the house. Each time poop is flushed down the toilet, it goes into this tank, where the solid part is separated from the liquid part. Biological processes are used to break down the solids and the liquid is usually drained out into a land drainage system. From this stage, it can escape into the soil and nearby water bodies to create pollution.

(*ix*) ***Ocean and Marine Dumping.*** Again, think of the rubbish we all make each day. Paper waste, food waste, plastic, rubber, metallic and aluminum waste. In some countries, they are dumped into the sea. All these waste types take time to decompose. For example, it is know that paper takes about 6 weeks, aluminium takes about 200 years and glass takes even more years. When these end up in the sea, they harm sea animals and cause a lot of water animal deaths.

(*x*) ***Underground Storage and Tube Leakages.*** Many liquid products (petroleum products) are stored in metal and steel tubes underground. Other sewage systems run in underground tubes. Overtime, they rust and begin to leak. If that happens, they contaminate the soils, and the liquids in them end up in many nearby water bodies.

(*xi*) ***Atmospheric.*** Atmospheric deposition is the pollution of water bodies caused by air pollution. Each time the air is polluted with sulphur dioxide and nitrogen oxide, they mix with water particles in the air and form a toxic substance. This falls on the earth as acid rain, and gets washed into water bodies. As a result of that, water bodies also get contaminated which affects animals and water organisms.

Prevention of Water Pollution

Many state governments have very strict laws that help minimize water pollution. These laws are usually directed at industries, hospitals, schools and market areas on how to dispose, treat and manage sewage. In many developed countries, waste or sewage treatment is very efficient, and designed to minimize pollution of water bodies. Dealing with water pollution is something that everyone (including governments and local councils) needs to get involved with. Here are a few things we can do to help.

(*i*) Never throw rubbish away anywhere. Always look for the correct waste bin. If there is none around, please take it home and put it in your trash can. This includes even places like the beach, riverside and water bodies.

(*ii*) Use water wisely. Do not keep the tap running when not in use. Also, you can reduce the amount of water you use in washing and bathing. If we all do this, we can significantly prevent water shortages and reduce the amount of dirty water that needs treatment.

(*iii*) Do not throw chemicals, oils, paints and medicines down the sink drain, or the toilet. Check with your local authorities if there is a chemical disposal plan for local residents.

(*iv*) Buy more environmentally safe cleaning liquids for use at home and other public places. They are less dangerous to the environment.

(*v*) If you use chemicals and pesticides for your gardens and farms, be mindful not to overuse pesticides and fertilizers. This will reduce runoffs of the chemicals into nearby water sources. Start looking at options of composting and using organic manure instead.

(*vi*) If you live close to a water body, try to plant lots of trees and flowers around your home, so that when it rains, chemicals from your home do not easily drain into the water.

SUMMARY

- *Any change or modification in the physical, chemical and biological properties of water that will have a detrimental consequence on living things is called water pollution. The types of water pollution are :*
  - (*i*) containing high levels of harmful nutrients,
  - (*ii*) hazardous substances coming into contact with this surface water,
  - (*iii*) Oxygen Depleted,
  - (*iv*) Ground water pollution,
  - (*v*) caused by micro-organisms like viruses and bacteria,
  - (*vi*) suspended particulate matter,
  - (*vii*) Chemical Water Pollution, and
  - (*viii*) Oil Spillage.

- *Water pollution is caused mainly by the untreated domestic waste and that of the industries. The industrial waste can be in the form of : (i) Sulphour, (ii) Asbestos, (iii) Lead and mercury, (iv) Nitrates and phosphates, and (v) Oils.*
- *Other sources can be, (i) domestic sewage, (ii) septic Tanks, (iii) underground leakages and (iv) atmospheric deposition of pollutants in water bodies. For preventing water pollution state governments have very strict laws that help minimize water pollution. These laws are usually directed at industries, hospitals, schools and market areas on how to dispose, treat and manage sewage.*

Short question answers

1. *Define the term water pollution.*

   Ans. Water pollution occurs when pollutants (particles, chemicals or substances that make water contaminated) are discharged directly or indirectly into water bodies, which change or modify the physical, chemical and biological properties of water.

2. *Differentiate between point source pollution and non-point source pollution.*

   Ans. If pollutants come from one source into that water body, (such as a factory disposal) it is called point source pollution. If the pollution comes from many sources, it is called non-point-sources pollution.

3. *How can we prevent water pollution ?*

   Ans. Dealing with water pollution is something that everyone (including governments and local councils) needs to get involved with. Few steps required to be taken by everybody are :

   (*i*) Always throw rubbish away in the correct waste bin,
   (*ii*) Do not waste water by keeping the tap running when not in use,
   (*iii*) Do not throw chemicals, oils, paints and medicines down the drain,
   (*iv*) Use environmentally safe cleaning liquids for use,
   (*v*) Do not to overuse pesticides and fertilizers, and vi) Plant lots of trees and flowers around your home.

Exercise

1. Describe non-point sources of water pollution.
2. Describe types of water pollution.
3. Explain the causes of water pollution.

3.5.4C Soil/Land Pollution

Soil pollution is caused by the presence of man-made chemicals in the natural soil environment. It is typically caused by industrial activity, agricultural chemicals, or improper disposal of waste. The most common chemicals involved are petroleum hydrocarbons, polynuclear aromatic hydrocarbons, pesticides, lead and other heavy metals. Soil contamination is a health risk, from direct contact with the contaminated soil, vapours from the contaminants, and from secondary contamination of water supplies within and underlying the soil. Pollution remains a major challenge and opportunity for India. Environmental issues are one of the primary causes of disease, health issues and long term livelihood impact for India. In India major environmental issues are forest and agricultural degradation of land, resource depletion (water, mineral, forest, sand, rocks etc.), environmental degradation, public health, loss of biodiversity loss of resilience in ecosystems and livelihood security for the poor.

Soil pollution can lead to water pollution if toxic chemicals reach groundwater, or if contaminated runoff reaches streams, lakes, or oceans. Soil also naturally contributes to air pollution by releasing volatile compounds into the atmosphere. Nitrogen escapes through ammonia volatilization and denitrification. The decomposition of organic materials in soil can release sulphur dioxide and other sulphur compounds, causing acid rain. Heavy metals and other potentially toxic elements are the most serious soil pollutants in sewage. Sewage sludge contains heavy metals and, if applied repeatedly or in large amounts, the treated soil may accumulate heavy metals and consequently become unable to even support plant life.

Polluted soil directly affects human health through direct contact with soil or via inhalation of soil contaminants which have vapourised. Potentially greater threats are posed by the infiltration of soil contaminants into groundwater aquifers used for human consumption. Health consequences from exposure to soil contamination vary, depending greatly on pollutant type, pathway of attack and vulnerability of the exposed population. Chronic exposure to chromium, lead and other metals, petroleum, solvents, and many pesticide and herbicide formulations can be carcinogenic which cause congenital disorders, or can cause other chronic health conditions. Industrial or man-made concentrations of naturally occurring substances, such as nitrate and ammonia associated with livestock manure from agricultural operations, have also been identified as health hazards in soil and groundwater.

Soil pollution is caused by :

(*i*) Accidental Spills,
(*ii*) Acid rain,
(*iii*) Intensive farming,
(*iv*) Deforestation,
(*v*) Genetically modified plants,
(*vi*) Nuclear wastes,

(*vii*) Industrial Accidents,
(*viii*) Landfill and illegal dumping,
(*ix*) Agricultural practices, such as application of pesticides, herbicides, and fertilizers,
(*x*) Mining and other industries,
(*xi*) Oil and fuel dumping,
(*xii*) Buried wastes,
(*xiii*) Disposal of coal,
(*xiv*) Disposal of munitions and agents of war,
(*xv*) Drainage of contaminated surface water into the soil, and
(*xvi*) Electronic waste.

The major sources of soil pollution in India include the rampant burning of fuel wood and biomass such as dried waste from livestock as the primary source of energy, lack of organised garbage and waste removal services, lack of sewage treatment operations, lack of flood control and monsoon water drainage system, diversion of consumer waste into rivers, and cremation practices near major rivers. Trash and garbage is a common sight in urban and rural areas of India. It is a major source of pollution. Indian cities alone generate more than 100 million tons of solid waste a year. Street corners are piled with trash. Public places and sidewalks are spoiled with filth and litter. Rivers and canals act as garbage dumps. India's garbage crisis is from rising consumption. India's waste problem also points to a stunning failure of governance. All Indian cities were asked by the supreme court of India to implement a comprehensive waste-management programme that would include household collection of segregated waste, recycling and composting. Forget waste segregation and recycling directive of the India's Supreme Court, the Organisation for Economic Cooperation and Development estimates that up to 40 per cent of municipal waste in India remains simply uncollected.

In 2011, several Indian cities embarked on waste-to-energy projects of the type in use in Germany, Switzerland and Japan. For example, New Delhi is implementing two incinerator projects aimed at turning the city's trash problem into electricity resource. These plants are being welcomed for addressing the city's chronic problems of excess untreated waste and a shortage of electric power. They are also being welcomed by those who seek to prevent water pollution, hygiene problems, and eliminate rotting trash that produces potent greenhouse gas methane.

Cleanup and remedial strategies :

(*i*) Excavate soil and take it to a disposal site away from ready pathways for human or sensitive ecosystem contact. This technique also applies to dredging of bay muds containing toxins.

(ii) Aeration of soils at the contaminated site (with attendant risk of creating air pollution).

(iii) Thermal remediation by introduction of heat to raise subsurface temperatures sufficiently high to volatize chemical contaminants out of the soil for vapour extraction. Technologies include ISTD, electrical resistance heating (ERH), and ET-DSP.

(iv) Bioremediation, involving microbial digestion of certain organic chemicals. Techniques used in bioremediation include land farming, bio-stimulation and bio-augmentating soil biota with commercially available micro flora.

(v) Extraction of ground water or soil vapor with an active electromechanical system, with subsequent stripping of the contaminants from the extract.

(vi) Containment of the soil contaminants (such as by capping or paving over in place).

(vii) Phytoremediation, or using plants (such as willow) to extract heavy metals.

(viii) Using fungus to metabolize contaminants and accumulate heavy metals.

(ix) Microbes can also be used in soil cleanup.

SUMMARY

Soil pollution is caused by the presence of man-made chemicals like petroleum hydrocarbons, poly-nuclear aromatic hydrocarbons, pesticides, lead and other heavy metals in the natural soil environment. In India major environmental issues are forest and agricultural degradation of land, resource depletion (water, mineral, forest, sand, rocks etc.), environmental degradation, public health, loss of biodiversity loss of resilience in ecosystems and livelihood security for the poor. Soil pollution can lead to water pollution if toxic chemicals reach groundwater. The decomposition of organic materials in soil can release sulphur dioxide and other sulphur compounds, causing acid rain. Polluted soil directly affects human health through direct contact with soil which is caused by ; Acid rain, Intensive farming, Deforestation, Nuclear wastes, Landfill and illegal dumping, application of pesticides, herbicides, and fertilizers, Mining , Oil and fuel dumping, Buried wastes, Drainage of contaminated surface water into the soil, and Electronic waste. Many Cleanup and remedial strategies have been suggested by the government in the year 2011 and it is being implemented by many cities in India.

Short question answers

1. *What is soil pollution ?*

Ans. When chemicals like petroleum hydrocarbons, poly-nuclear aromatic hydrocarbons, pesticides, lead and other heavy metals soak in up to deep soil or get mixed up with the upper soil, reducing content of oxygen therein, it is called soil pollution.

2. *Describe the effects of soil pollution on humans.*

Ans. Polluted soil directly affects human health through direct contact with soil or via inhalation of soil contaminants which have vapourised. Potentially greater threats are posed by the infiltration of soil contaminants into groundwater aquifers used for human consumption.

3. *What is the major source of soil pollution in India ?*

Ans. The major sources of soil pollution in India include the rampant burning of fuel wood and biomass such as dried waste from livestock as the primary source of energy, lack of organised garbage and waste removal services, lack of sewage treatment operations, lack of flood control and monsoon water drainage system, diversion of consumer waste into rivers, and cremation practices near major rivers.

Exercise

1. How is soil pollution caused ?
2. Describe the effect of soil pollution on land.
3. Suggest the strategies to prevent and clean up the land pollution.

3.6 COMPUTER ETHICS

Computer ethics primarily enforce the ethical implementation and use of computing resource. It includes methods and procedures to avoid infringing copyrights, trademarks and the unauthorized distribution of digital content. Computer ethics also entails the behaviour and approach of a human operator, workplace ethics and compliance with the ethical standards that surround computer use. The following are the *ten* commandments of Computer Ethics created by the Computer Ethics Institute in 1992.

(*i*) ***Do not use a computer in ways that may harm other people.*** This commandment says that it is unethical to use a computer to harm another user. It is not limited to physical injury. It includes harming or corrupting other users' data or files. The commandment states that it is wrong to use a computer to steal someone's personal information. Manipulating or destroying files of other users is ethically wrong. It is unethical to write programs, which on execution lead to stealing, copying or gaining unauthorized access to other users' data. Being involved in practices like hacking, spamming, phishing or cyber bullying does not conform to computer ethic.

(*ii*) ***Do not use computer technology to cause interference in other users' work.*** Computer software can be misused in ways that disturb other users or disrupts their work. Viruses, for example, are programs meant to harm useful computer programs or interfere with the normal functioning of a computer. Malicious software can disrupt the functioning of computers in more ways than one. It may overload computer memory through excessive consumption of computer resources, thus slowing its functioning. It may cause a computer to function wrongly or even stop working. Using malicious software to attack a computer is unethical.

(*iii*) ***Do not spy on another person's computer data.*** We know it is wrong to read someone's personal letters. On the same lines, it is wrong to read someone else's email message or files. Obtaining data from another person's private files is nothing less than breaking into someone's room. Snooping around in another person's files or reading someone else's personal messages is the invasion of his privacy. There are exceptions to this *i.e.*, spying is necessary and cannot be called unethical when it is done against illegitimate use of computers. In some cases intelligence agencies working on cybercrime cases need to spy on the internet activity of suspects.

(*iv*) ***Do not use computer technology to steal information.*** Stealing sensitive information or leaking confidential information is as good as robbery. It is wrong to acquire personal information of an employee from an employees' database or a patient's history from a hospital database or other such information that is meant to be confidential. Similarly, breaking into a bank account to collect information about the account or account holder is wrong. Illegal electronic transfer of funds is a type of fraud. With the use of technology, stealing of information has become much easier. Computer can also be used to store stolen information. Both of these actions are also unethical.

(*v*) ***Do not contribute to the spread of misinformation using computer technology.*** Because of the internet, spreading of information has become viral today. This also means that false news or rumors can spread speedily through social networking sites or emails. Being involved in the circulation of incorrect information is unethical and illegal. Mails and pop-ups are commonly used by terrorists to spread the wrong information or give false alerts with the only intent of spreading terror. Mails from untrusted sources advertising certain products or spreading some hard-to-believe information, are not uncommon. Direct or indirect involvement in the circulation of false information is ethically wrong.

(*vi*) ***Refrain from copying software or buying pirated copies.*** Pay for software unless it is free Like any other artistic or literary work, software is copyrighted. A piece of code is the original work of the individual who created it. It is copyrighted in his name. In case of a developer writing software for the organization he works for, the organization holds the copyright for it. Copyright holds true unless its creators announce it is not. Obtaining illegal copies of copyrighted software is unethical.

(*vii*) ***Do not use someone else's computer resources unless authorized to.*** Multi-user systems have user specific passwords. Breaking into some other user's password, thus intruding his private space is unethical. It is not ethical to hack passwords for gaining unauthorized access to a password-protected computer system. Accessing data that you are not authorized to access or gaining access to another user's computer without his permission is not ethical.

(*viii*) ***It is wrong to claim ownership on a work which is the output of someone else's intellect.*** Programs developed by a software developer are his/her property. If he is working with an organization, they are the organization's property. Copying them and propagating them in one's own name is unethical. This applies to any creative work, program or design. Establishing ownership on a work which is not yours is ethically wrong.

(*ix*) ***Before developing a software, think about the social impact it can have.*** Looking at the social consequences that a program can have, describes a broader perspective of looking at technology. A computer software on release, reaches millions. Software like video games and animations or educational software can have a social impact on their users. When working on animation films or designing video games, for example, it is the programmer's responsibility to understand his target audience/users and the effect it may have on them. For example, a computer game for kids should not have content that can influence them negatively. Similarly, writing malicious software is ethically wrong. A software developer/development firm should consider the influence their code can have on the society at large.

(*x*) ***In using computers for communication, be respectful and courteous with the fellow members.*** The communication etiquette we follow in the real world applies to communication over computers as well. While communicating over the internet, one should treat others with respect. One should not intrude others' private space, use abusive language, make false statements or pass irresponsible remarks about others. One should be courteous while communicating over the web and should respect others' time and resources. Also, one should be considerate with a novice computer user.

3.6.1 Cyber-Crimes

The term cyber-crime refers to criminal activities including computers, networks, or the internet. Computer crime is any crime that is committed with a computer over a network. The computer or network may be the target of the crime, or the computer may be the device utilized for carrying out other crimes.

Cyber-crime falls into *two* general categories : those which target computer networks or devices and those which merely use a computer network to target individuals.

The following are some types of computer crimes :

(*i*) Hacking or unlawfully accessing a computer system or network.
(*ii*) Changing, damaging, copying or stealing software or data.
(*iii*) Placing malware or a virus on a computer system.
(*iv*) Launching denial of service attacks.
(*v*) Using a computer for fraud or identity theft.
(*vi*) Blocking someone's computer or network access.
(*vii*) Using encryption to carry out a crime.
(*viii*) Faking email source information.
(*ix*) Cyber stalking, or stalking someone over the internet.
(*x*) Stealing services or information.
(*xi*) Stealing personal information (phishing).

Cyber war is being waged, malware is the attack tool, and internet users are on the front-lines of the battlefield. Criminals are attacking *via* the Web, using social engineering tricks and the compromised websites to foist malware onto victims computers. The goal : to steal financial and intellectual property from individuals and companies across the globe.

3.6.2 Stealing Computer Data

The development of ever higher-capacity portable data storage devices, such as USB pen drives, has made it almost trivially easy to copy large quantities of data from almost any computer. We have also seen users use e-mail and web-mail to transfer key files from their computer systems often in large quantities, and most computers still have CD and DVD burners that provide another potential route for data to be stolen. Data theft is sufficiently common that, ideally, any organization should have some kind of incident response plan to deal with it. Most organization, however, do not have it. The following brief information for IT personnel or other managers who are faced with potential data theft or are thinking of preparing a plan for dealing with it. Though it is not a complete incident response plan, however, it is hoped that it will provide a useful guide to the key issues in dealing with data theft incidents and may help anyone faced suddenly with dealing with such an event. It deals with most of the main issues being faced by organizations who have encountered this kind of problem.

How is data generally stolen ?

In most of the common methods used to steal data is by using a USB "*thumb drive*" or a similar small data storage device. Indeed, any device with substantial amounts of on-board memory can be employed for data theft. A recent phenomenon, for example, is the use of portable digital players to remove data from computers, a practice referred to as "*podding*" by its practitioners. There are however other modes of data theft which we also see on an ever increasing basis :

Common modes of data theft :

USB "*pen*" or "*thumb*" drive devices are cheap, easy to hide, and have large storage capacities. This makes them a perfect device for data theft.

Portable hard drive :

While USB pens can store several gigabytes of data (*i.e.*, hundreds of documents) it is possible to purchase small portable hard drives that can store hundreds of gigabytes (tens of thousands of documents). These devices are often not much larger than an iPod, and can be powered from the USB ports of the computers they are connected to.

MPS players, digital cameras, memory cards or PDAS :

Many modern devices now have substantial onboard memory capacities, all of which can be used for removing data. Some of these devices have the additional advantage that their use is more easily explainable by the data thief, and more difficult for an investigator to follow.

CD/ DVD :

Again, using a CD or DVD has the advantage to being more apparently legitimate. Also writable DVD's now have capacities of nearly 9 gigabytes, comparable to larger USB thumbs.

E-mails :

Some data thieves simply use e-mail to transfer files out. Often this is done over a long period of time, so organization IT staff do not notice large messages passing through their servers. It is also common to see such mails sent to private or web-based e-mail addresses, on the pretence that the sender is preparing to work on the data "*at home*".

Web-mail :

Data thieves use web-mail to send data from their organization. This has the advantage of greater apparent privacy than conventional e-mails, and often allows for larger attachments to be sent. Fortunately, web mail often leaves significant forensic traces that a skilled investigator can recover.

Printing :

Some careful data thieves will not make any electronic copies at all, but will print out key documents and steal them in hard-copy form. This, of course, limits the amount of

material that can be stolen, but it does not prevent the stolen material being quickly transferred back into electronic form later, through techniques like scanning and Optical Character Recognition.

Remote Access :

Some organizations make data theft even easier by allowing remote access to their systems from employee's private computers. This makes data theft difficult to trace, and makes it very difficult for investigators to identify the computers and other devices to which the stolen data has been transferred.

3.6.3 Hacking and Malware Attacks

Cybercriminals know that the best way to breach defences is to trick the user into doing something harmful. Their methods range from cleverly worded email, to fake websites, to even phone and snail mail. Everyone is a potential target and anyone who uses the Web risks social engineering attacks each time they open their email or browse to a website. To effectively defend yourself, you need to become aware of just how much personal information about you is publicly available via the web and learn to control the information so it cannot be used against you, your friends, or your family.

(i) Social Engineering Attacks

A social attack is one in which the intended victim is somehow tricked into doing the attacker's bidding. An example would be responding to a phishing email, following the link and entering your banking credentials on a fraudulent website. The stolen credentials are then used for everything from finance fraud to outright identity theft. An old adage comes to mind here, *"it pays to be suspicious"*. With socially engineered attacks, the opposite is also true if aren't suspicious, you likely will end up paying. In addition to phishing, social engineering attacks can come in many forms email that masquerades as breaking news alerts, or greeting cards, or announcements of bogus lottery winnings. Pump and dump stock scams are also a form of social engineering, playing on the recipients' natural desire to take advantage of a good deal. It's important to remember that if something sounds too good to be true, it's probably a scam.

Social engineering attacks are also often used to tick users into infecting their own systems for example, by disguising the malware as a video codec or Flash update. An email is sent enticing the recipient to view a bogus video clip, the victim visits the link contained in the email and installs the "codec/ update" which turns out to be a backdoor Trojan or keystroke logger. Remember: with social engineering scams, the attacker is relying on you to make the wrong choice. Choose not to be a victim.

(ii) Targeted Attacks

Targeted attacks are on the increase. Some of the biggest targets are corporate executives in sensitive sectors such as energy, weapons research, and finance. In many cases,

the victim is enticed via email into opening a malicious email attachment or visiting a nefarious website. But these email messages aren't the badly written, easy to spot scams most of us are familiar with. Instead, attackers pinpoint a specific person and include personal and often (seemingly) confidential details in order to appear as if the email were legitimate correspondence from a business associate or government entity. So how do attackers gain the type of knowledge needed to pull this off ?

Part of the answer may lie in social networking sites. Attackers can create an account, find a weak friend of the target's, and get that friends to add them as a friend. Once the attacker is a friend of a friend, they may be able to leverage that relationship to get added as a friend by the target. This, of course, allows the attacker access to the target's profile, discovers who their contacts are, and glean any other information provided as part of the service. It may seem far fetched, but the reality is that many people will add near (or perfect) strangers to their friend's list-either as an attempt to boost their own perceived popularity or because they don't want to risk hurting and feeling of someone. The easiest way to avoid this type of casual disclosure is to never add friends you don't absolutely, really know. You can further minimize the risk by adding only those friends you actually do know and whom you have a legitimate social or business need to remain in contact with. Search engines can also reveal many personal and business details. To see what type of information is publicly searchable about you, simply pull up your favorite search engine, type in your name, and read through the results. If you've ever written a letter to the editor of a newspaper, commented on a blog, or participated in a community forum or mailing list, chances are you'll find all of these in the search results. Highly placed executives are also often quoted in press releases or their comments carried in news articles, providing even more fodder for attackers. In the latter case, an attacker can simply subscribe to a newsfeed with the target's name as a keyword in order to keep a current and running tab.

Those in sensitive sectors should also monitor the type of information discoverable about their spouse and children. Attackers have been known to target family members as well. While there's not much that can be done about the information already available on the Web, forewarned is forearmed. Simply knowing the information out there can help you avoid being tricked by the inclusion of personal details in an email. It's a bit ironic that while the technology behind the Internet provides anonymity for would-be attackers, the Web itself can dissolve any semblance of privacy for would-be victims.

(iii) Online Games Attack

Blizzard, makers of the very popular World of War craft series of MMORPG, has been aggressively warning players to the risks of key loggers and other Trojans that can lead to compromise of their online gaming credentials. After ploughing through 12 pages of player comments in the Blizzard customer support forum, it is convincing that there's more than just a malware at play. For many of the impacted players, the cause could boil down to good old fashioned trickery, aka Social Engineering.

No one wants to believe or admit that they were the victim of a social engineering scam. At least with an outright malware infection, you can blame Windows or the failure of your antivirus (regardless of whether it's either of those at fault). But with a social engineering scam, we have only ourselves to blame. However, until we confess up to our own fallibility, we can't take the steps necessary to change our behaviour (and avoid getting fooled again and again). Many social engineering scams are done with extreme cleverness. Consider a phishing scam that masquerades as a password change notice from a website that you have an account with. The email advises you that a new password has been provided for the account and includes a link to visit in case the request wasn't initiated by you. Click that link and you get taken to what looks to be the site you know and trust. You're prompted to enter your username and the old password (pre-change) for confirmation. So you do. Problem is, the site is just a false front for the attacker. What you've really done is just sent the attacker your valid login ID and password. Chances are equally good that it's not even the website (or online game) credentials that have been compromised. Instead, chances are that the email you've specified in the account has been compromised. Consider that many folks use the same username and password for their email as they do for their IM. This is a bad practice, but still lots of folks do it. One popular (and for some reason, wildly successful) IM scam works as follows :

You get an IM from someone on your contact list. It has a link, perhaps claiming to be a video or something else. You click the link and it takes you to a website that tells you that you need to login to your IM account (or Facebook, or MySpace, or whatever) in order to view the video. You 'login' on the page provided, but once again it's just a false front and what you're really doing is sending the attackers your login credentials.

Let's say the attackers want to steal some WoW accounts. First, they'll probably work through the list of email credentials they've already stolen. For those who use the same account info in multiple places, they may be able to login with just that. If not, they initiate a bunch of forgotten password requests. Those passwords will be sent to the respective email addresses on record for each of the respective accounts. All that the attackers have to do now is sit back and monitor the stolen email accounts and intercept any of these password change notices before they reach the legitimate email account holder. Now you can't login, but the attacker can. This is a pretty pervasive scam - odds are that if you do actually receive a change notice from an account for which you have not just made a change, it's almost undoubtedly a phishing scam. On the other hand, if the attackers are making the change, you're almost certain not to get a change notification. To play it safe, if you ever do receive a change notification from an online account for which you did not initiate the change, do not click any links provided in the email. Instead, visit the site just as you normally would and check your account that way. And to prevent a scam on one account leading to the compromise of another, never use the same credentials across multiple accounts.

When account credentials for IM, email, Facebook, MySpace, etc. are stolen, they end up on big lists that get sold to other criminals. It can be weeks, months, even years, between the original scam that led to the compromise of the credentials, to those credentials being used to steal your online game assets. So just because you don't remember getting scammed, it doesn't mean you weren't. Sadly, scammers may not even need to work that hard. Often all they need to do is persuade the gamer that they are a GM. Now I'm not sure why people are so willing to believe that X is a GM - maybe it's the cool factor. Two things about real GM's. One, if they want to play the game, they aren't going to advertise the fact that they are also a GM. Otherwise, players will never stop bothering them with questions. So if another player claims to be a GM, think twice. In any event, never and ever will a legitimate GM ask for your username and password. So if you supply your username and/or password to a GM, whether in-game or out, you've just been scammed.

(iv) The Web Attacks

There's an old acronym in the computing industry WYSIWYG. Pronounced *"wizzy-wig"*, it stands for *"What You See Is What You Get"*. While that used to be true with computers, today nothing could be further from the truth. Today, many of the websites we trust and visit routinely are being compromised and hidden code references are inserted. While you can't see any visible signs of the compromise, that hidden code reference is silently loading exploits and malware onto your computer. Here's what you need to know to defend yourself against hidden website compromises.

The web browser interprets the HTML, JavaScript, and other scripting language used on the web into readable form for you to view. But while everything might look fine on the page, it's what you can't see that can hurt you. Hidden frames and external JavaScript references can execute malicious code behind the scenes, silently infecting your computer while you browse perfectly legitimate website. You can reduce that risk by properly securing your browser.

3.6.4 Embezzlement and Scams

Scammers continue to exploit job seekers, but the *"Shopper Needed"* scam isn't just enlisting innocent folks into illegal money laundering activities. Scams are also exploiting good name of legitimate professional shopper services. Bear that in mind when reading the copy that though the scammers use the name of a company, it is not affiliated in any way with the real company. The shopper-needed scam sends the *'new hire'* a bank cheque for a few thousand rupees, instructing them to encash the cheque and take their portion, then forward on the remaining funds to the *"employer"*. Of course, the cheque is bogus, it will bounce eventually, and you the victim will be liable for the funds you spent from the cheque, plus the amount you forwarded on, plus any service fees or fines that result. Never assume that because a bank releases funds after 5 days, that the cheque has actually cleared. That grace period has no bearing on whether the cheque is good for payment or not.

Wire Transfer Scams

Small businesses in India are having their hard-earned funds stolen by cybercriminals and transferred overseas, all thanks to the willing gullibility of scam victims. The typical crime

begins with an infection of a data theft/backdoor Trojan which steals login credentials from key employees at the business. The stolen credentials enable the attackers to gain access to the business' bank account and initiate an ACH transfer of funds. But most banks will alert on an overseas transfer, and that's where the middleman - the gullible scam victim - comes into play.

To avoid sounding alarms at the bank, the criminals need someone in India to accept the initial transfer and then forward it to the overseas attackers. All they need is a person willing to turn a blind eye to the red flags. And with these tough economic times, there are unfortunately far too many willing to do just that.

The scam takes many forms, typically masquerading as solicitation for a mystery shopper, or some other bogus job offer. The scam may also claim to be a pay out for a lottery winnings. All the scams have one thing in common that they involve you in depositing funds into your bank account, then withdrawing and wiring a portion of those funds via Western Union or some other unrecoverable wire transfer method. By unrecoverable, we mean that once the scam is discovered, the scam victim will be 100% liable for the transferred/stolen funds. Now that the criminals have the cash in hand they will be untraceable.

Online Scams

The internet makes it easier to accomplish many things as banking, research, travel, and shopping are all at our virtual fingertips. Just as the internet makes it easier for legitimate pursuits, it also makes it easier for scammers, con artists, and other online miscreants to carry out their virtual crimes impacting our real life finances, security, and peace of mind. Online scams are constantly evolving, but here are the most common ones today.

(*i*) ***Phishing scams.*** Phishing email try to trick the intended victim into visiting a fraudulent website disguised to look like a valid eCommerce or banking site. The victim thinks they are logging into their real account, but instead everything they enter on the fake site is being sent to the scammers. Armed with this information, the scammer can wipe out the victim's accounts, run up their credit cards, or even steal their identity.

(*ii*) ***Nigerian 419 scams.*** Nigerian 419 scams (aka Advanced Fee Fraud) date back to the days when fax machines and snail were the primary business communication tools. Today, email is the preferred method of these scammers and there are more Nigerian 419 Advance Fee Fraud scams and victims than ever before.

(*iii*) ***Greeting Card Scams.*** Greeting card scams arrive in email pretending to be from a friend or family member. Clicking the link to view the card typically leads to a booby-trapped web page that downloads Trojans and other malicious software onto the systems of the unsuspecting victim.

(*iv*) ***Shopper Needed Cheque Fraud Scam.*** The shopper-needed scam sends the 'new hire' a cheque for a few thousand rupees, instructing them to cash the cheque and take their portion, then forward on the remaining funds to the "*employer*". Of course, the cheque is bogus, it will bounce eventually, and you the victim will be liable for the funds you spent from the cheque, plus the amount you forwarded on, plus any service fees or fines that result.

(*v*) ***Reshipping and Payment Processing Fraud.*** Normally for such a fraud an advertisement reads: Help Wanted to legally launder money on behalf of criminals. But it doesn't. Instead it couches the crime in soft terms like 'payment processing' and 'reshipping transactions'. Don't be fooled. Victims not only find themselves engaged in illegal activity, but they will also be on the legal hook for the entire amount transferred and any fees that result.

(*vi*) ***Lottery Winning Scams.*** Lottery winning scams attempt to trick recipients into believing that they have won large sums of cash, and then draws them out of their own dough in a similar fashion to the Nigerian 419 scam.

(*vii*) ***Pump and Dump Stock Scams.*** Pump and dump scams send large volumes of email that pretend to disclose confidential information about a particular stock in an attempt to inflate the price.

(*viii*) ***Fraudulent Link Scams.*** Scams, in general, are the new malware delivery method. Social engineering is the norm. Falsifying a link is the hallmark of phishing scams, seeded downloader Trojans, and other web-based malware. And it's all trivially easy to do, basic HTML.

(*ix*) ***Killer Spam.*** Imagine opening your email inbox and reading a message from an alleged claimer that you're the target. It sounds like something out of a horror movie, but it's been happening in real life to hundred of people. The gist of the email being to either pay the hit man thousands of rupees, or die.

(*x*) ***Scare ware Scams.*** Scare ware erroneously claims the system is infected and instructs the user to purchase a '*full version*' in order to clean the bogus infections. Sometimes, fake antivirus software gets installed by the user who fell victim to an advertising scam. Other times, a rogue antispyware scanner may be installed by exploit, a so called '*drive-by install*'. Regardless of how the rogue software gets installed, the user is often left a hijacked, crippled system. To avoid becoming a victim, before installing any software over the internet search on the name of the product using your favourite search engine. Don't' skip this step and you'll go along ways towards a safer online experience.

SUMMARY

- *Computer ethics primarily enforces the ethical implementation and use of computing resources. It includes methods and procedures to avoid infringing copyrights, trademarks and the unauthorized distribution of digital content. The Computer Ethics Institute has created the ten commandments for computer users i.e.,*
  - (*i*) *Do not use a computer in ways that may harm other people,*
  - (*ii*) *Do not use computer technology to cause interference in other users' work,*
  - (*iii*) *Do not spy on another person's computer data,*
  - (*iv*) *Do not use computer technology to steal information,*
  - (*v*) Do not contribute to the spread of misinformation using computer technology,

(vi) *Refrain from copying software or buying pirated copies. Pay for software unless it is free,*
(vii) *Do not use someone else's computer resources unless authorized,*
(viii) *It is wrong to claim ownership on a work which is the output of someone else's intellect,*
(ix) *Before developing a software, think about the social impact it can have, and*
(x) *In using computers for communication, be respectful and courteous with the fellow members.*

◆ *Computer crime (cyber-crime) is any crime that is committed with a computer over a network. The computer or network may be the target of the crime, or the computer may be the device utilized for carrying out other crimes. Cyber war is being waged, malware is the attack tool, and internet users are on the front-lines of the battlefield. Everyone, whether individual or a company, is a potential target and anyone who uses the Web risks social engineering attacks, Malware attacks, Web attacks and targeted attacks each time they open their email or browse to a website. Apart from embezzlement scam, wire transfer scam, online scam, the scammers also steal Computer Data through portable Hard Drive, MPS Players, DVD, E-Mails, Web-Mail, Printing and Remote Access.*

Short Question Answers

1. *Why are computer ethics important in use of computing resources ?*

Ans. Computer ethics primarily enforces the ethical implementation and use of computing resource. It includes methods and procedures to avoid infringing copyrights, trademarks and the unauthorized distribution of digital content. Computer ethics also entails the behaviour and approach of a human operator, workplace ethics and compliance with the ethical standards that surround computer use.

2. *What is cyber-crime and how does it affect the individuals and companies ?*

Ans. Computer crime (cyber-crime) is any crime that is committed with a computer over a network. The computer or network may be the target of the crime, or the computer may be the device utilized for carrying out other crimes. Cyber-crime falls into two general categories: those which target computer networks or devices and those which merely use a computer network to target individuals. The goal: to steal financial and intellectual property from individuals and companies across the globe. Cybercriminals know that the best way to breach defences is to trick the user into doing something harmful. Their methods range from cleverly worded email, to fake websites, to even phone and snail mail. Everyone, whether individual or a company, is a potential target and anyone who uses the Web risks social engineering attacks, Malware attacks, Web attacks and targeted attacks each time they open their email or browse to a website. To effectively defend yourself, you need to become aware of just how much personal information about you is publicly available via the web and learn to control the information so it cannot be used against you, your friends, or your family.

3. *Why and how the term "what you see in what you get" called to be an old acronym in the "Web attacks" ?*

Ans. There's an old acronym in the computing industry WYSIWYG. Pronounced *"wizzy-wig"*, it stands for *"What You See Is What You Get"*. While that used to be true with computers, today nothing could be further from the truth. Today, many of the websites we trust and visit routinely are being compromised and hidden code references are inserted. The web browser interprets the HTML, JavaScript, and other scripting language used on the web into readable form for you to view. But while everything might look fine on the page, it's what you can't see that can hurt you. Hidden frames and external JavaScript references can execute malicious code behind the scenes, silently infecting your computer while you browse perfectly legitimate website. You can reduce that risk by properly securing your browser.

4. *How are scammers exploiting job seekers ?*

Ans. Scammers continue to exploit job seekers by enlisting innocent folks into illegal money laundering activities. Though the scammers use the name of a company, it is not affiliated in any way with the real company. The shopper-needed scam sends the 'new hire' a bank cheque for a few thousand rupees, instructing them to encash the cheque and take their portion, then forward on the remaining funds to the "employer". Of course, the cheque is bogus, it will bounce eventually, and the victim becomes liable for the funds spent from the cheque, plus the amount he forwarded on, plus any service fees or fines that result.

5. *Explain the term "Wire Transfer Scams" which are affecting individuals and banking services.*

Ans. The typical crime begins with an infection of a data theft/backdoor Trojan which steals login credentials from key employees at the business. The stolen credentials enable the attackers to gain access to the business' bank account and initiate an ACH transfer of funds. But most banks will alert on an overseas transfer, and that's where the scam victim comes into play. To avoid sounding alarms at the bank, the criminals need someone in India to accept the initial transfer and then forward it to the overseas attackers. The scam takes many forms, typically masquerading as solicitation for a mystery shopper, or some other bogus job offer. The scam may also claim to be a payout for lottery winnings. All the scams have one thing in common that they involve you in depositing funds into your bank account, then withdrawing and wiring a portion of those funds via Western Union or some other unrecoverable wire transfer method.

Exercise

1. Explain in brief the Ten Commandments created by the computer Ethics Institute.
2. How is social engineering attack used to trick users ?
3. Explain the term "Targeted Attacks". How is it used as a search engine to harm the social and business circles ?
4. Explain in brief the misuse of online games by the scammers with examples.
5. Describe in brief the most common online scams being used for framed and embezzlement of money.
6. Explain the various methods used by scammers to steal data from individuals and organizations.

CHAPTER 4

Engineer as a Role Model

4.1 INDUSTRIAL PRODUCTION

For boosting industrial production we have to exploit and make a maximum utilization of our production capacity by proper and efficient use of our resources related to man, machine and material. It also depends on other indirect supports *i.e.*, quantity, quality and efficiency of manufacturing apart from capacity utilization, choice of product, available energy, process of manufacturing technique and raw material used. Utilization of capacity is a measure of performance indicators of an industry. Every industry is endlessly in a course of self-appraisal for measuring its own current performance vis-a-vis its various targets, past achievements and operative capacity. The main aim of any industry is to produce an item (or service) to sell at a profit. However, a well organised business will wish to make this profit making an ongoing process. Whilst a one-off sale will usually return a short-term profit, continuous and sustained income from profits is much more desirable.

In order to continue in business, any industry or company needs to make a continuous profit. This profit provides income that enables growth and development within the industry. It may be used to keep shareholders happy by paying them a dividend. It may be used to repair machinery, buy new equipment or to maintain current stock, or it may be directed to the owner's pay packet.

It is important to return a profit and in order to return a profit ; an industry needs to become efficient in whatever process it does. In becoming efficient, it will also produce more goods, which can be sold for a profit. This profit can then be re-invested in the company to help it become more efficient, and so on.

A century ago, industrial manufacturing was dominated by large-scale, energy-hungry processes such as smelting ores and machining metals. Today, the industrial landscape features an array of novel techniques operating on much smaller scales, making computer

Exercise

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A century ago, industrial manufacturing was dominated by large-scale, energy-hungry processes such as smelting ores and machining metals. Today, the industrial landscape features an array of novel techniques operating on much smaller scales, making computer

chips, carbon nano-fibers and other sophisticated products. Traditional processes included melting and casting metal, grinding and machining, and injection moulding of plastics, along with more recent innovations such as the use of lasers and water jets to shape materials. Rounding out the list of techniques were the wide range of processes used in the microelectronics sector, such as chemical vapour deposition and sputtering, as well as carbon Nano-fibre production. The evolution towards more technologically advanced manufacturing has happened at the cost of a sharp decrease in efficiency. The most hi-tech processes can take as much as a million times more energy and materials to make a given quantity of finished product than traditional industrial methods *i.e.*, a trend that may hinder efforts to build a more energy-conscious industrial economy using cutting-edge materials and technology.

4.1.1 Production

Production is inevitably linked to efficiency. The more efficient an industry is, the more it can produce. Then it can make a large profit that reflects the company's efficiency. This increased production and profit can lead the company or industry in re-investing into its own operations in buying more equipment and/or to modernise the current equipment. It will need to do this in order to maintain its competitiveness against other similar companies. If too much of the profit is taken away from the business, then the efficiency of that company is in decline, as measured against other similar companies.

4.1.2 Efficiency

Efficiency is dependent upon the company's resources and its ability to manage these in respect to such areas *e.g.*, it's location (or address), access to surrounding industrial or technological facilities, the capabilities of the resources, technology and equipment on site skilled and semiskilled workers' expertise, management expertise, access to finance/ loans/ capital, access to modern assembly techniques and similar technologies access to labour saving devices and a flexible and willing workforce. The following strategies are just a few examples of current industry management solutions resolve to efficiency problems.

(*i*) Mass production (*ii*) Robotics
(*iii*) Power tools, *e.g.*, electric, battery, pneumatic (air powered), hydraulic
(*iv*) Conveyor belts (*v*) Standardisation
(*vi*) Lean production (*vii*) Outsourcing
(*viii*) Computer-assisted equipment, *e.g.*, computer-aided design (CAD), computer-aided manufacturing (CAM)
(*ix*) Quality control and "*quality circles*"
(*x*) Multiskilling
(*xi*) Specialisation
(*xii*) Electronic ordering and fund transfers
(*xiii*) Invoiceless purchasing.

4.1.3 Quality Control

Quality control is a process that evaluates output relative to a standard and takes corrective action when output doesn't meet these predetermined standards. Therefore, quality control in relation to customers would be the continuous act of making sure that products, designed and manufactured, are produced to meet and exceed the needs of customers. The purpose of quality control is to make sure that certain processes are performing up to a company's set standards. The statistical process control tries to correct processes that are not in line with the predetermined limits. Lastly, process capability studies the output standards to make sure they are up to specifications. Inspections can be considered an appraisal technique that compares goods or services to a standard. Inspection should not be eliminated because it is a vital aspect of quality control and service operations. Inspection increases production/service costs, so it is important to be efficient in your inspection efforts and only allocate inspection at points that maximize effectiveness. Some of these points include :

- Raw materials and Purchased Parts
- Finished Products
- Prior to Large Investments
- Prior to Irreversible Changes
- Before a Covering Process

4.1.4 Quantity

For efficient mass production, automation is used in different processes of manufacturing such as machining and welding. Automated manufacturing refers to the application of automation to produce goods in a factory. The main advantages of automated manufacturing for the manufacturing process are realized with effective implementation of automation and include: higher consistency and quality, reduction of lead times, simplification of production, reduced handling, improved work flow and improved worker morale. Robotics is the application of mechatronics and automation to create robots, which is also often used in manufacturing to perform tasks that are dangerous, unpleasant, or repetitive. These robots may be of any shape and size, but all are pre-programmed and interact physically with the work. To create a robot, an engineer typically employs kinematics (to determine the robot's range of motion) and mechanics (to determine the stresses within the robot). Robots are used extensively in manufacturing engineering. Robots allow businesses to save money on labour, perform tasks that are either too dangerous or too precise for humans to perform economically, and to ensure better quality. Many companies employ assembly lines of robots, and some factories are so robotized that they can run by themselves. Outside the factory, robots have been employed in bomb disposal, space exploration, and many other fields.

4.1.5 Power/Energy Costs

Any manufacturing process uses power/ energy to transform raw materials into a desired product. But some fraction of the raw materials will generally go waste, and energy is not always used as efficiently as it might be. To better understand these losses, technocrats have developed a framework based on the laws of thermodynamics, that keeps track of both the energetic, as well as the physical or chemical transformations of materials, as they pass through the steps of an industrial process. With the exception of the methods that involved melting metal, the overall power requirements for each process were surprisingly similar, ranging from about 5 to 50 kilowatts of electricity. On the other hand, the amounts of material processed varied enormously, ranging from hundreds of kilograms per hour or more for the older processes to just a few milligrams per hour for two of the most novel techniques. A striking trend emerged: as processes become more technologically sophisticated, they tend to manipulate smaller and smaller quantities of material at slower rates, but since power consumption per process has stayed about the same, the amount of energy needed to generate a given quantity of finished product has been growing fast. An inefficient process operating on a tiny amount of material may not be very important when set against the entirety of industrial energy use. The world now produces more than 20,000 tons of electronics-grade silicon per year, consuming about 50 billion kilowatt hours of electricity in the process. Production of carbon fibres, which are often proposed for large scale applications, is in the same category in terms of energy used per kilogram of product.

Modern industrial techniques often require elaborate materials and procedures with exact energetic and material costs but don't get directly incorporated into the product. For example, highly reactive gases may be used to clean production equipment for silicon chips in preparation for other steps, and those gases may have to be chemically treated after use for safety or pollution-control reasons. These ancillary but essential elements of a hi-tech manufacturing process can reduce enormously its "*degree of perfection*" *i.e.*, the ratio of the thermodynamic value of the product to the thermodynamic value of everything that was needed to make it. The more ideal a process, the closer that ratio will be to 1:1. In reality, processes can vary significantly in their degree of perfection. For example, it was calculated that an electric furnace that melts scrap and other iron to produce a refined metal output can have a degree of perfection of 0.79. By contrast, a chemical vapour deposition method used by the semiconductor industry to produce thin layers of silicon dioxide can have a degree of perfection of not quite four millionths. In designing processes that turn expensive materials into small quantities of hi-tech products, manufacturers have focused their attention on a variety of issues such as size and quality, but haven't had strong incentives to reduce energy consumption. Manufacturers of solar panels, for example, are well aware of the energy-intensive nature of the processes they use, and figure it into estimates of the pay-back time in energy as well as money of the devices they make. To be truly green, in other words, a solar panel must deliver substantially more energy over its lifetime than was consumed in creating it. That kind of thinking hasn't yet taken hold in other areas, such as Nano-materials, where the energy costs of manufacturing are not widely known. As more applications of such materials gain attention, especially in the context of "*green*" technology, there will have to be a serious conversation about dealing with energy costs.

4.1.6 Capacity Utilization

Manufacturing capacity utilization is such a key indicator of manufacturing efficiency and economic performance which explains changes in investment, inflation, long-run growth etc. It may be noted that even the analysis of total factor productivity would be more meaningful if adjustment is made for fluctuations in capacity utilization.

The overriding importance of capacity utilization in the overall resource-use and efficiency of the economy shows the existence of excess capacity in the industrial sector in India because most of the industries are demand-constrained. The definition of installed capacity differs from firm to firm. There is no uniform way to define it and it is not clear how firms respond to the question of their capacity. Many of the firms report capacity based on a single shift operation, which is not the case in practice. This creates ambiguity in explaining the results also. Shortage of raw materials and foreign exchange, labour unrests etc. has been identified to be the such underutilization. Industrial products are classified into five groups of industries namely-metal products, machinery other than electrical, electrical machinery and appliances, transport equipments, chemicals and chemical products, paper products and consumer goods.

Products with more than 60 percent unutilized capacity consist of chemical, fertilizer's, drugs, steel, rubber, steel forgings and nonferrous alloys etc. Shortage of raw materials, shrinkage of demand and labour problem followed by shortage of power might be the possible reasons for underutilization of capacity.

The supply factors that affect capacity utilization include availability of raw materials and inputs, infrastructural bottlenecks such as power shortage and transport bottlenecks etc. the demand factors include changes in domestic and foreign demand caused by changes in tastes or by general macro-economic situations. Industry groups like diesel engines, railway wagons and vanaspati etc. which operate with more than excess capacity face mainly demand constraints. Agricultural tractors and cotton cloth (mills) with excess capacity of more than 25 percent face mainly supply constraints. Capacity utilization has improved after the path breaking economic reforms got under way in 1991. While there does not exist a unique relationship between the prevalent policy regime and industrial performance, optimal combination of policies capable of correcting some of the structural imbalances can create a favourable environment for better industrial performance. Low capacity utilization of the state owned Indian airlines and Air India has deteriorated on account of fuel prices, excess staff, serving uneconomic route and increasing expenses on insurance. Low capacity utilization has rarely been cited as one of the main reasons for their poor financial performances.

Other major issues which play the significant role are demand and supply factors affecting the level of capacity utilization. The impact of economic reforms per se is not significant, the policy changes may influence supply and demand side factors determining the level of industrial capacity utilization. Capacity utilization is positively related to size of the firm, market share and market concentration. Import liberalization has an adverse effect on capacity utilization in the industries.

> *"It has been found that capacity utilization in India as a measure of performance of industrial sector has received very little attention."*

SUMMARY

- *The main aim of any industry is to produce an item (or service) to sell at a profit. However, a well organised business will wish to make this profit making an on-going process. Whilst a one-off sale will usually return a short-term profit whereas, continuous and sustained income from profits is much more desirable. For boosting industrial production we have to exploit and make a maximum utilization of our production capacity by proper and efficient use of our resources related to man, machine, material and other indirect supports. In the earlier times industrial manufacturing was dominated by large-scale, energy-hungry whereas, today, the industrial landscape features an array of novel techniques operating on much smaller scales, making computer chips, carbon nano-fibers and other sophisticated products. The more efficient an industry is, the more it can produce to make a large profit. This increased production and profit can lead the company or industry in re-investing, to maintain its competitiveness against other similar companies. Efficiency of industry is dependent upon the company's resources and its ability to manage these in respect to such areas e.g., it's location, industrial facilities, workers' expertise and access to finance. Quality control and quantity produced are very important factors for survival of any industry. Any manufacturing process uses power/ energy to transform raw materials into a desired product. In modern industrial techniques a striking trend has emerged as processes become more technologically sophisticated, the amount of energy needed to generate a given quantity of finished product has been growing fast. Importance of capacity utilization in the overall resource-use and efficiency of the economy shows the existence of excess capacity in the industrial sector in India because most of the industries are demand-constrained.*

Short Question Answers

1. *Define the term "Industrial Productions".*

   Ans. Industrial production is maximum profitable utilization of our production capacity by proper and efficient use of our resources related to man, machine and material with the help of other indirect supports *i.e.*, quantity, quality and efficiency of manufacturing apart from capacity utilization, choice of product, available energy, process of manufacturing, technique and raw material used.

2. *How is production linked to efficiency ?*

   Ans. Production is inevitably linked to efficiency. The more efficient an industry is, the more it can produce. Then it can make a large profit that reflects the company's efficiency.

3. *How profit earned is important to continue in business ?*

   Ans. The increased production and profit can lead the company or industry in re-investing into its own operations in buying more equipment and/or to modernise the current equipment. It will need to do this in order to maintain its competitiveness against other similar companies. If too much of the profit is taken away from the business, then the efficiency of that company is in decline, as measured against other similar companies.

4. *Why and how the quality control and quantity produced are related to each other to become important for the survival of industry ?*

   Ans. Quality control is a process that evaluates output relative to a standard and takes corrective action when output doesn't meet these predetermined standards. Higher the quantity of production, higher will be the profit. For efficient mass production, automation is used in different processes of manufacturing. The main advantages of automated manufacturing advantages include higher consistency of quality production with greater profits.

5. *Explain the importance of power/energy cost in manufacturing.*

   Ans. Any manufacturing process uses power/energy to transform raw materials into a desired product. In modern industrial techniques a striking trend has emerged: as processes become more technologically sophisticated, the amount of energy needed to generate a given quantity of finished product has been growing fast, hence also the electricity bills.

6. *How is capacity utilization important in manufacturing ? Compare the effects of under utilisation of capacity and excess manufacturing capacity.*

   Ans. Major issues which play the significant role are demand and supply factors affecting the level of capacity utilization. Manufacturing capacity utilization is such a key indicator of manufacturing efficiency and economic performance which explains changes in investment, inflation, long-run growth etc. The overriding importance of capacity utilization in the overall resource-use and efficiency of the economy shows the existence of excess capacity in the industrial sector in India because most of the industries are demand-constrained. Capacity utilization is positively related to size of the firm, market share and market concentration. Import liberalization has an adverse effect on capacity utilization in the industries.

Exercise

1. How is efficiency linked to higher production ?
2. Compare the present industrial manufacturing processes with that of the past.
3. Explain the factors responsible for higher efficiency in the industry.
4. Why is quality control important and related to production for survival of business ?
5. How does automation and robotics help enhancement in quantity of production, explain ?
6. What do you mean by utilisation of capacity in industrial production ?

4.2 TEAM WORK SPIRIT

It has been recognised as a link between the staff as a group which works closely together at a happy productive workplace. Extra-curricular activities which take place outside the office are usually a mix of work-oriented social activities used as team building events. Their purpose is to simultaneously break down barriers between individuals and departments and foster a close understanding among employees. Team working events and policies need careful planning for keeping a balance between goals and responsibilities of each employee. A best team award can also be established to motivate the employees. The ethos of teamwork extends to treat every employee the same way, whether on contract or permanent basis. The teamwork between permanent and contract staff has to be so seamless that any business partner remains unaware that who is contract staff and who is permanent one. Team working does not arise spontaneously among staff. It requires an investment of time, attention and budget to create, maintain, harvest and monitor.

Communication between different departments requires being encouraged through formal and informal measures so that all senior managers and their juniors sit in a common area, rather than in their own teams. Everybody should have an understanding of his/her mutual roles and responsibilities with set objectives to identify the different roles needed to achieve their goals in different ways, *i.e.*, by delivering, managing and supporting each other. A culture of team working reduces excessive competitiveness between staff in the same department, which can otherwise harm overall productivity.

Although emphasis on teamwork brings a host of benefits *i.e.*, from helping each other to bonding colleagues to work collaboratively, yet it is important that it should not become an excuse for staff to shirk from their individual obligations and targets. It is important to note that the individuals retain clear ownership of their objectives and the business benefits they are responsible for delivering. The employees are to be encouraged to work outside their usual role, as and when necessary to help colleagues. Team working can help knowledge transfer between staff. Everybody as a team has to be flexible to support each other according to the requirement of situation. Although they may have their own jobs, yet sometimes it is a question of 'whosoever is there'. The teamwork ethos is also boosted by the challenging nature of the job at work because the increasing complexity of work and speed of change means that there is no place for the classic stereotype of working. Everyone in the team has to communicate and be a proactive part of it. Teamwork is not an end in itself, and is justified only when it contributes to overall, long-term productivity.

Teamwork needs to be nurtured by the organisation because, however many mechanisms you may have in place to create and support teamwork, you can still be taken by surprise on various occasions *i.e.*, unanticipated issues crop up, or someone doesn't know something you thought he/she did. All the teams don't work well together therefore managers must ensure that the right mix of personalities is engaged, otherwise friction can develop in the team, which can be destructive.

Teamwork has also to adapt to changing business circumstances. Within various departments team members should sit down and run through key business projects together, and set up all projects on corporate portal so that everyone in the team on the different business projects can see the status of individual projects. This step will aid mutual communication and understanding on projects.

SUMMARY

- *Team work spirit has been recognised as a link between the staff as a group which works closely together at a happy productive workplace. Communication between different departments requires being encouraged through formal and informal measures so that all senior managers and their juniors sit in a common area, rather than in their own teams. The employees are to be encouraged to work outside their usual role, as and when necessary to help colleagues. Team working can help knowledge transfer between staff. Everyone in the team has to communicate and be a proactive part of it. Teamwork is not an end in itself, and is justified only when it contributes to overall, long-term productivity. All the teams don't work well together therefore managers must ensure that the right mix of personalities is engaged.*

Short Question Answers

1. *What do you understand by the term "Team Work spirit", explain ?*

   Ans. It has been recognised as a link between the staff as a group which works closely together at a happy productive workplace. Extra-curricular activities which take place outside the office are usually a mix of work-oriented social activities used as team building events. Their purpose is to simultaneously break down barriers between individuals and departments and foster a close understanding among employees.

2. *How is communication important for team work ?*

   Ans. Communication between different departments requires being encouraged through formal and informal measures so that all senior managers and their juniors sit in a common area, rather than in their own teams. Everybody should have an understanding of his/her mutual roles and responsibilities with set objectives to identify the different roles needed to achieve their goals in different ways.

3. *How does the term "Whosoever is there" boost team work ethos ?*

   Ans. Everybody as a team has to be flexible to support each other according to the requirement of situation. The teamwork ethos is also boosted by the challenging nature of the job at work because the increasing complexity of work and speed of change means that there is no place for the classic stereotype of working. Everyone in the team has to communicate and be a proactive part of it. Although they may have their own jobs, yet sometimes it is a question of 'whosoever is there'.

Exercise

1. What is the importance of colleagueship in team work ?
2. Why is it important to have a right mix of personalities in team work ?
3. How does team work handle changing business circumstances ?

4.3 WORK CULTURE

Work Culture in any organisation includes the organisation's vision, values, norms, systems, symbols, language, assumptions, beliefs and habits. Work culture is a set of shared assumptions that guides what happens in organisations by defining appropriate behaviour for various situations. It is also the pattern of such collective behaviours and assumptions that are taught to new organisational members as a way of perceiving and, even, thinking and feeling. Thus, organisational culture at the work place affects the way people and groups interact with each other, with clients, and with stakeholders. In addition, organisational culture may affect how much employees identify with an organisation and are satisfied with their job.

A strong culture is said to exist in an organisation where staff responds to stimulus because of their alignment to organisational values. In such environments, strong, cultures help firms operate like well-oiled machines, engaging in outstanding execution with only minor adjustments to existing procedures as needed. Conversely, where there is weak culture there is little alignment with organisational values, and control must be exercised through extensive procedures and bureaucracy.

Research shows that organisations that foster strong cultures have clear values that give employees a reason to embrace that culture. A "*strong*" culture may be especially beneficial to firms operating in the service sector, since members of these organisations are responsible for delivering the service. Research indicates that organisations may derive the following benefits from developing strong and productive work cultures :

(*i*) Better aligning the company towards achieving its vision, mission, and goals.

(*ii*) High employee motivation and loyalty.

(*iii*) Increased team cohesiveness among the company's various departments and divisions.

(*iv*) Promotion consistency and encouraging coordination and control within the company.

(*v*) Shaping employee behaviour at work, enabling the organisation to be more efficient.

(*vi*) High job satisfaction to employees.

Where work culture is strong, people do work because they believe it is the right thing to do, and there is a risk of another phenomenon called group think, wherein the members' strivings for unanimity override their motivation to realistically appraise alternatives of action. This is a state in which even if they have different ideas, do not challenge organisational thinking, and therefore there is a reduced capacity for innovative thoughts. This could occur, for example, where there is heavy reliance on a central charismatic figure in the organisation, or where a friendly climate is at the base of their identity (avoidance of conflict). Members that are defiant are often seen as a negative influence by the rest of the group because they bring conflict.

In order to increase productivity, growth, efficiency and reduce counter productive behaviour, organisations should strive for what is considered a "*healthy*" organisational culture. A variety of characteristics given below describe a healthy work culture, which include ;

(*i*) Acceptance and appreciation for diversity.

(*ii*) Regard for and fair treatment of each employee as well as respect for each employee's contribution to the company.

(*iii*) Employee's pride and enthusiasm for the organization to derive a job satisfaction.

(*iv*) Equal opportunity for each employee to realize his/ her full potential within the company.

(*v*) Strong communication with all employees regarding policies and company issues.

(*vi*) Strong company leaders/managers with a strong sense of direction and purpose.

(*vii*) Ability to compete in industry innovation and customer service, as well as price.

(*viii*) Higher than average total turnover (perpetuated by a healthy work culture).

(*ix*) Investment in learning, training, and employee knowledge.

Performance oriented work culture have been shown to possess statistically better financial growth. Such cultures possess high employee involvement, strong internal communications and an acceptance and encouragement of a healthy level of risk-taking in order to achieve innovation. Additionally, organisational work cultures the explicitly emphasize factors related to the demands placed on them by industry technology and growth will be better performers in their industries.

4.3.1 Types of Organisational Work Culture

Before we get into the specific details of the different types of cultures, there are two overarching models that companies will fall into *i.e.*, strong culture and weak culture. In a strong culture, employees have a sense of empowerment and understanding of the company goals, regulations and philosophy. This kind of culture allows employees to be driven and feel respected which benefits the overall health of a company. In a weak organisational culture, employees are lost, unmotivated and operate under a regime of fear. Fear may motivate individuals but not for long and for all of the wrong reasons. Employees should never feel that they will be wrongly reprimanded for making mistake or for needing a little extra guidance. If you have trouble disciplining your employees, don't get crazy on them for minor oversights. Let's explore some organisational work cultures below :

(*i*) ***Academic Culture.*** Academic culture depends on employees who are highly skilled, studious and welcome further training and advancement. This type of work place environment thrives on account of intense training for employees being brought on board and ongoing training for the employees already there. Organisations that choose to follow this culture are very particular about who they hire, their existing skill sets and their willingness to learn and grow. Although this format of management keeps turn-over rates low, yet the

employees are eager to do their job to the best of their ability. Many hospitals, universities and other educational institutions rely on academic culture to stay up to date on the newest information and technology.

(*ii*) ***Normative Culture.*** At corporate workplace, normative culture is very dry, following strict regulations and guidelines that uphold the policies of the organisation. Employees rarely deviate from their specific job role, break rules or do anything other than what is asked of them. These types of organisations run a tight ship and are not suited for every type of employee.

(*iii*) ***Pragmatic Culture.*** You know the saying "*the customer is always right*". Well, that is the first and only rule of a pragmatic culture workplace. The customer or client comes before anything or anyone else. Because every customer is different, these types of work places are very opposite of the normative culture environment as employees don't adhere to strict rules. Whatever the customer wants, the customer gets (within reason, of course).

(*iv*) ***Club Culture (i.e., Nothing but the best).*** This type of culture requires employees to be very skilled and competent in their niche of work. Educational qualifications, prior work experience and even personal interests are taken into consideration before an employee is hired. Club culture can be seen in organisations like the RAW, commercial pilots and specialty branches of the military. The hiring process can be pretty intense for these work environments, requiring multiple interviews, a stellar resume (and references to back it up), background checks and so on. The upside of being a part of a club culture is that only your hard work will pay off. These types of employers often reward hard work with promotions but with that are frequent appraisals of your work and role within the company.

(*v*) ***Sports Team Culture.*** This could be the best type of organisational culture from an employee's stand point. Remember how pragmatic culture focuses on the customers ? Well, sports team environments say it's all about the employees. As long as the workers are happy, comfortable and feel respected, the work will get done and the employees will want to stick with the company for the long haul. TCS is a good example of a sports team culture, the employees get to pretty much to do what they want, soup up their offices with whatever makes them feel creative. Company outings are a regular thing, social events within the office and incentives are a big component of this type of culture.

(*vi*) ***Fortress Culture.*** Contrary to sports team culture, fortress culture could be the worst for employees. This type of environment is all about the numbers. If the organisation is doing well as a result of the employee's productivity then the employees continue to have a job. If the organisation begins to see a downfall in success then the individuals who aren't pulling well are terminated. This type of work culture promotes wastage of the time and money invested in training these employees. With such a high termination rate these companies have to hire a new set of people and are forced to train them and later on to find that few of them cannot stay up to the required speed.

(*vii*) ***Expectations Culture.*** This culture is basically another way of saying micro-management. Employees are monitored at every step of the way and when something does not meet the standards or expectations of the company the employee is given guidance and

monitored further. It can be a tough (may also be called tough guy culture) environment for some to work in, especially if you are independent and have a creative mind. These types of companies just want to ensure consistency and commitment to their customers and they need employees who can be shaped to do just that. Performance evaluation comments can be tricky, try not to intimidate your employees, instead find tactful ways to say what you need to say.

(*viii*) ***Process Culture.*** This type of work culture provides a set of regulations and procedures that the employees follow. It's different than the normative culture as the regulations are not a bullet-pointed list of do's and don'ts. Employees know what they are getting into when they sign-up and are often self-starters. These employees are not micro-managed and they rarely are given performance reviews. If they are given reviews it's annually and it's to assess their work on a large scale, their aspirations within the company and potentially a discussion about salary. More often than not, government offices run and operate under the process culture.

(*ix*) ***Bet Culture.*** This culture is for the patient risk-takers. Organisations that follow this culture are known to literally bet the success or failure of their company on a single decision, of which the outcome is completely unknown. It can be a wild ride working for this type of company as you don't know what is going to happen each day. The consequences of the decisions made by the individuals working in the bet culture can be so dire that the company may go in heavy losses and contrarily, they can be so excellent that the company thrives more than ever before.

> *"There are many different types of cultures that develop within a company. Some companies practice with more than one of these and some are strictly one of the above. Overall, routing your employees on while ensuring the customers are happy is the best balanced culture. Try talking to your employees about what they like and dislike about the work place and you can begin understanding what changes need to be made for the health of your organization."*

4.3.2 Rules for Creating the Right Conditions for a Good Organisational Work Culture

(*i*) ***Hire the Right People.*** Hire for passion and commitment first, experience second, and credentials third. There is no shortage of impressive CVs out there, but you should try to find people who are interested in the same things you are. You should get a sense of what the potential employee believes by asking the right key questions *e.g.*, what do you love about your chosen career ? What inspires you ? What courses in school did you read ?

(*ii*) ***Communicate.*** Once you have the right people, you need to sit down regularly with them and discuss what is going well and what isn't. It's critical to take note of your victories, but it's just as important to analyze your losses. A fertile culture is one that recognizes when things don't work and adjust to rectify the problem. Employees need to feel safe and trusted, to understand that they can speak freely without fear of repercussion. The art of

communication tends to put the stress on talking, but listening is equally important. Great cultures grow around people who listen *e.g.*, what is the market saying ? What developments, trends and calamities are going on ?

(iii) ***Replace the Whiners.*** A culture of passion capital can be compromised by the wrong people. One of the most destructive corporate weeds is the whiner. They don't stand up in meetings and think that everything is wrong with the company. Instead, they move through the organisation, speaking privately, sowing doubt and strangling passion. Constructive criticism is healthy, but relentless complaining is toxic. Identify these people and replace them.

(iv) ***Reward Hard Workers.*** In the global economy we can understand who is leading in productivity on account of superior work ethics. Many industries thrive on more than forty eight hour work per week. A culture where everyone understands that long hours of work are sometimes required will work, if this sacrifice is recognized and rewarded.

(v) ***Be Ambitious.*** Ambition is sometimes seen as a negative attitude these days, but without it we would stagnate. We need a culture that supports big steps and powerful beliefs.

(vi) ***Celebrate Diversity.*** Great cultures are built on a diversity of background, experience, and interests. These differences generate energy, which is critical to any enterprise.

(vii) ***Create the Space.*** The organisations should design spaces where people from different disciplines can come together, whether in workspace or in common leisure space. Reasoning is simple *i.e.*, it is this interaction that helps breed revolutionary ideas. Create a free atmosphere and engineer chat over coffee. Let HR and marketing people bump into one another in the fitness center. Culture is made in the physical space. Look at your space to promote interaction and connectivity.

(viii) ***Take the Long View.*** If your work culture is dependent on this quarter's earnings or this month's sales targets, then it is handicapped by short-term thinking. We tend to overestimate what we can do in a year, but underestimate what we can do in five years. The culture needs to look ahead, not just in months but in years and even decades.

SUMMARY

- *Work Culture in any organisation includes the organisation's vision, values, norms, systems, symbols, language, assumptions, beliefs and habits. Organisational culture may affect, how much employees identify themselves with their organisation and are satisfied with their job. There are two types of work cultures i.e., (i) strong culture and weak culture. In a strong culture, employees have a sense of empowerment and understanding of the company goals, regulations and philosophy, and (ii) weak organisational culture, wherein employees are lost, unmotivated and operate under a regime of fear. In order to increase productivity, growth, efficiency and reduce counterproductive behaviour, organisations should strive for what is considered a "healthy" organisational culture which includes ; appreciation, fair treatment of each employee, Employee's pride and enthusiasm, Equal opportunity, Strong communication, Strong company leaders, Ability to compete in industry, Higher turnover, and Investment in learning. There are many different types of cultures that develop within a company. Some companies practice with more than one of these and some are strictly one of the following ; (i) Academic Culture, (ii) Normative Culture, (iii) Pragmatic Culture, (iv) Club Culture (i.e., Nothing but the best), (v) Sports Team Culture, (vi) Fortress Culture, (vii) Expectations Culture, (viii) Process Culture, and (ix) Bet Culture. For creating the right conditions for a good organisational work culture the company should ; (i) Hire the Right People, (ii) Communicate with employees, (iii) Replace the Whiners, (iv) Reward Hard Workers, (v) Be Ambitious, (vi) Celebrate Diversity, (vii) Create the space, and (viii) Take the long view.*

Short Question Answers

1. *Differentiate between strong culture and weak culture.*

Ans. There are two overarching models that companies will fall into i.e., strong culture and weak culture. In a strong culture, employees have a sense of empowerment and understanding of the company goals, regulations and philosophy. This kind of culture allows employees to be driven and feel respected which benefits the overall health of a company. In a weak organisational culture, employees are lost, unmotivated and operate under a regime of fear. Fear may motivate individuals but not for long and for all of the wrong reasons. Employees should never feel that they will be wrongly reprimanded for making mistake or for needing a little extra guidance.

2. *Describe the benefits of a strong culture in an organization.*

Ans. A strong culture is said to exist in an organisation where staff responds to stimulus because of their alignment to organisational values. In such environments, strong cultures help firms operate like well-oiled machines, engaging in outstanding execution with only minor adjustments to existing procedures as needed. Conversely, where there is weak culture there is little alignment with organisational values, and control must be exercised through extensive procedures and bureaucracy. Where work culture is strong, people do work because they believe it is the right thing to do.

3. *What is healthy work culture, define ?*

Ans. A work culture which increases productivity, growth, efficiency and reduces counter productive behaviour is considered a "healthy" organisational culture.

4. *State and explain in brief the types of work culture in organistations.*

Ans. Some organisational work cultures are ; (i) Academic Culture, (ii) Normative Culture, (iii) Pragmatic Culture, (iv) Club Culture (i.e., Nothing but the best), (v) Sports Team Culture, (vi) Fortress Culture, (vii) Expectations Culture, (viii) Process Culture, and (ix) Bet Culture.

Exercise

1. What do you understand by the term "Work Culture" in any organization ?
2. Describe characteristics of healthy work culture.
3. Describe in brief the rules for creating good organizational work culture.
4. If you are an entrepreneurs which type of or combination of work culture would you like to adopt and why ?

4.4 FEELING OF JOB SATISFACTION

Every day in the newspapers we find hundreds of advertisements on vacancies in various companies/offices/organizations within and outside the country. These advertisements contain some details and description about the salary, bonus, future promotion prospects, job location and facilities and perks provided like residential accommodation, club, Gym, transport, medical, children education etc. Every person is unique in what he/she wishes to achieve from his/ her work, but there are some job satisfaction factors that psychologists usually agree upon. Actually the details mentioned in the advertisements indicate the direct factors which give job satisfaction to a person. We will briefly discuss these and other indirect factors responsible for job satisfaction.

An employee's overall satisfaction with his job is the result of a combination of above said factors and most important of all is the financial compensation. Management's role in enhancing employees' job satisfaction is to make sure the work environment is positive, morale is high and employees have the resources they need to accomplish the tasks they have been assigned, by keeping an eye on the following points :

(*i*) ***Job Security.*** Everybody wants a secure job for the security of his/her family and dependents however, job security is rapidly becoming a thing of the past. Most people will have many jobs over the course of their working lives. What job security means today is that you have strong transferable skills and knowledge that you can bring with you to each new job therefore one should plan to develop solid reading, math, technical and thinking skills.

(*ii*) ***Working Environment.*** Few workplaces are exactly as we want them to be but a poor work environment can make us hate getting up in the morning. Is the workplace comfortable ? How are the ventilation, lighting and temperature ? Is there adequate privacy ? Is it attractive and welcoming ? Is it conducive to work ? Employees spend much of the time in their work environment, it's important for companies to try to optimize good working conditions. Provision of things such as providing spacious work areas rather than cramped ones, adequate lighting and comfortable work stations contribute to favourable work conditions. Providing productivity tools such as upgraded information technology to help employees accomplish tasks more efficiently contributes to job satisfaction as well.

(*iii*) ***Workload and Stress Level.*** A heavy workload can lead to stress and burnout, on the other hand, a light workload can be totally boring and unsatisfying. Of course there will be more and less intense periods with every job but over a long period you want to have a balance. A good job will give you enough work to keep you productive and challenged and yet not so much that you feel you're being taken advantage of. Dealing with a workload that is far too heavy and deadlines that are impossible to reach can cause job satisfaction to erode for even the most dedicated employee. Falling short of deadlines results in conflict between employees and supervisors and raises the stress level of the workplace. Many times, this environment is caused by ineffective management and poor planning. The office operates in a crisis mode because supervisors don't allow enough time for employees to perform their assigned tasks effectively or because staff levels are inadequate.

(*iv*) ***Opportunity for Advancement.*** Employees are more satisfied with their current job if they see a path available to move up the ranks in the company and be given more responsibility and along with it higher compensation. Many companies encourage employees to acquire more advanced skills that will lead to the chance of promotion. For example, companies often pay the cost of tuition for employees taking university courses. During an employee's annual performance review, a supervisor should map out a path showing his/her what he/she needs to accomplish and what new skills he/she needs to develop in order to be on a track to advancement within the organization. Management should reward achievements with increased responsibility with opportunities for growth or promotion. Lack of opportunity can be frustrating and demoralizing.

(*v*) ***Interpersonal Relations.*** Good relationships in the workplace are essential ingredients of a good job. The workplace is a social environment. Employees are happier and do better when there is a sense of teamwork and camaraderie. When employees get along and work well together, there is higher turnover, less friction and better performance. Employees seek to be treated with respect by those, they work with. A hostile work environment with rude or unpleasant co-workers is one that usually has lower job satisfaction. Managers need to step in and mediate conflicts before they escalate into more serious problems requiring disciplinary action. Employees may need to be reminded what behaviours are considered inappropriate when interacting with co-workers.

(*vi*) ***Recognition.*** Effective managers know their employees need recognition and praise for their efforts and accomplishments. A good company will not take much time to acknowledge and appreciate employee efforts, especially when an employee goes above and beyond the job description. This may be making a suggestion that saves the company money, streamlining a procedure or helping the company exceed production or sales quotes. It can also mean doing what you were hired to do taking pride in your work, being friendly and doing your job consistently well. Employees also need to feel that their supervisor's door is always open for them to discuss any concerns they have that are affecting their ability to do their jobs effectively and harming their satisfaction at the office.

(*vii*) ***New Technologies.*** Companies that use cutting edge technology provide you with new challenges, new skills and new experiences that you take along your career path. Having to jumble along with insufficient resources and aging technology can be difficult and draining. A job that doesn't stretch you can lead to frustration and dissatisfaction. If you're bored, resentful and unhappy you are not doing yourself or your employer much good.

(*viii*) ***Interesting Projects.*** Working on interesting projects can be greatly rewarding. When you work with a motivated group of people on a project that is meaningful to you *e.g.*, organising a major event, building a bridge, launching a new product, helping out in a natural

disaster, it is an opportunity to build new skills and to establish yourself as a team player who can contribute under pressure.

(ix) **Flexibility.** The office environment is expanding beyond the building walls. Workers belonging to the same work team may be from different states or even different countries. The standard 9-5 work day isn't suited to everyone or to every situation. Check out the possibilities for flexible working hours or online working from home or a site away from office.

(x) ***Ability to Influence Decisions.*** Having a real say in the decision making process can be personally satisfying which contributes to your sense of involvement and identification with the company. When you contribute, people notice and opportunities open up.

(xi) ***Financial Benefits.*** Job satisfaction is impacted upon by the employee's views about the fairness of the company wage scale, as well as, the current compensation he/she may be receiving. Companies need to have a mechanism in place to evaluate employee performance and provide salary increase to top performers. Opportunities to earn special incentives, such as bonuses, extra paid time off or vacations, also bring excitement and higher job satisfaction to the workplace. A good salary may not look so great once you consider the cost of insurance, health care and retirement savings etc. A good benefits package can more than make up for a lower salary.

SUMMARY

- *For a job satisfaction, every person is unique in what he/she wishes to achieve from his/her work e.g., salary, bonus, future promotion prospects, job location and facilities and perks provided like residential accommodation, club, Gym, transport, medical, children education etc. Management's role in enhancing employees' job satisfaction is to make sure the work environment is positive, morale is high and employees have the resources they need to accomplish the tasks they have been assigned. There are some job satisfaction factors that psychologists usually agree upon ; (i) Every employee should feel his job secure for the security of his/her family and dependents, (ii) it's important for companies to try to optimize good working conditions because adequate lighting and comfortable work stations contribute to favourable work conditions for the employees, (iii) A balanced job will keep employees productive and challenged and yet not so much that they feel that they are being taken advantage of, (iv) Management should reward achievements with increased responsibility and opportunities for growth or promotion, (v) Good relationships in the workplace are essential ingredients of a good job, (vi) employees need recognition and praise for their efforts and accomplishments, (vii) cutting edge technology provides employees with new challenges, new skills and new experiences that take them ahead in their career path, (viii) working with a motivated group of people on a project is an opportunity to build new skills and to establish employees as a team player, (ix) Check out the possibilities for flexible working hours or online working from home or a site away from office, (x) Employees having a real say in the decision making process can be personally satisfying, and (xi) Companies need to have a mechanism in place to evaluate employee performance and provide salary increase to top performers.*

Short question answers

1. *What are Jab Satisfaction factors for an employee ?*

Ans. In any job provision of salary, bonus, future promotion prospects, job location and facilities and perks provided like residential accommodation, club, Gym, transport, medical, children education etc. are the main factors for the job satisfaction of employees.

2. *How do you feel that job security and financial benefits are primarily most important ?*

Ans. Ans. Everybody wants a secure job for the security of his/her family and dependents. Job security means today that you have strong transferable skills and knowledge that you can bring with you to each new job. Job satisfaction is impacted upon by the employee's views about the fairness of the company wage scales, as well as, the current compensation he/she may be receiving.

3. *How are opportunities for advancement and provision of new technologies are interrelated and important job satisfaction ?*

Ans. Employees are more satisfied with their current job if they see a path available to move up the ranks in the company along with higher compensation. Management should use cutting edge technology and provide them with new challenges and new skills and reward achievements with increased opportunities for growth or promotion. Lack of opportunity can be frustrating and demoralizing.

4. *What points should the management keep an eye to enhance employees job satisfaction.*

Ans. By keeping an eye on the following points management can enhance employees' job satisfaction *i.e.*,

(i) Feeling of Job Security,
(ii) Good Working Environment,
(iii) Check on Workload and Stress Level,
(iv) Provide Opportunity for Advancement,
(v) Good Interpersonal Relations of Employees,
(vi) Recognition of Talent,
(vii) Provide New Technologies,
(viii) Interesting Projects,
(ix) Working Flexibility,
(x) Employees Ability to Influence Decisions, and
(xi) Provide Attractive Financial Benefits.

Exercise

1. What is management's rule in enhancing employees job satisfaction ?
2. How are interpersonal relations and working environment affect the job satisfaction of an employee ?
3. Recognition and appreciation of efforts and accomplishments of employees boasts their moral to do better production, justify.

4.5 NATIONAL INTEGRATION

In the words of Nehru the Indian state is based on the principle of unity in diversity. Each nation has its own boundary and set of rules. Therefore, a nation can be treated as a community. Nation constitutes the largest community among all the groups of man. National integration is the awareness of a common identity amongst the citizens of a country. It means that though we belong to different castes, religions and regions and speak different languages we recognize the fact that we are all one. This kind of integration is very important in the building of a strong and prosperous nation.

4.5.1 Unity in Diversity

A unique feature of our country is that all the major religions of the world are practiced here like Hinduism, Islam, Christianity, Buddhism, Sikhism, Jainism, and Zoroastrianism community etc. There are also great varieties in costume, food habits, and social customs. Geographically our land is diverse and there are amazing differences in climate. Despite all these differences India is a political entity, every part of which is governed under the same Constitution. But what the *'community'* means according to sociology is a group of people who inhabit a region by mingling with each other. There is no territorial limit in community. That is the major difference between society and community. Unity in our country does not mean the kind of oneness that comes from racial and cultural similarity. It is unity in spite of great differences, in other words, unity in diversity. Each group of people follows its own culture. By culture is meant the sum total of what exists in a society with regard to dress, language, customs, practices and beliefs. The culture which exists in India is multicentric but, it is these elements of culture that unite India. That is the reason why the principle "unity in diversity" suits Indian society and culture.

India is a very large country. We have the second largest population in the world and our land area is of quite big size. About one thousand six hundred fifty-two languages and dialects are spoken in our country out of which eighteen languages have been given special recognition by our Constitution as National languages of our country. We have to co-exist with each other peacefully, respect the culture and religion of our fellow Indians.

4.5.2 Factors Harming National Integration

There are many factors that come in the way of our national integration. Often people have very strong feelings about their own caste, religion and language and oppose those of others. Such feelings lead to clashes between different sects. Such occurrences damage our unity and prove to be a hindrance to our progress.

Communalism is one factor that poses a great danger to our unity. The formation of the State of Pakistan in 1947 led to terrible communal riots. A very large number of people lost their lives and their homes and had to undergo a lot of suffering to resettle. The British had encouraged communalism because a division between Hindus and Muslims made it easier for them to control our country. Unfortunately, even with the passage of time these communal feelings have not ended. More than fifty years after independence communal feelings still exist and riots flare-up even now in different parts of the country. It is the result of narrow-mindedness, prejudice, and lack of knowledge of other religions by few people. This is also because of the exploitation of such feelings by some politicians to further their interests. If we give more importance to our religion rather than our country we cannot contribute to its progress and development. We have to develop tolerance and understanding for other religions and not let such feelings destroy our unity.

Linguistic differences also create problems. Our Constitution has given recognition to eighteen languages. This is something important in a country such as ours. One's mother tongue is dear to each and every one. It is also essential to impart education in the mother tongue for quick and easy learning. This also helps a language to develop and grow. Hindi and English act as link languages between States in our country. Sometimes people display hostility towards the language of other people. This again harms the cause of our national unity. As responsible citizens we must give due respect to other languages and cultures and realize that they add to the greatness of our country.

Casteism also poses a great threat to our unity. People of one caste support each other and oppose the progress and development of people belonging to other castes. Appointments in jobs, admissions in educational institutions are often on the basis of caste considerations. People also avoid social interaction with other castes. Politicians often exploit such feelings at the time of elections. This leads to feelings of resentment and hostility that threaten the integrity of our country.

4.5.3 National Integration Promoting Factors

Being aware that there were threats to our unity from various forces, our forefathers placed certain safeguards in our Constitution which took the form of certain ideals and principles like Democracy, Secularism, and Social Equality guaranteed under our Fundamental Rights. Thus, our ***Constitution*** is the most important force that promotes national integration.

Secularism. India is a secular state. This means that each citizen of our country has the right to practice his or her religion. The government cannot show preference to one religion at the expense of another.

Democracy. As a democratic state all the citizens of India are equal under the law of the country. Our Fundamental Rights and Directive Principles of State Policy specifically state that each citizen is equal in every way. People cannot be discriminated against on the basis of differences of caste, religion, language, and culture.

National Festivals. They act as an important unifying force. Independence Day, Republic Day, and Gandhi Jayanti are festivals that are celebrated by all Indians and in all parts of the country, regardless of language, religion or culture. They remind us of our common nationality.

Five Year Plans. for economic development are made for our country as a whole. The Central and State Governments are working together to achieve these common objectives. Different regions of the country are dependent on each other for supplying and consuming various kinds of products that result in their economic growth. Wheat grown in Punjab may be sold in Tamil Nadu and cotton textiles from Gujarat may be sold in Bihar. No region is so self-sufficient that it can do without the other. These factors also bind the country together. We all grow economically together as a nation.

National Symbols. like the National Flag, the National Anthem, and the National Emblem also help to remind us of unity in diversity. For this reason we stress on the importance of showing proper respect to these symbols. These act as strong unifying forces both in times of celebration and adversity.

> *"At present, the identification is on the basis of state, language, religion, caste and culture but not at all on the basis of country. To achieve the goal of national integration, every citizen of India must first identify himself or herself as Indian but, not as Bengali, Punjabi, south Indian or north Indian. National integration is actually a harmonious situation that binds the people of India together. The nation is built by its people so all the people must live in unity for the development of the nation as a whole. Being an Indian is our common identity and we must say it proudly."*

SUMMARY

- *National integration is the awareness of a common identity amongst the citizens of a country. A unique feature of our country is that all the major religions of the world are practiced here. We have to co-exist with each other peacefully, respect the culture and religion of our fellow Indians. There are many factors that come in the way of our national integration e.g., (i) Communalism is one factor that poses a great danger to our unity, (ii) Linguistic differences, and (iii) Casteism. Our* ***Constitution*** *is the most important force that promotes national integration. Our forefathers placed certain safeguards in our Constitution which took the form of certain ideals and principles like Democracy, Secularism, and Social Equality guaranteed under our Fundamental Rights. At present, the identification is on the basis of state, language, religion, caste and culture but not at all on the basis of country. To achieve the goal of national integration, every citizen of India must first identify himself or herself as Indian but, not as Bengali, Punjabi, south Indian or north Indian. Being an Indian is our common identity and we must say it proudly.*

Short Question Answers

1. *Define the term "National Integration".*

Ans. National integration is the awareness of a common identity amongst the citizens of a country. It means that though we belong to different castes, religions and regions and speak different languages we recognize the fact that we are all one.

2. *How and why do we say that India has unity in its diversity ?*

Ans. A unique feature of our country is that all the major religions of the world are practiced here like Hinduism, Islam, Christianity, Buddhism, Sikhism, Jainism, and Zoroastrianism community etc. There are also great varieties in costume, food habits, and social customs. Geographically our land is diverse and there are amazing differences in climate. Despite all these differences India is a political entity, every part of which is governed under the same Constitution.

3. *Explain in very short, the method to achieve national integration by every citizen of India.*

Ans. At present, the identification is on the basis of state, language, religion, caste and culture but not at all on the basis of country. To achieve the goal of national integration, every citizen of India must first identify himself or herself as Indian but, not as Bengali, Punjabi, south Indian or north Indian. National integration is actually a harmonious situation that binds the people of India together. The nation is built by its people so all the people must live in unity for the development of the nation as a whole. Being an Indian is our common identity and we must say it proudly.

Exercise

1. How is communalism and casteism harming the national integration of our country ?
2. The social linguistic differences create problem, is it true in the context of India ?
3. It is invariably said that secularism and democracy are two pillars of our constitutions for promoting national integrations, explain.
4. How do the national festivals and national symbols help our national integration ?

4.6 LIFE OF ILLUSTRIOUS PROFESSIONALS

4.6.1 Dr. A.P.J. Abdul Kalam

Dr. A.P.J. Abdul Kalam (Avul Pakir Jainulabdeen Abdul Kalam), an Aerospace engineer, is India's most distinguished scientist known as "*Missile man of India*". He served as the 11th President of India from 25 July, 2002 to 24 July, 2007. During his term as President, he was popularly known as the People's President. Kalam was the third President of India to have been honoured with India's highest civilian honour, the Bharat Ratna.

Dr. Abdul Kalam was born on 15 October 1931 in a Muslim family in Tamil Nadu. He came from a poor background. His father Jainulabudeen was a boat owner, at Rameswaram. He started working at an early age by distributing newspapers to financially contribute and supplement his family's income. After completing his school education at the Ramanathapuram Schwartz Matriculation School, Kalam went on to attend Saint Joseph's College, Tirucnirappalli, affiliated with the University of Madras, from where he graduated in physics in 1954. He got his degree in "*Aeronautical Engineering*" from the Madras Institute of Technology in 1958. Thereafter he joined Defence Research and Development Organization (DRDO). In 1962, Dr. Abdul Kalam joined the Indian Space Research Organisation (ISRO), where he and his team launched several satellites successfully. He made a significant contribution as Project Director to develop India's first indigenous Satellite Launch Vehicle (SLV-III). Kalam was also director of two projects, which sought to develop ballistic missiles from the technology of the successful SLV programme. For these aerospace projects, the then Prime Minister Indira Gandhi allotted secret funds through her discretionary powers under Kalam's directorship. Kalam played a major part in developing many missiles including Agni, an intermediate range ballistic missile and Prithvi, the tactical surface-to-surface missile. He was the Chief Scientific Adviser to the Prime Minister and the Secretary of Defence Research and Development Organisation from July 1992 to December 1999. The Pokhran-II nuclear tests were conducted during this period where he played an intensive technological role. Kalam served as the Chief Project Coordinator, along with R Chidambaran during the testing phase. His book India 2020 strongly advocates an action plan to develop India into a knowledge superpower with a view that India ought to take a more assertive stance in international relations. He regards his work on India's nuclear weapons program as a way to assert India's place as a future superpower.

Controversy surrounds Kalam's role as a nuclear scientist is the lack of reliable and factual reporting of the yield of Pokhran-II tests. The director of the site test, K Santhanam, publicly admitted that the thermonuclear bomb was a "*fizzle*" test, criticizing Kalam for issuing the wrong report. However, Kalam dismissed the claims and R Chidambaram, a key associate of Pokhran-II, also described these claims as incorrect.

Kalam continued to take an active interest in other developments in the field of science and technology as well. He is a supporter of open source software over proprietary solutions and believes that the use of open source software on a large scale will bring, people more benefits of Information Technology. Even during his tenure as president, APJ Kalam took avid interest in the spheres of India's science and technology.

Kalam was criticised by civil groups over his stand on the Koodankulam Nuclear Power Plant, where he supported setting up of the nuclear power plant. He was perceived to be a pro-nuclear scientist and people were unimpressed by the assurance provided by him on the safety features of the plant. In his last years of Presidency Kalam was also criticised for inaction in deciding the fate of 20 out of the 21 mercy petitions. Constitution of India empowers the President of India to grant pardon, suspend and remit death sentences and commute the death sentence of convicts on death row.

He was a visiting professor at Indian Institute of Management Shillong, Indian Institute of Management Ahmedabad and Indian Institute of Management Indore, honorary fellow of Indian Institute of Science, Banglaroe, Chancellor of the Indian Institute of Space Science and Technology Thiruvananthapuram, a professor of Aerospace Engineering at Anna University (Chennai), JSS University (Mysuru) and an adjunct/visiting faculty at many other academic and research institutions across India.

Dr. Kalam observed strict personal discipline, practicing vegetarianism, teetotalism and celibacy. Kalam has written several inspirational books, most notably his autobiography Wings of fire, aimed at motivating Indian youth. Another of his books guiding Souls: Dialogues on the purpose of Life reveals his spiritual side.

SUMMARY

- *Dr. A.P.J. Abdul Kalam (Avul Pakir Jainulabdeen Abdul Kalam), an Aerospace engineer, is India's most distinguished scientist known as "Missile man of India". He served as the 11th President of India from 25 July, 2002 to 24 July, 2007. Kalam was born on 15 October 1931 in a poor boat owner's Muslim family in Tamil Nadu. He graduated in physics in 1954 and got "Aeronautical Engineering" degree in 1958. Thereafter he joined Defence Research and Development Organization (DRDO). In 1962, Dr. Abdul Kalam joined the Indian Space Research Organisation (ISRO). He made a significant contribution as Project Director in development of India's first indigenous Satellite Launch Vehicle (SLV-III). Kalam played a major part in developing many missiles including Agni, an intermediate range ballistic missile and Prithvi, the tactical surface-to-surface missile. He was the Chief Scientific Adviser to the Prime Minister and the Secretary of Defence Research and Development Organisation from July 1992 to December 1999. The Pokhran-II nuclear tests were conducted during this period which were surrounded in Controversy that the thermonuclear bomb was a "fizzle" test, however it was told to be untrue by Dr. Kalam.*

Short Question Answers

1. *Who is Dr. Abdul Kalam ?*

   Ans. Dr. A.P.J. Abdul Kalam (Avul Pakir Jainulabdeen Abdul Kalam), an Aerospace engineer, is India's most distinguished scientist known as *"Missile man of India"*. He served as the 11th President of India from 25 July, 2002 to 24 July, 2007.

2. *State the controversies surrounding Abdul Kalam.*

   Ans. *(i)* The Pokhran-II nuclear tests conducted were surrounded in Controversy that the thermonuclear bomb was a "fizzle" test, however it was told to be untrue by Dr. Kalam.

   (ii) Kalam was criticised for being perceived as a pro-nuclear scientist by civil groups over his stand on the Koodankulam Nuclear Power Plant.

   (iii) In his last years of Presidency Kalam was also criticised for inaction in deciding the fate of 20 out of the 21 mercy petitions.

Exercise

1. What qualifications were acquired by APJ Abdul Kalam ?
2. Describe Dr. APJ Abdul Kalam's contribution to the scientific development of India.
3. Describe Abdul Kalam's life, post his retirement.

4.6.2 Dr. Sam Pitroda

Satyanarayan Gangaram Pitroda is popularly known as Dr. Sam Pitroda. He is an inventor, entrepreneur and policymaker and better known as *"The father of India's communication revolution"*. Presently besides being the chairman and CEO of World-Tel Limited and the founder and CEO of C-SAM, Inc. he is also the Chairman of India's National knowledge Commission. He also worked as an advisor to the United Nation in 1992.

Satyanarayan Gangaram Pitroda was born on 16th November 1942 in Titlagarh, Odisha, India, to parents from Gujarat. He had seven siblings and is third oldest among them. The family was deeply influenced by Mahatma Gandhi and his philosophy. Consequently, Pitroda and his brother were sent to Gujarat to imbibe Gandhian philosophy. He completed his schooling from Vallabh Vidyanagar in Gujarat and completed his Master's degree in Physics and Electronics from Maharaja Sayajirao University in Vadodara. After completing his Masters in Physics in the year 1964 he went to the US and obtained a Masters in Electrical Engineering from the Illinois Institute of Technology in Chicago. Throughout the late 1960s and early 1970s Pitroda was involved in technology research work in telecommunications and hand-held computing. In 1966 he went to work for GTE in Chicago.

In 1974, Pitroda joined *"Wescom Switching"* which was one of the first digital switching companies. He developed the 580 DSS switch, over in nearly four years. Wescom was acquired by Rockwell International in 1980, where Pitroda became vice president. During his four decades as an engineer, Pitroda filed scores of patents in telecommunications. The latest set of patents relate to mobile phone based transaction technology, both financial and non-financial, via mobile phones. He is regarded as one of the earliest pioneers of hand-held computing because of his invention of the Electronic Diary in 1975.

When we think about yellow phone booths all across India, we must remember Sam Pitroda. For this facility to public, totally credit goes to Sam Pitroda. It is interesting to know that Sam Pitroda first used a telephone only after moving to the US. The biggest virtue of Sam Pitroda is that he has a definite vision to use technology for the benefit and betterment of society. Along with being a pioneer in telecom, Sam Pitroda has made strong case for food, clean water, and adequate shelter for the unprivileged section. Due to his hard work, Sam Pitroda has brought telephones to some of the worlds previously isolated regions. In the field of telecom, Sam's emphasis was on accessibility rather than density. By providing public access to telephones, Mr. Sam Pitroda revolutionized the state of telecommunications in India.

Sam Pitroda was involved in research work on telecommunications and handheld computing, and has many technology patents to his name. He introduced microprocessor in telephone switches leading to digital switching and invented the Electronic Diary in 1975. He designed his own computer-themed card game called Compucards in 1983. He returned to India in 1984 on the suggestion of the then Prime Minister Mrs. Indira Gandhi and founded the Centre for Development of Telematics (C-DOT). In 1987, he became advisor to the then Prime Minister Rajiv Gandhi and was responsible for revolutionizing India's foreign and domestic telecommunications policies. He is widely known as the brain behind the introduction of the Public Call Offices (PCO) across the length and breadth of the country. In the 1990s Pitroda returned to Chicago to resume his business interests. In May 1995, he became the first chairman of World Tel initiative of the International Telecommunication Union. When the United Progressive Alliance government came to power following the 2004 General Elections, Prime Minister Manmohan Singh invited him to head the National Knowledge Commission of India. In July 2009, the Government of India invited Mr. Sam Pitroda to head an expert committee on ICT in Railways. In October 2009, Sam Pitroda was appointed as Advisor to Prime minister of India (Dr. Manmohan Singh) on Public Information Infrastructure and Innovations with the rank of Cabinet Minister. He has been awarded the Padma Bhushan award in 2009 by the Government of India for his contribution to Science and Engineering. In August 2010, Pitroda was appointed chairman of National Innovation Council. Pitroda contributed to India's foreign and domestic telecommunications policies.

Awards

- Dataquest gave Pitroda a lifetime achievement award in 2002.
- IEEE Communication Society, Award for Public Service in the Field of Telecommunications in 2007.
- In 2008, Pitroda was elected as a world prominent leader by the World Network of Young Leaders and Entrepreneurs.
- Andhra University honored Pitroda with D.Sc in 2008.
- The Skoch Challenger Lifetime Achievement Award in 2009 for ushering in the telecom and IT revolution in India.
- Padma Bhushan in 2009 by the Government of India for his contribution to Science and Engineering.
- He was felicitated on 31 March 2009 by Akhila Bharatiya Viswakarma Mahasabha (ABVM) for service to the viswakarma community.
- In May 2010, the University of Illinois at Chicago College of medicine presented him an honorary degree.
- Sambalpur University honored Pitroda with D.Sc. on its 23rd convocation on 14 July 2010.
- International Telecommunication Union (ITU) conferred the World Telecommunication and Information Society Award to Pitroda in Geneva on 17 May 2011. He was awarded in recognition of his dedication to promoting Information, communication and technology as a means of providing a better life for humanity and social and economic empowerment. He was the first Indian to receive this award.

SUMMARY

Satyanarayan Gangaram Pitroda popularly known as Dr. Sam Pitroda is an inventor, entrepreneur and policymaker and better known as "The father of India's communication revolution". He developed the 580 DSS switch and filed scores of patents in telecommunications. He invented the Electronic Diary in 1975. Sam Pitroda has brought telephones to some of the world's previously isolated regions. When we think about yellow phone booths all across India, we must remember Sam Pitroda. In 1987, he became advisor to the Prime Minister of India and was responsible for revolutionizing India's foreign and domestic telecommunications policies. . In May 1995, he became the first chairman of World Tel initiative of the International Telecommunication Union. In October 2009, Sam Pitroda was appointed as Advisor on Public Information Infrastructure and Innovations with the rank of a Cabinet Minister. He has received many awards including the Padma Bhushan award in 2009 by the Government of India for his contribution to Science and Engineering.

Short Question Answers

1. *Who is Dr. Sam Pitroda ?*

Ans. Satyanarayan Gangaram Pitroda is popularly known as Dr. Sam Pitroda. He is an inventor, entrepreneur and policymaker and better known as "The father of India's communication revolution". Presently he is chairman and CEO of World-Tel Limited and the founder and CEO of C-SAM, Inc.

2. *Why is Sam Pitroda called "the father of communication revolution in India" ?*

Ans. Sam Pitroda was involved in research work on telecommunications and handheld computing, and has many technology patents to his name. He introduced microprocessor in telephone switches leading to digital switching and invented the Electronic Diary in 1975. He designed his own computer-themed card game called Compucards in 1983. He was responsible for revolutionizing India's foreign and domestic telecommunications policies. He is widely known as the brain behind the introduction of the public Call Offices (PCO) across the length and breadth of the country.

3. *Write the various senior Govt. jobs held by Sam Pitroda.*

Ans. (*i*) In 1987, he became advisor to the then Prime Minister Rajiv Gandhi.

(*ii*) In 2004, Prime Minister Manmohan Singh invited him to head the National Knowledge Commission of India.

(*iii*) In July 2009, the Government of India invited Mr. Sam Pitroda to head an expert committee on ICT in Railways.

(*iv*) In October 2009, Sam Pitroda was appointed as Advisor to Prime minister of India on Pubiic Information Infrastructure and Innovations with the rank of Cabinet Minister.

Exercise

1. Describe Sam Pitroda's family background and his education.
2. Describe in brief Sam Pitrods's Contribution in Computers.
3. Write the awards given to Sam Pirtoda in Communication.

4.6.3 Dr. Har Gobind Khurana

Hargobind Khurana was born on January 9, 1922 in a small village of Raipur, Punjab (Pakistan). His father was the village patwari. He completed his secondary education from D A V High School in Multan, (Pakistan). He obtained his B.Sc. and M.Sc. degree from Punjab University at Lahore. Then he went to England on a Government scholarship and there he obtained a PhD from the University of Liverpool in 1948. Dr. Khurana spent an year in Zurich in 1949 as a post-doctoral fellow at the Swiss Federal Institute of Technology. He returned to England in 1950 and spent two years on a fellowship at Cambridge, and began research on nucleic acids under Sir Alexander Todd and Kenner. His interest in proteins and nucleic acids took root at that time. In 1952, he went to the University of British Columbia, Vancouver on a job offer and there a group began to work in the field of biologically interesting phosphate esters and nucleic acids. When he returned to his native place, he was unable to find academic work in Punjab's crony-filled colleges. Khurana instead sought a career in Canada and finally the United States.

Hargobind Khurana was an India born American famous as a molecular biologist. In 1968, He was awarded the Nobel Prize in Physiology of Medicine for his excellent work on the interpretation of the genetic code and its function in protein synthesis. This award made him famous all over the world. Khorana and his team had established that the mother of all codes, the biological language common to all organisms, is spelled out in three-letter words: each set of three nucleotides codes for a specific amino acid. Their Nobel lecture was delivered on December 12, 1968. Khurana was the first scientist to chemically synthesize oligonucleotides.

He extended the above to long DNA polymers using non-aqueous chemistry and assembled these into the first synthetic gene, using polymerase and ligase enzymes that link pieces of DNA together, as well as methods that anticipated the invention of PCR. These custom-designed pieces of artificial genes are widely used in biology labs for sequencing, cloning and engineering new plants and animals, and are integral to the expanding use of DNA analysis to understand gene-based human disease as well as human evolution. Khurana's invention(s) have become automated and commercialized so that anyone now can order a synthetic gene from any of a number of companies. One merely needs to send the genetic sequence to one of the companies to receive an oligonucleotide with the desired sequence.

Since the middle of the 1970s, his lab studied the biochemistry of bacteriorhodopsin, a membrane protein that converts light energy into chemical energy by creating a proton gradient. Later, his lab went on to study the structurally related visual pigment known as rhodopsin. Dr. Khurana who showed how the genetic code determines all life processes by directing the synthesis of all cell proteins finally unravelled the secret of the DNA code of life. Khurana's work, which is a most important scientific landmark of the twentieth century, has brought closer the day when synthetic DNA may be introduced into the defective human tissues to bring about their repair or treat mentally retarded people and change them into more intelligent and healthy human beings. His synthesis of RNA, capable of replication in laboratory, is a step towards the creation of life artificially. In fact, the research has opened up a new branch called Genetic Engineering in Science.

Dr. Khurana won many awards and honours like the Nobel Prize for his achievement. Distinguished Service Award, Watumull Foundation, Honolulu, Hawaii, American academy of achievement awards, Philadelphia, Pennsylvania, Padma Vibhushan, Presidential Award, J C Bose Medal and Willard Gibbs medal of the chicago section of American Chemical Society. He was also elected a member of the National Academy of Sciences, Washington, as well as a Fellow of the American Association for the Advancement of Science. In 1971, he became a foreign member of USSR Academy of Sciences and in 1974, an Honorary Fellow of the Indian Chemical Society.

The University of Wisconsin-Madison, the Government of India (Department of Biotechnology), and the Indo-US Science and Technology Forum jointly created the Khorana Program in 2007. The mission of the Khurana Program is to build a seamless community of scientists, industrialists, and social entrepreneurs in the United States and India. The program is focused on three objectives: Providing graduate and undergraduate students with a transformative research experience, engaging partners in rural development and food, security, and facilitating public-private partnerships between the U.S. and India. Dr. Har Gobind Khurana breathed his last at the age of 89 years while living in the U.S.A.

SUMMARY

- *Hargobind Khurana was an India born American famous as a molecular biologist. He was born on January 9, 1922 in a small village of Raipur, Punjab (Pakistan). He obtained his B.Sc. and M.Sc. degree from Punjab University at Lahore. Then he went to England on a Government scholarship and there he obtained a PhD from the University of Liverpool in 1948. In 1968, he was awarded the Nobel Prize in Physiology of Medicine for his excellent work on the interpretation of the genetic code and its function in protein synthesis. In fact, the research has opened up a new branch called Genetic Engineering in Science. Apart from Nobel Prize Dr. Khurana won many awards like the Distinguished Service Award, Watumull Foundation, Honolulu, Hawaii, American academy of achievement awards, Philadelphia, Pennsylvania, Padma Vibhushan, Presidential Award, J C Bose Medal and Willard Gibbs medal of the chicago section of American Chemical Society. Dr. Har Gobind Khurana breathed his last at the age of 89 years while living in the U.S.A.*

Short Question Answers

1. *Describe the childhood and later on acquisition of various qualification and fellowships by Har Gobind Khurana.*

2. *Describe how and why was Har Gobind Khurana awarded a Nobel Prize ?*

Ans. In 1968, He was awarded the Nobel Prize in Physiology or Medicine for his excellent work on the interpretation of the genetic code and its function in protein synthesis. Khurana and his team had established that the mother of all codes, the biological language common to all organisms, is spelled out in three-letter words: each set of three nucleotide codes for a specific amino acid. Their Nobel lecture was delivered on December 12, 1968. Khurana was the first scientist to chemically synthesize oligonucleotides.

Exercise

1. Dr. Har Gobind Khurana used DNA and it's analysis after receipt of Nobel Prize, Describe how ?
2. Name the various awards won by Dr. Har Gobind Khurana.
3. What is the mission of "Khurana Programme" ?

4.6.4 Dr. Satish Dhawan

Satish Dhawan born on 25, September 1920 was an Indian aerospace engineer, widely regarded as the father of experimental fluid dynamics research in India. Born in Srinagar, Dhawan was educated in India and further in the United States. Dhawan was a graduate of the University of Punjab in Lahore (Pakistan), where he completed a Bachelor of Arts in mathematics and Bachelor of Science in physics, followed by a Master of Arts in mathematics from the same institution. In 1943, he moved to the United States to further his education. He attended the University of Minnesota, Minneapolis and completed a Bachelor of mechanical engineering. In 1947, he completed a Master of Science in aerospace engineering and an Aeronautical Engineer's Degree from the California Institute of Technology, followed by a double PhD. in mathematics and aerospace engineering in 1951. Dr. Dhawan joined as faculty at the Indian Institute of Science (IISC), Bangalore in 1951 and became its Director in 1962. Dhawan was one of the most eminent researchers in the field of turbulence and boundary layers, leading the successful and ingenious development of the Indian space programme. He succeeded Vikram Sarabhai, the founder of the Indian space programme and was Chairman of the Indian Space Research Organisation (ISRO) from 1972 to 1982. He also worked as secretary to the Govt. of India in the Department of Space.

Although he was the head of the Indian space programme, he devoted substantial efforts towards boundary layer research. His most important contributions are presented in the seminal book "*Boundary Layer Theory*" by Hermann Schlichting. He set up the country's first supersonic wind tunnel at IISc. He also pioneered research on relaminarization of separated boundary layer flows, three-dimensional boundary layers and trisonic flows.

Dhawan carried out pioneering experiments in rural education, remote sensing and satellite communications. His efforts led to operational systems like INSAT, a telecommunations satellite, IRS, the Indian Remote Sensing satellite, and the Polar Satellite Launch Vehicle (PSLV), that placed India in the league of space faring nations.

During his tenure at the Indian Institute of Science, Bangalore, he worked as Senior Scientific Officer in 1951, as Professor and Head of the Department of Aeronautical Engineering, 1955 and as it Director, 1962-1981. While at California Institute of Technology, US he was visiting Professor in 1971-72. At National Aerospace Laboratories, Bangalore he was Chairman, Research council, 1984-93. At the Indian Academy of Science he was President, 1977-1979 and at the Indian Space Research Organisation he was Chairman, 1972-1995. He worked at Indian Space Commission as chairman, 1972-2002.

Following his death in 2002, the satellite launch centre at Sriharikota, Andhra Pradesh, located about 100 km north of Chennai in South India, was renamed in his honour as the Satish Dhawan Space Centre. Satish Chandra Dhawan Govt. College, Ludhiana is named after him.

He was awarded :

(*i*) Distinguished Alumnus Award, by California Institute of Technology in 1969.
(*ii*) Padma Vibhushan (India's Second highest civilian honour), in 1981.
(*iii*) Indira Gandhi Award for National Integration, in 1999.
(*iv*) Distinguished Alumnus Award by Indian Institute of Science.

SUMMARY

- *Satish Dhawan an Indian aerospace engineer, widely regarded as the father of experimental fluid dynamics research in India was born in Srinagar on 25 September 1920. In 1947, he completed a Master of Science in aerospace engineering and an Aeronautical Engineer's Degree from the California Institute of Technology, followed by a double PhD. in mathematics and aerospace engineering in 1951. Dhawan was one of the most eminent researchers in the field of turbulence and boundary layers, leading the successful and ingenious development of the Indian space programme. He was Chairman of the Indian Space Research Organisation (ISRO) from 1972 to 1982. Dhawan carried out pioneering experiments in rural education, remote sensing and satellite communications. His efforts led to operational systems like INSAT, a telecommunations satellite, IRS, the Indian Remote Sensing satellite, and the Polar Satellite Launch Vehicle (PSLV), that placed India in the league of space faring nations.*
- *Before his death in 2002 he received many awards including Padma Vibhushan.*

Short Question Answers

1. *Who was Dr. Satish Dhawan ?*

Ans. Satish Dhawan born on 25 September 1920 was an Indian aerospace engineer, widely regarded as the father of experimental fluid dynamics research in India.

2. *State in brief the research work carried out by Dr. Satish Dhawan.*

Ans. Dhawan carried out pioneering experiments in rural education, remote sensing and satellite communications. His efforts led to operational systems like INSAT, a telecommunations satellite, IRS, the Indian Remote Sensing satellite, and the Polar Satellite Launch Vehicle (PSLV).

Exercise

1. Describe the qualifications acquired by Satish Dhawan.
2. Write the awards won by Dr. Satish Dhawan in his life.
3. Describe the carrier followed by Satish Dhawan in India.

4.6.5 Dr. Homi J Bhabha

Homi J. Bhabha was an eminent scientist who played a key role in the development of the Indian atomic energy program. He is also considered as the father of India's nuclear program. Before India's independence, Dr Bhabha and Nobel Laureate Sir C V Raman established the Cosmic Ray Research unit at the Indian Institute of Science in Bangalore in 1939. In 1945, he established the Tata Institute of Fundamental Research at Mumbai with the help of J R D Tata. Bhabha received the blessing of Pandit Nehru for effort towards peaceful development of atomic energy in India. He was selected a Fellow of the Royal Society on March 20 1941. He also established the Atomic Energy Commission of India in 1948. He represented India in International Atomic Energy Forums, and in Geneva in 1955 as President of the United Nations Conference on the Peaceful Uses of Atomic Energy. He died in a plane crash near Mont Blanc on January 24, 1966. After the death of Bhabha, the Atomic establishment was renamed as the Bhabha Atomic Research Centre.

His contribution to India's development goes far beyond the sphere of atomic energy. He had established two great research institutions namely the Tata Institute of Fundamental Research (TIFR), and the Atomic Energy Establishment at Trombay (which after Bhabha's death was renamed as the Bhabha Atomic Research Centre (BARC). He played a crucial role in the development of electronics in India. Bhabha was an outstanding scientist and a brilliant

engineer. He derived a correct expression for the probability of scattering positrons by electrons, a process now known as Bhabha scattering. Whatever he set himself to do, he did as a professional, but one who worked with love. He was relentlessly creative, enhancing life because he loved all forms of it. So he became a living proof that scientific excellence can go with excellence in arts and, racial differences need be no bar to friendship.

Homi Jehangir Bhabha was born on 30 October 1909 in a wealthy Parsi family of Mumbai. Bhabha's family had a long tradition of learning and service in the field of education. Bhabha's father was educated at Oxford and later qualified as a lawyer. His mother was grand-daughter of Sir Dinshaw Maneckji Petit, widely respected in Bombay for his philanthropic endowments.

Bhabha attended the Cathedral and John Connon Schools in Bombay. After passing Senior Cambridge Examination at the age of 15, Bhabha entered the Elphinstone College in Bombay and later the Royal Institute of Science, also in Bombay. In 1927 Bhabha joined the Gonville and Caius College in Cambridge. He took the Mechanical Sciences Tripos in 1930. At Cambridge Bhabha's interests gradually shifted to theoretical physics. In 1928 Bhabha in a letter to his father wrote : *"I seriously say to you that business or job as an engineer is not the thing for me. It is totally foreign to my nature and radically opposed to my temperament and opinions. Physics is my line. Bhabha joined the Cavendish Laboratory, from where he obtained his Ph.D. in theoretical physics"*. He also held Salomons Studentship in Engineering during 1931-1932. His first research paper published in 1933 won him the Isaac Newton Studentship.

At Cambridge Bhabha's work centered around cosmic rays. The radiations reaching the top of the atmosphere from outer space are referred, to as primary cosmic rays. Bhabha jointly with W.Heitler explained the cosmic-ray shower formation in a paper published in 1937. Before this the mechanism responsible for shower formation was the subject of much speculation. The important contributions made by Bhabha while working at Cambridge have been explained by G. Venkataraman as relativistic exchange scattering (Bhabha Scattering).

In 1939 when the Second World War broke out, Bhabha was in India. He came for a short holiday. However, the war changed his plan. Most of the scientists in England had to take part in war activities and there was no scope for doing basic research. In 1940 Bhabha joined the Indian Institute of Science at Bangalore where a Readership in Theoretical Physics was specially created for him. At the Indian Institute of Science Bhabha guided research on cosmic rays. He organised a group of young researchers in experimental and theoretical aspects of cosmic ray research. After spending a few years in India Bhabha was no longer interested in going back to England. He became convinced that it was his duty to build up research groups in the frontier of scientific knowledge.

In the early 1940s when Bhabha was working at the Indian Institute of Science, there was no institute in the country which had the necessary facilities for original work in nuclear physics, cosmic rays, high energy physics, and other frontiers of knowledge in physics. This prompted him to send a proposal in March 1944 to the Sir Dorab J. Tata Trust for establishing 'a vigorous school of research in fundamental physics'. The trustees of Sir Dorab J. Tata Trust decided to accept Bhabha's proposal and financial responsibility for starting the Tata Institute

for fundamental Research (TIFR) in April 1944. Mumbai (then Bombay) was chosen as the location for the prosed Institute as the Government of Bombay showed interest in becoming a joint founder of the proposed institute. The Institute received financial support from the Government of India from its second year, through the Council of Scientific and Industrial Research (CSIR) and the Ministry of Natural Research and Scientific Research. Today the main financial support for the Institute comes from the Government of India through the Department of Atomic Energy. It should be emphasised here that no organisational chart for future development was prepared for TIFR. Bhabha picked up the right kind of people first and then gave them opportunities to grow.

On April 26, 1948 Bhabha sent a note entitled *'Organisation of Atomic Research in India'* to the then Prime Minister of India, Jawaharlal Nehru. In this note Bhabha wrote: "The development of atomic energy should be entrusted to a very small and high powered body composed of say, three people with executive power, and answerable directly to the Prime Minister without any intervening link. For brevity, this body may be referred as the Atomic Energy Commission", independent of the secretariat of any other ministry or department of the government, including the envisaged Department of Scientific and Industrial Research. The Atomic Energy Commission was formed in August 1948. The first three things that Bhabha felt necessary for putting India's nuclear programme on a sound footing were :

(*i*) The survey of natural resources, particularly materials of interest to atomic energy programme such as uranium, thorium, beryllium, graphite etc. To achieve this, a special unit named Rare Minerals Division was created with the help of Darashaw Nosherwan Wadia (1883-1969).

(*ii*) Development of strong research schools in basic sciences particularly physics, chemistry and biology by providing facilities to and training of high quality research scientists.

(*iii*) Development of a programme for instrumentation particularly in electronics. A unit called Electronics Production Unit was started in TIFR, which later formed the nucleus of the large corporation known as Electronics Corporation of India Limited (ECIL) at Hyderabad.

When Bhabha realised that technology development for the atomic energy programme could no longer be carried out within TIFR he decided to build a new laboratory entirely devoted to this purpose.

Bhabha was elected a Fellow of the Royal Society in 1941. In 1943 he was awarded the Adams Prize by the Cambridge University for his work on cosmic rays, and in 1948 the Hopkins prize of the Cambridge Philosophical Society. In 1963 he was elected Foreign Associate of the U.S. National Academy of Sciences, and Honorary Life Member of the New York Academy of Sciences. In 1964 he was made Foreign Corresponding Academician of the Royal Academy of Sciences, Madrid. From 1960 until 1963 he was President of the International Union of Pure and Applied Physics. He was president of the historic International Conference of the Peaceful uses of atomic energy held, under U.N. auspices, at

Geneva in August, 1955. Bhabha was President of the National Institute of Sciences of India in 1963 and President of the Indian Science Congress Association in 1951. He was awarded the title of Padma Bhushan by the Government of India in 1954.

Bhabha was killed in an air-crash near the famous Mont Blanc peak of the Alps on January 24, 1966, while he was on his way to Vienna to attend a meeting of the Scientific Advisory Committee of the International Atomic Energy Agency. At the time of his death, Bhabha was Director and Professor of Theoretical Physics of the Tata Insitute of Fundamental Research, Secretary to the Government of India in the Department of Atomic Energy, ex-officio Chairman of the Indian Atomic Energy Commission, and Director of the Atomic Energy Establishment at Trombay. J R D Tata paid homage on the death of Bhabha in the words: *"A Scientist, engineer, master-builder and administrator, steeped in humanities, art and music, Homi was truly a complete man".*

SUMMARY

- *Homi Jehangir Bhabha was an eminent scientist who played a key role in the development of the Indian atomic energy program. He is also considered as the father of India's nuclear program. Homi Jehangir Bhabha was born on 30 October 1909 in a wealthy Parsi family of Mumbai. Bhabha obtained his Ph.D. in theoretical physics after joining the Cavendish Laboratory, Cambridge. The trustees of Sir Dorab J. Tata Trust accepted Bhabha's proposal and financial responsibility for starting the Tata Institute for fundamental Research (TIFR) in April 1944. As per recommendations of Bhabha to the Govt. of India, Atomic Energy Commission was formed in August 1948 and thereafter Rare Minerals Division and Electronics Corporation of India Limited (ECIL) were started. He was president of the historic International Conference of the Peaceful uses of atomic energy held, under U.N. auspices, at Geneva in August, 1955. Bhabha was President of the National Institute of Sciences of India in 1963 and President of the Indian Science Congress Association in 1951. He was awarded the title of Padma Bhushan by the Government of India in 1954. Bhabha was killed in an air-crash near the famous Mont Blanc peak of the Alps on January 24, 1966, while he was on his way to Vienna.*

Short Question Answers

1. *What is Bhabha scattering, describe ?*

   Ans. Bhabha's work centered around cosmic rays. The radiations reaching the top of the atmosphere from outer space are referred, to as primary cosmic rays. Bhabha jointly with W.Heitler explained the cosmic-ray shower formation in a paper published in 1937. Before this the mechanism responsible for shower formation was the subject of much speculation. The important contributions made by Bhabha while working at Cambridge have been explained as relativistic exchange scattering (Bhabha Scattering).

2. *Write and describe in brief the three things that were felt necessary by Bhabha for India's nuclear prgramme.*

Ans. The first three things that Bhabha felt necessary for putting India's nuclear programme on a sound footing were ;

(*i*) The survey of natural resources, particularly materials of interest to atomic energy programme such as uranium, thorium, beryllium, graphite etc.,

(*ii*) Development of strong research schools in basic sciences particularly physics, chemistry and biology, and

(*iii*) Development of a programme for instrumentation particularly in electronics.

3. *Mention the various posts held by Dr. Bhabha in the Govt. of India at the time of his death.*

Ans. At the time of his death, Bhabha was Director and Professor of Theoretical Physics of the Tata Insitute of Fundamental Research, Secretary to the Government of India in the Department of Atomic Energy, ex-officio Chairman of the Indian Atomic Energy Commission, and Director of the Atomic Energy Establishment at Trombay.

Exercise

1. How will you describe Dr. Homi J Bhabha as an eminent scientist of India ?
2. Describe the family back ground and education of Homi Bhabha.
3. How did Bhabha Establish research institutes in India ?
4. Write down the prize and fellowships won by Dr. Homi J Bhabha.

4.7 NEED FOR ETHICAL CODES

Ethics may be defined as a system of moral principles concerning appropriate conduct for an individual or group ; or as the study of moral standards and how they affect one's behaviour. Individuals constantly have to make the choice between undertaking a particular action and/or doing what is right. This depends on listening to one's conscience, and the values there relate to family, cultural and religious backgrounds. There are several models and forms: codes, standards, charters, principles, declarations, policies, and guidelines, among others. They are usually prepared by organizations (often non-governmental) when there is no law or no adequate national or international laws existing to guide people in making particular decisions. They articulate a set of values based on notions of achieving the highest possible good. In the corporate sector ethical codes are adopted by organizations to assist members in understanding the difference between 'right' and 'wrong' and in applying that understanding to their decisions. An ethical code generally implies documents at three levels: codes of business ethics, codes of conduct for employees, and codes of professional practice. Ethical codes are often adopted by management, not to promote a particular moral theory, but rather because they are seen as pragmatic necessities for running an organization in which moral concepts play an important part. They are distinct from moral codes that may apply to the culture, education, and religion of a whole society.

Everyone who works in a community program of any kind, or who deals with other people in a professional or semi-professional capacity is subject to a code of ethics. There are, however, a number of formal ethical codes usually set down by professional organizations, but sometimes by law that apply to people in particular professional or other positions. Here are some examples of people expected to adhere to a formal code of ethics :

- Medical professionals (*i.e.*, doctors, nurses).
- Mental health professionals (*i.e.*, psychiatrists, psychologists, psychotherapists)
- Social workers
- Clergy
- Public officials
- Educators
- Youth workers
- People who work in child protective services
- Lawyers
- Mediators
- Administrators of all types of community programs
- Non-professional line staff (home health aides, overnight staff at residential facilities and shelters)

Ethics is a code of thinking and behaviour to be adopted in practice. It is governed by a combination of personal, moral, legal, and a social standard of what is right. Although the definition of "right" varies with situations and cultures, its meaning in the context of a community intervention involves a number of following guiding principles.

(i) ***Don't attempt an intervention in areas in which you're not trained and/or competent.*** This goes along with "*do no harm,*" but it's not always possible. Just as there are times when no intervention may be preferable to doing something counter productive, there may be times when any intervention is better than none at all. In those circumstances, you may have to learn as you go, getting all the help you can and hoping you don't do anything harmful. It's important to distinguish between doing what you can and getting in over your head to the point where what you're doing becomes truly unethical and harmful.

(ii) ***Do what is best for everyone under the circumstances.*** You're not necessarily going to be able to help everyone all the time, but you can try to get as close as possible.

(iii) ***Respect participants' ability to play a role in determining what they need.*** Don't assume that professional staff or program planners necessarily know what's best for a community or individual.

(iv) ***Respect people as ends, not means.*** consider and treat everyone as a unique individual who matters, not as a number in a political or social or clinical calculation.

(v) ***Don't abuse your position or exploit a participant*** to gain a personal advantage or to exercise power over another person. This refers to taking advantage of participants or others for political, social, sexual, or financial gain.

(vi) ***Actively strive to improve or correct, to the extent possible, the situations of participants in your program and the community.*** In other words, it's incumbent on you to try to create the best and most effective program possible to meet the needs of participants, and to address underlying conditions or situations in a way that will benefit the community as a whole.

(vii) ***Respect everyone's human, civil, and legal rights.*** This encompasses such issues as non-discrimination and cultural sensitivity.

(viii) ***Do no harm to anybody.***

SUMMARY

- *Ethics is a code of thinking and behaviour to be adopted in practice. Ethics may be defined as a system of moral principles concerning appropriate conduct for an individual or group. This depends on listening to one's conscience, and the values there relate to family, cultural and religious backgrounds. An ethical code generally implies documents at three levels : codes of business ethics, codes of conduct for employees, and codes of professional practice. There are a number of formal ethical codes usually set down by professional organizations. People expected to adhere to a formal code of ethics are ; doctors, nurses, psychiatrists, psychologists, Clergy, Educators, Lawyers and Administrators etc. Although the definition of "right" varies with situations and cultures, its meaning in the context of a community intervention involves more than eight guiding principles.*

Short Question Answers

1. *Define Ethics.*

Ans. Ethics may be defined as the study of moral standards and how they affect one's behaviour. It can also be called as a system of moral principles concerning appropriate conduct for an individual or group.

2. *How are models of Ethics prepared ?*

Ans. There are several models and forms: codes, standards, charters, principles, declarations, policies, and guidelines, among others. They are usually prepared by organizations (often non-governmental) when there is no law or no adequate national or international laws existing to guide people in making particular decisions.

3. *Ethics is a code of thinking and behaviour, explain.*

Ans. Ethics is a code of thinking and behaviour to be adopted in practice. It is governed by a combination of personal, moral, legal, and a social standard of what is right. Although the definition of "*right*" varies with situations and cultures.

Exercise

1. Name the professionals and other people who are expected to adhere to a formal code of ethics.
2. What is the difference between moral codes and ethical codes ?
3. Describe in brief the guiding principle for establishing Ethical Codes.

4.8 COMPUTER SOCIETY OF INDIA (C.S.I.)

Since the time of its formation in 1965, the CSI has been instrumental in guiding the Indian IT industry down the right path. Today, the CSI has 66 chapters all over India, 381 student branches, and more than 50,000 members, including India's most famous IT Industry leaders, brilliant scientists and dedicated academicians. The mission of the CSI is to facilitate research, knowledge sharing, learning and career enhancement for all categories of IT professionals, while simultaneously inspiring and nurturing new entrants into the industry and helping them to integrate into the IT community. The Society functions under the guidance of an Executive Committee. The members of this Committee are elected by voting members of the Society. Functional head of the Society is the President and is assisted by the Vice President, Secretary and Treasurer. The membership of the Society is open to all professionals involved in the field of information technology. The membership includes categories at the individual and institutional level. In the individual member category there are five grades namely Fellow, Senior, Member, Associate and Student, whereas institutional membership includes organizations and educational institutions.

The purpose of the society is scientific and educational, directed towards the advancement of the theory and practice of computer science, computer engineering and technology, systems science and engineering, information processing and related arts and sciences. Computer Society of India regularly organizes workshops, seminars, conventions, and technical talks for the benefit of professionals and users of IT. CSI also organizes a number of international conferences regularly. National Student Conventions have been the annual events since 1985. CSI along with its member institutions also hosts National, Regional, State level students symposia and conventions. It extends funding support for research projects as well as funds for visits of researchers presenting papers at international conferences. It facilitates industry-academia interaction through CIO meets and Professors' meets. There are awards for professionals, industry and government organizations to recognize achievements in ICT domain. It endeavours to :

(*i*) Promote interchange of information, in these disciplines and sub-disciplines, amongst the specialists and between specialists and the public.

(*ii*) Encourage and assist the professionals engaged in these fields to maintain the integrity and competence of the profession and foster a sense of partnership amongst the professionals, engaged in these fields.

Chapters of Student Branch

A Chapter of the Society is a group of members in a particular locality or city. Being closely associated with students, the Society has developed a well-established network of "Student Branches" all across the country. The activities conducted for the students associated with the Society include lecture meetings, seminars, conferences, training programmes, programming contests and practical visits to installations. CSI has a strong Educational Directorate which undertakes activities related to Certification of professionals related to the latest technologies. It was set up in 1985, and a number of modules, such as Systems Analysis and Design, Data Communication, OS, and DBMS, are covered, in order to ensure a minimum level of professional competence, especially among those without a university background. It's recent initiative of distance education in the Business Domain areas offers technology enabled learning supported by personal counseling and expert advice. The Education Directorate organizes continuing educational and professional development programmes. It also extends finance assistance to research projects undertaken by faculty and postgraduate students. In an ever changing environment, CSI offers professional counseling being a great need of the hour. This is done by being in close contact with its young members through various events, conferences and symposia.

Special Interest Groups have been formed by Computer Society of India (CSI), to promote activities and research in few focused areas such as ;

(*a*) Special Interest Group on Artificial Intelligence (SIGAI) as a national forum for promoting Artificial Intelligence (AI) with Central objectives which include,
- To provide a national forum for interaction among Indian Artificial Intelligence community.
- To act as an interface to other national AI forums and international bodies and initiatives.
- To promote research and practical applications of AI in academia and industry.

(*b*) Special Interest Group on eGovernance to focus on important areas where Information Technology can be leveraged.

(*c*) Special Interest Group (SIG) on Free and Open Source Software (CSI-SIG-FOSS), for carrying out activities across the country in promoting the use of FOSS.

Computer Society of India brings out three national publications namely

(*i*) CSI Journal of Computing,

(*ii*) CSI Communications, and

(*iii*) CSI Adhyayan.

Code of Ethics for IT Professionals

(Approved by CSI Executive Committee in its Meeting on 8th May, 1993)

The need for a Code of Ethics for the CSI has been felt for a long time. This has been formulated as given below :

A Professional member of the Computer Society of India (CSI) shall

- Organise the resources available to him and optimise these in attaining the objectives of his organization.
- Use the codes of practice conveyed by the CSI from time to time in carrying out his tasks.

- Not misuse his authority or office for personal gains.
- Comply with the Indian laws relating to the management of his organisation particularly with regard to Privacy and Piracy, and operate within the spirit of these laws.
- Conduct his affairs so as to uphold project and further the image and reputation of the CSI.
- Maintain integrity in research and publications.

Codes of Practice

(*i*) As regards to his organisation an IT professional should :

- Act with integrity in carrying out the lawful policy and instructions of his organisation and uphold its image and reputation.
- Plan, establish and review objectives and tasks for himself and his subordinates which are compatible with the Codes of Practice of other professionals in the enterprise, and direct all available effort towards the success of the enterprise rather than of himself.
- Fully respect the confidentiality of information which comes to him in the course of his duties, and not use confidential information for personal gain or in a manner which may be detrimental to his organisation or clients.
- Not snoop around in other people's computer files.
- In his contacts and dealings with other people, demonstrate his personal integrity and humanity and when called to give an opinion in his professional capacity, shall, to the best of his ability, give an opinion that is objective and reliable.

(*ii*) As regards the Employees, an IT professional should

- Set and example to his subordinates through his own work and performance, through his leadership and by taking account of the needs and problems of his subordinates.
- Develop people under him to become qualified for higher duties.
- Pay proper regard to the safety and well-being of the personal for whom he is responsible.
- Share his experience with fellow professionals.

(*iii*) As regards the CLIENTS, an IT professional should :

- Ensure that the terms of all contracts and terms of business be stated clearly, unambiguously and honoured.
- In no circumstances supply inherently unsafe goods or services.
- Not use the computer to harm other people or to bear false witness.
- Be objective and impartial when giving independent advice.

(*iv*) As regards the COMMUNITY, an IT professional should :

- Make the most effective use of all natural resources employed.
- Be ready to give professional assistance in community affairs.
- Not appropriate other people's intellectual output.
- Always use a computer in ways that ensures consideration and respect for fellow humans.

Code of Ethics Undertaking

I ..... affirm that as a professional member, I shall abide by the Code of Ethics of the Computer Society of India (CSI). I further undertake that I shall uphold the fair name of the Computer Society of India by maintaining high standards of integrity and professionalism. I am aware that any breach of the Code of Ethics may lead to disciplinary action against me under the Byelaws and rules of the CSI. I hereby confirm that I shall be bound by any decision taken by the CSI in such matters.

Place : ..... Signature :

Date : ..... Name :

Procedure for action against a member for any breach of the code of conduct of ethics

This procedure aims at setting out a strategy for dealing with the breaches of the Code of Ethics by the members of the CSI. The term members, includes Institutional members individually as well as collectively.

Complaints :

(*i*) All complaints shall be made in writing within 60 days of the violation of the Code of Ethics being noticed. These may be addressed to any Office Bearer of a Chapter or a member of the Executive Committee.

The complaint should include the following information :

(*a*) Date of breach/violation: person/persons involved.

(*b*) Place of event and circumstances.

(*c*) Witnesses.

(*ii*) All complaints will be sent to the President CSI, by the recipient, with his/her comments.

Sequence of Action :

(i) The President will send the complaint to the Honours Committee of the CSI consisting of one Past President as Convenor and two Past Presidents/ Other Bearers as members.

(ii) The Honours Committee will be appointed by the Executive Committee every year in its first meeting in July.

(iii) The Honours Committee would meet and take the following actions :

(a) If the case is clear-cut, get written explanation/comments from various parties and set a date for hearing.

(b) Carry out investigation, by visit to the location, if necessary.

(c) Fix a date for a formal hearing. The hearing would go into evidences offered and allow witnesses to be brought and examined.

(iv) The findings of the Honours Committee would depend on the merits of each case and their recommendation to the Executive Committee may be ;

(a) Honourable acquittal.

(b) Removal from membership.

(v) The recommendations of the Honours Committee whenever any removal of a member from the membership of the CSI is involved, will be publicized through the CSI Publications after the approval of the Executive Committee.

SUMMARY

- *Since 1965 the CSI has been instrumental in guiding the Indian IT industry. It has 66 chapters all over India, 381 student branches, and more than 50,000 members. The mission of the CSI is to facilitate research, knowledge sharing, learning and career enhancement for all categories of IT professionals. It extends funding support for research projects as well as funds for visits of researchers presenting papers at international conferences. It facilitates industry-academia interaction through CIO meets and Professors' meets. The Society has developed a well-established network of "Student Branches" all across the country. CSI has a strong Educational Directorate which undertakes activities related to Certification of professionals related to the latest technologies. Special Interest Groups have been formed by Computer Society of India (CSI), to promote activities and research in areas ; (a) Artificial Intelligence, (b) eGovernance, and (c) Free and Open Source Software. Code of ethics for IT professionals approved by CSI are ; (i) Organise the resources available, (ii) Use the codes of practice conveyed by the CSI, (iii) Not misuse his authority, (iv) Comply with the Indian laws, (v) uphold the image and reputation of the CSI, and (vi) Maintain integrity. In case of breach of code of ethics, CSI has formed procedure for action against such member.*

Short Question Answers

1. *Give an introduction of the Computer Society of India.*

Ans. The CSI has been instrumental in guiding the Indian IT industry down the right path. Today, the CSI has 66 chapters all over India, 381 student branches, and more than 50,000 members, including India's most famous IT Industry leaders, brilliant scientists and dedicated academicians.

2. *How does Computer Society of India help conduct research ?*

Ans. The mission of the CSI is to facilitate research, knowledge sharing, learning and career enhancement for all categories of IT professionals, while simultaneously inspiring and nurturing new entrants into the industry and helping them to integrate into the IT community. It extends funding support for research projects as well as funds for visits of researchers presenting papers at international conferences. It facilitates industry-academia interaction through CIO meets and Professors' meets.

3. *Describe the functioning of chapters of student branch in Computer Society of India.*

Ans. The Society has developed a well-established network of "Student Branches" all across the country. The activities conducted for the students associated with the Society include lecture meetings, seminars, conferences, training programmes, programming contests and practical visits to installations.

Exercise

1. How does the Computer Society of India function ?
2. Describe the purpose of establishing Computer Society of India.
3. Write down the activities of Special Interests Group formed by Computer Society of India.
4. Describe the code of ethics for IT professionals approved by CSI.

4.8.1 Importance of an Oath to be taken by an Engineering Graduate

Engineers have a direct and vital impact on the quality of life of all the people in the society. As members of this profession, engineers are expected to exhibit the highest standards of honesty and integrity. Accordingly, the services provided by engineers require honesty, impartiality, fairness, and equity, and must be dedicated to the protection of the public health, safety, and welfare. Engineers must perform under a standard of professional behaviour that requires adherence to the highest principles of ethical conduct. Engineers, in the fulfillment of their professional duties, ***should take an oath,*** to follow ;

4.8.1A Rules of Practice in the Profession of an Engineer

Engineers shall hold paramount the safety, health, and welfare of the public :

(a) If engineers' judgment is overruled under circumstances that endanger life or property, they shall notify their employer or client and such other authority as may be appropriate.

(b) Engineers shall approve only those engineering documents that are in conformity with applicable standards.

(c) Engineers shall not reveal facts, data, or information without the prior consent of the client or employer except as authorized or required by law or this Code.

(d) Engineers shall not permit the use of their name or associate in business ventures with any person or firm that they believe is engaged in fraudulent or dishonest enterprise.

(e) Engineers shall not aid or abet the unlawful practice of engineering by a person or firm.

(f) Engineers having knowledge of any alleged violation of this Code shall report thereon to appropriate professional bodies and, when relevant, also to public authorities, and cooperate with the proper authorities in furnishing such information or assistance as may be required.

Engineers shall perform services only in the areas of their competence :

(a) Engineers shall undertake assignments only when qualified by education or experience in the specific technical fields involved.

(b) Engineers shall not affix their signatures to any plans or documents dealing with subject matter in which they lack competence, nor to any plan or document not prepared under their direction and control.

(c) Engineers may accept assignments and assume responsibility for coordination of an entire project and sign and seal the engineering documents for the entire project.

Engineers shall issue public statements only in an objective and truthful manner :

(a) Engineers shall be objective and truthful in professional reports, statements, or testimony. They shall include all relevant and pertinent information in such reports, statements, or testimony, which should bear the date indicating when it was current.

(b) Engineers may express publicly technical opinions that are founded upon knowledge of the facts and competence in the subject matter.

(c) Engineers shall issue no statements, criticisms, or arguments on technical matters that are inspired or paid for by interested parties, unless they have prefaced their comments by explicitly identifying the interested parties on whose behalf they are speaking, and by revealing the existence of any interest the engineers may have in the matters.

(d) Engineers shall act for each employer or client as faithful agents or trustees.

(e) Engineers shall disclose all known or potential conflicts of interest that could influence or appear to influence their judgment or the quality of their services.

(f) Engineers shall not accept compensation, financial or otherwise, from more than one party for services on the same project, or for services pertaining to the same project, unless the circumstances are fully disclosed and agreed to by all interested parties.

(g) Engineers shall not solicit or accept financial or other valuable consideration, directly or indirectly, from outside agents in connection with the work for which they are responsible.

(h) Engineers in public service as members, advisors, or employees of a governmental or quasi-governmental body or department shall not participate in decisions with respect to services solicited or provided by them or their organizations in private or public engineering practice.

(i) Engineers shall not solicit or accept a contract from a governmental body on which a principal or officer of their organization serves as a member.

Engineers shall avoid deceptive acts :

(a) Engineers shall not falsify their qualifications or permit misrepresentation of their or their associates' qualifications. They shall not misrepresent or exaggerate their responsibility in or for the subject matter of prior assignments. Brochures or other presentations incident to the solicitation of employment shall not misrepresent pertinent facts concerning employers, employees, associates, joint ventures, or past accomplishments.

(b) Engineers shall not offer, give, solicit, or receive, either directly or indirectly, any contribution to influence the award of a contract by public authority, or which may be reasonably construed by the public as having the effect or intent of influencing the awarding of a contract. They shall not offer any gift or other valuable consideration in order to secure work. They shall not pay a commission, percentage, or brokerage fee in order to secure work, except to a bona fide employee or bona fide established commercial or marketing agencies retained by them.

4.8.1B Professional Obligations of an Engineer

Engineers shall be guided in all their relations by the highest standards of honesty and integrity.

(a) Engineers shall acknowledge their errors and shall not distort or alter the facts.

(b) Engineers shall advise their clients or employers when they believe a project will not be successful.

(c) Engineers shall not accept outside employment to the detriment of their regular work or interest. Before accepting any outside engineering employment, they will notify their employers.

(d) Engineers shall not attempt to attract an engineer from another employer by false or misleading pretenses.

(e) Engineers shall not promote their own interest at the expense of the dignity and integrity of the profession.

Engineers shall at all times strive to serve the public interest :

(a) Engineers are encouraged to participate in civic affairs ; career guidance for youths ; and work for the advancement of the safety, health, and well-being of their community.

(b) Engineers shall not complete, sign, or seal plans and/or specifications that are not in conformity with applicable engineering standards. If the client or employer insists on such unprofessional conduct, they shall notify the proper authorities and withdraw from further service on the project.

(c) Engineers are encouraged to extend public knowledge and appreciation of engineering and its achievements.

(d) Engineers are encouraged to adhere to the principles of sustainable development in order to protect the environment for future generations.

Engineers shall avoid all conduct or practice that deceives the public :

(a) Engineers shall avoid the use of statements containing a material misrepresentation of fact or omitting a material fact.

(b) Consistent with the foregoing, engineers may advertise for recruitment of personnel.

(c) Consistent with the foregoing, engineers may prepare articles for the lay or technical press, but such articles shall not imply credit to the author for work performed by others.

Engineers shall not disclose, without consent, confidential information concerning the business affairs or technical processes of any present or former client or employer, or public body on which they serve :

(a) Engineers shall not, without the consent of all interested parties, promote or arrange for new employment or practice in connection with a specific project for which the engineer has gained particular and specialized knowledge.

(b) Engineers shall not, without the consent of all interested parties, participate in or represent an adversary interest in connection with a specific project or proceeding in which the engineer has gained particular specialized knowledge on behalf of a former client or employer.

Engineers shall not be influenced in their professional duties by conflicting interests :

(a) Engineers shall not accept financial or other considerations, including free engineering designs, from material or equipment suppliers for specifying their product.

(b) Engineers shall not accept commissions or allowances, directly or indirectly, from contractors or other parties dealing with clients or employers of the engineer in connection with work for which the engineer is responsible.

Engineers shall not attempt to obtain employment or advancement or professional engagements by untruthfully criticizing other engineers, or by other improper or questionable methods :

(a) Engineers shall not request, propose, or accept a commission on a contingent basis under circumstances in which their judgment may be compromised.

(b) Engineers in salaried positions shall accept part-time engineering work only to the extent consistent with policies of the employer and in accordance with ethical considerations.

(c) Engineers shall not, without consent, use equipment, supplies, laboratory, or office facilities of an employer to carry on outside private practice.

Engineers shall not attempt to injure, maliciously or falsely, directly or indirectly, the professional reputation, prospects, practice, or employment of other engineers :

(a) Engineers who believe others are guilty of unethical or illegal practice shall present such information to the proper authority for action.

(b) Engineers in private practice shall not review the work of another engineer for the same client, except with the knowledge of such engineer, or unless the connection of such engineer with the work has been terminated.

(c) Engineers in governmental, industrial, or educational employ are entitled to review and evaluate the work of other engineers when so required by their employment duties.

(d) Engineers in sales or industrial employ are entitled to make engineering comparisons of represented products with products of other suppliers.

Engineers shall accept personal responsibility for their professional activities :

(a) Engineers shall conform with state registration laws (if any) in the practice of engineering.

(b) Engineers shall not use association with a non-engineer, a corporation, or partnership as a "*cloak*" for unethical acts.

Engineers shall give credit for engineering work to those to whom credit is due, and will recognize the proprietary interests of others :

(a) Engineers shall, whenever possible, name the person or persons who may be individually responsible for designs, inventions, writings, or other accomplishments.

(b) Engineers using designs supplied by a client recognize that the designs remain the property of the client and may not be duplicated by the engineer for others without express permission.

(c) Engineers, before undertaking work for others in connection with which the engineer may make improvements, plans, designs, inventions, or other records that may justify copyrights or patents, should enter into a positive agreement regarding ownership.

(d) Engineers' designs, data, records, and notes referring exclusively to an employer's work are the employer's property. The employer should indemnify the engineer for use of the information for any purpose other than the original purpose.

(e) Engineers shall continue their professional development throughout their careers and should keep current in their specialty fields by engaging in professional practice, participating in continuing education courses, reading in the technical literature, and attending professional meetings and seminars.

4.8.1C Hypothetic Oath of an Engineer

I _____ as an engineer in my profession, promise to always ; maintain the prestige of the engineering profession ; limit the impact of my work on the environment ; know my limitation and ask for help when I need it ; make the best use of resources ; remember my responsibility to future generations ; respect confidential information and do my best to protect it ; report wrong doing or corruption ; use my skills and knowledge to improve the lives of society ; keep up with new developments in technology, and minimize and avoid health and safety risks to the public.

Place : ..... Signature : .....

Date : ..... Name : .....

SUMMARY

- *The services provided by engineers require honesty, impartiality, fairness, and equity, and must be dedicated to the protection of the public health, safety, and welfare. Engineers, in the fulfillment of their professional duties are required to take an oath, to follow rules of practice in the profession of an Engineer by*
  - *(i) upholding paramount the safety, health, and welfare of the public,*
  - *(ii) performing services only in the areas of their competence,*
  - *(iii) issuing public statements only in an objective and truthful manner, and*
  - *(iv) avoiding deceptive acts.*
- *As an Engineer he/she has to fulfill the obligations of his profession i.e.,*
  - *(i) shall be guided in all their relations by the highest standards of honesty and integrity,*
  - *(ii) shall at all times strive to serve the public interest,*
  - *(iii) shall avoid all conduct or practice that deceives the public,*
  - *(iv) shall not disclose, without consent, confidential information concerning the business affairs or technical processes of any present or former client or employer, or public body on which they serve,*
  - *(v) Engineers shall not be influenced in their professional duties by conflicting interests,*
  - *(vi) shall not attempt to obtain employment or advancement or professional engagements by untruthfully criticizing other engineers, or by other improper or questionable methods,*
  - *(vii) shall not attempt to injure, maliciously or falsely, directly or indirectly, the professional reputation, prospects, practice, or employment of other engineers,*
  - *(viii) shall accept personal responsibility for their professional activities, and*
  - *(ix) shall give credit for engineering work to those to whom credit is due, and will recognize the proprietary interests of others.*

Short Question Answers

1. *Enumerate the qualities that an engineer is supposed to poses.*

   Ans. Engineers have a direct and vital impact on the quality of life of all the people in the society. As members of this profession, engineers are expected to exhibit the highest standards of honesty and integrity. Accordingly, the services provided by engineers require honesty, impartiality, fairness, and equity, and must be dedicated to the protection of the public health, safety, and welfare.

2. *What precautions should be taken by an engineer while making a public statement ?*

   Ans. Engineers shall be objective and truthful in professional reports, statements, or testimony. They shall include all relevant and pertinent information in such reports,

statements, or testimony. Engineers may express publicly technical opinions that are founded upon knowledge of the facts and competence in the subject matter. They should issue no statements, criticisms, or arguments on technical matters that are inspired or paid for by interested parties.

3. *Write down the hypothetic oath an Engineer.*

Ans. I _____ as an engineer in my profession, promise to always ; maintain the prestige of the engineering profession ; limit the impact of my work on the environment ; know my limitation and ask for help when I need it ; make the best use of resources ; remember my responsibility to future generations ; respect confidential information and do my best to protect it ; report wrong doing or corruption ; use my skills and knowledge to improve the lives of society ; keep up with new developments in technology, and minimize and avoid health and safety risks to the public.

Exercise

1. What are the responsibilities of an engineer towards the public ?
2. How is an engineer guided by the standards of honesty and integrity ?
3. How is confidentiality important for an engineer's profession ?
4. How is an engineer supposed to behave with other fellow engineers ?

4.9 ETHICAL CONDUCT AND ITS AUDIT IN BUSINESS

Ethics audits rely on honesty from all employees. It is the process whereby the auditor determines the degree to which one's ethics program meets the standards set forth in applicable law, regulation and policy, and the degree to which organizational and individual behaviour satisfies the requirements of that program. Conducting yourself ethically as a business owner and encouraging your employees to engage in ethical business conduct brings about several benefits for your company. Similarly, unethical conduct can hurt your business financially and tarnish its image, leading to diminished future opportunities for your company.

Ethics involve people from different walks of life, different countries and different cultures all agreeing on some basic principles of how to conduct themselves. Since business transactions in our increasingly global economy involve businesses with employees and owners who come from different backgrounds interacting with each other on a regular basis, business ethics provide a common ground everyone can agree upon. For example, accountants from different backgrounds may all prescribe to the same system of accounting standards such as *General Accepted Accounting Principles (GAAP)*. By everyone adhering to the same standards, investors and other groups can assess the financial performance of one company using the same methods it uses to evaluate another company.

If the employees feel that they are expected to act ethically and are treated ethically by their employer, they are less likely to engage in unethical behaviour that would hurt their employer. Employees are less likely to take company property, including office supplies, or make larger claims on expenses for travel or other business-related activities, including the cost of conducting some non-business activities. Employees who act ethically also do not take excessive breaks or spend company time and resources engaging in personal activities, lowering their productivity and the profitability of the business.

When your company, or the employees within your company, engage in behaviour that is either ethical or unethical, the members of the public who interact with your company take notice. If your company acts in ways the public considers ethical, your company enjoys an increase in public trust. Building a positive image in the public sphere helps your company unlock future opportunities and avoid intense public scrutiny during periods when your firm may struggle.

Each type of ethical audit is progressively more complex and offers the client a set of data which is more comprehensive. There is nothing wrong with any of them. Each serves a different purpose.

Cultural audits explore how employees and other stakeholders feel about the standards and behaviour of the organization. They assess perceived priorities and ethical effectiveness of individuals, groups, units or the organization as a whole.

In systems audit, the auditor assesses compliance and culture as part of a bigger whole; the degree to which the ethical principles, guidelines and processes of the organization are integrated within the organizational system.

The actual problem arises when clients' needs are not served because they have received the wrong audit for their desired outcomes. If, the clients' organization has an existing program to "prevent and detect ethics violations" and merely wishes to ensure that the program satisfies the specified guidelines for ethics violations, then a ***compliance audit*** *is an appropriate response. For some clients a compliance audit may be all that they know to ask for. These clients may not appreciate what else might be accomplished through a culture or systems focused ethics audit.*

If the client suspects intentional or unintentional wrongdoing and wants to understand its reason for occurring, then a cultural or systems audit may be a better choice. If the client wants to address the root causes of unethical behaviour then a systems audit may be the only effective alternative.

Depending on the country, state or even city where you are conducting business, engaging in some unethical activities may lead to trouble with the law. You may have to work to defend your business from legal action as a result, which takes away from any profit the business earns. Problems arising from unethical behaviour may seriously affect the company's ability to operate in certain markets.

4.9.1 Procedure to Conduct an Ethical Audit

Audits are designed to dig deep into company records to ensure reliability and accuracy in areas like accounting systems, financial reporting and legal compliance. Audits generally deal with quantitative, easily measurable data. Ethical issues, on the other hand, are more often qualitative or subjective in nature. A number of qualitative research techniques make an ethical audit possible, but an ethical audit still necessarily functions differently from any kind of financial audit. Considering the below mentioned multiple perspectives, to gain a picture of a company's commitment to ethics is the key to an ethical audit.

(i) Review the company's formal codes of ethics, ethics training programs and compliance policies for legal and industry guidelines regarding ethics. A commitment to ethics begins with formal policies in the employee handbook. Although having such policies in place does not guarantee real-world compliance, it is a vital first step in building a culture of strong ethics, and it can show how serious management is about ethical issues. Make sure ethics policies cover the full range of common issues in business, including discrimination, equal employment opportunity, financial management, sourcing, customer relations and the impact of company operations on the environment, the community and the world.

(ii) Look into past breaches of ethics through company records and archived sources. Begin by asking the business owner or an executive to discuss any legal issues the company has experienced, but do not let known that you intend to investigate. If you find something the company representative tried to hide, it can be a large red flag pointing to a culture of dishonesty. When searching past news releases, look for any negative press about the company, and scrutinize the story for breaches of ethics. If any previous ethical lapses have occurred, speak with the company owner or an executive about what the company has done to prevent similar incidents from occurring since then and in the future.

(iii) Speak with employees regarding their impressions of the company's commitment to ethics. Take this opportunity to ask them to share their experiences about co-workers, managers and executives. Make sure all employees know their interviews are confidential and that honest answers will help to improve their organizations. Insiders know a large amount of information that the public, the press and government regulators are not aware of. Every breach of ethics is not illegal. Employees can be an insightful source of information on legal breaches of ethics, occurring on a regular basis. To make this information more quantitative, look for patterns in the responses you receive and record the number of times specific issues come up.

SUMMARY

- *It is the process whereby the auditor determines the degree to which one's ethics program meets the standards set forth in applicable law, regulation and policy, and the degree to which organizational and individual behaviour satisfies the requirements of that program. Ethics involve people from different walks of life, different countries and different cultures all agreeing on some basic principles of how to conduct themselves. If the employees feel that they are expected to act ethically and are treated ethically by their employer, they are less likely to engage in unethical behaviour that would hurt their employer. Cultural audits explore how employees and other stakeholders feel about the standards and behaviour of the organization. In systems audit, the auditor assesses compliance and culture i.e., the degree to which the ethical principles, guidelines and processes of the organization are integrated within the organizational system. If, the clients' organization has an existing program to "prevent and detect ethics violations" and merely wishes to ensure that the program satisfies the specified guidelines for ethics violations, then a compliance audit is an appropriate response.*

Short question answers

1. *Define ethical audit.*

   Ans. It is the process whereby the auditor determines the degree to which one's ethics programme meets the standards set forth in applicable law, regulation and policy, and the degree to which organizational and individual behaviour satisfies the requirements of that programme.

2. *Describe importance of ethical audit in business.*

Ans. Ethics involve people from different walks of life, different countries and different cultures all agreeing on some basic principles of how to conduct themselves. Since business transactions in our increasingly global economy involve businesses with employees and owners who come from different backgrounds interacting with each other on a regular basis, business ethics provide a common ground everyone can agree upon.

3. *How is ethical conduct of Employees important in any company/ business ?*

Ans. If the employees feel that they are expected to act ethically and are treated ethically by their employer, they are less likely to engage in unethical behaviour that would hurt their employer. Employees are less likely to take company property, including office supplies, or make larger claims on expenses for travel or other business-related activities, including the cost of conducting some non-business activities. Employees who act ethically also do not take excessive breaks or spend company time and resources engaging in personal activities, lowering their productivity and the profitability of the business.

4. *Describe the types of ethical audits.*

Ans. There are three types of ethical audits *i.e.*, (*i*) *Cultural audits* explore how employees and other stakeholders feel about the standards and behaviour of the organization, (*ii*) In *systems audit*, the auditor assesses compliance and culture as part of the whole system *i.e.*, the degree to which the ethical principles, guidelines and processes of the organization are integrated within the organizational system and (*iii*) *Compliance audit* is an appropriate response, if the clients' organization has an existing program to "*prevent and detect ethics violations*" and merely wishes to ensure that the program satisfies the specified guidelines for ethics violations.

5. *How is ethical audit designed and processed with ?*

Ans. Audits are designed to dig deep into company records to ensure reliability and accuracy in areas like accounting systems, financial reporting and legal compliance. Audits generally deal with quantitative, easily measurable data. Ethical issues, on the other hand, are more often qualitative or subjective in nature. A number of qualitative research techniques make an ethical audit possible, but an ethical audit still necessarily functions differently from any kind of financial audit.

Exercise

1. How is ethical audit important and involved in different walks of life ?
2. How is ethical conduct of employees important for a company/business ?
3. Describe in details any two types of ethics audit.
4. Name the areas covered in ethics audit.
5. How and why speaking to employees is important during ethics audit ?