

Unit-VI

Environmental & Techno Ethics

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6.1.0 Objectives

- To create awareness about the environment around us.
- To make the students ethically concerned about the environment.
- To foster an understanding of resource conservation at an individual level and promote sustainable lifestyles.

6.1.1 Introduction

This course on environmental ethics aims to foster an understanding of the facts, information, and aspects related to the environment. It encompasses our surroundings, natural resources, and the way we lead our lives. The beauty of nature and its manifestations should be preserved for all generations to come. The growing population, industrialization, and deforestation demand heightened environmental concern. Climate change is a major global issue. When we develop a concern for our own environment, we begin to conserve and protect it. The skill of nurturing the environment should be inculcated through a comprehensive understanding of the environment, nature, climate changes, natural resources, and the challenges related to these aspects.

The younger generation has the potential to be real change-makers if they can initiate change and start protecting the environment. There are three major concerns: the lack of understanding of the environment as a gift of nature, the need for environmental conservation for future generations, and the overuse of natural resources. The time has come to protect our only home in the universe. It is crucial to protect nature to ensure our prosperity and safeguard the future of generations to come.

Understanding our environment and its relation to our present and future will create awareness and concern for the environment. From villages to college campuses, there is a need to protect them from pollution and conserve forests. Maintaining greenery, ensuring clean air, providing clean water, conserving soil and biodiversity should be priorities for every individual. A sustainable lifestyle can only be possible if we start nurturing plants, soil, water, and the environment. Therefore, as change-makers, students should take the lead in protecting the environment and the beauty of nature. Students need to take responsibility for creating awareness in their own surroundings, conserving water, soil, biodiversity, and energy, as well as saving trees, planting trees, reducing the use of plastic, and properly disposing of waste.

6.1.2 Definition and Important Concepts

6.1.2.1 Environment

The term ‘Environment’ refers to the surroundings where we live. The surroundings are basically consisting of natural landscapes, forests, mountains, rivers and other natural resources. The environment encompasses not only the physical elements like air, water, land, fire, sky and ecosystems but also non-physical aspects such as social, cultural, economic, and other factors that can affect living entities and their overall well-being. We use water, breathe air, and use natural resources for our food, livelihood and shelter. The human being is completely dependent on nature. The plants provide oxygen. Waterbodies provide water,

forest provides wood and other food products, mountains provide minerals and soil gives all agricultural products. If these aspects of the environment will not be nurtured and protected then the future generations may struggle for food, water, air and hygienic life. Understanding the concept of the environment is essential for comprehending how living organisms interact with their surroundings. Thus, it is vital for addressing issues related to the environment and sustainability.

6.1.2.2 Ecological Values

Nature possesses a captivating beauty, and we are an integral part of its creation. Therefore, all forms of life hold significance. Every element within nature is intricately interconnected, and any disturbance can have far-reaching consequences.

Earth, our home, harbours a rich biodiversity comprising diverse flora and fauna, along with varied landscapes and seascapes. It also encompasses essential bio-geochemical cycles involving water, oxygen, carbon, sulphur, phosphorous, and nitrogen.

In the 1960s, society began recognizing the paramount importance of 'ecology' at all levels. Galang et al. (2003) articulated seven fundamental messages concerning ecology and environmental matters. These 'Seven Lenses' are as follows:

- Nature knows best
- All forms of life are equally important
- Everything is connected to everything else
- Everything changes
- Everything must go somewhere
- Ours is a finite Earth
- Nature is beautiful and we are stewards of God's creation.

Ecological values are intrinsic to the health and sustainability of our natural world, and they are nurtured through a deep understanding of the concept. These values encompass a wide array of functions carried out by biodiversity, encompassing uplands, wetlands, water surfaces, fish and wildlife habitats, other species, breeding, nesting grounds, etc. The overarching objective is to safeguard all these components of nature. Ecosystems are at their ecological zenith when they exist in their most natural state. Cole (2000) aptly states, "Ecological value is directly and positively correlated with the degree of naturalness." Nonetheless, every species plays a crucial role in maintaining ecological balance.

To perpetuate ecological value, it is vital to uphold the sanctity of the natural environment through protection and restoration. This includes monitoring and preserving:

- Forest health: Ensuring the vitality of our forests.
- Soil quality: Maintaining soil health and fertility.
- Water availability: Managing water resources for long-term sustainability.
- Amount of habitat: Preserving diverse habitats for various species.
- Vegetation quality: Upholding the quality of plant life.
- Prescribed fires: Employing controlled fires for ecosystem health.
- Ecological sensitivity: Recognizing and safeguarding delicate ecosystems.
- Drought-tolerant species: Promoting species adapted to arid conditions.

- Economic use of ecology: Utilizing natural resources responsibly for economic benefits.
- Aesthetic value of landscape: Appreciating the beauty of natural surroundings.
- Geological structure: Protecting geological features.
- Rock type: Conserving diverse rock formations.
- Water species: Safeguarding aquatic ecosystems.
- Land use: Ensuring responsible land management.
- Soil conservation: Preventing soil erosion and degradation.
- Suspended solids: Minimizing pollutants in water bodies.

Caring for nature and striking a balance between the economic utilization of natural resources and conservation efforts are fundamental for sustaining ecological value. The aim is to avoid disturbing and destabilizing the natural ecosystem.

Ecosystem services underpin our well-being by providing:

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| <ol style="list-style-type: none"> 1. Purification and detoxification: Cleaning and detoxifying air, water, and soil. 2. Cycling processes: Nutrient cycling, nitrogen fixation, carbon sequestration, and soil formation. 3. Regulation and stabilization: Controlling pests and diseases, regulating climate, mitigating storms and floods, erosion control, and managing rainfall and water supply. 4. Habitat provision: Offering refuge for diverse flora and fauna, safeguarding genetic diversity. 5. Regeneration and production: Generating biomass for raw materials and sustenance, facilitating pollination and seed dispersal. 6. Information and life fulfilment: Serving aesthetic, recreational, cultural, and spiritual purposes, as well as contributing to education and research. |
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These ecosystem services, as vital as they are, depend on the preservation and responsible management of the natural environment to continue serving humanity effectively.

Source: Adapted from "The Economic, Social and Ecological Value of Ecosystem Services: A Literature Review" by Economics for the Environment Consultancy, 16 Pency St, London W1T-7DT.

6.1.2.3 Environmental Values and Valuing Nature

Environmental values and the act of valuing nature are interconnected concepts vital to our relationship with the environment. In essence, "environmental values" refer to the profound impact the environment has on our lives. The existence of human life hinges on the functioning of natural elements such as forests, rivers, and soils, which provide us with the sustenance, clean air, and water necessary for our well-being and prosperity. The contributions of the environment to our healthy existence and overall quality of life are immeasurable. In summary:

- Economic Values of the Environment:

Food production is one of the major contributions of nature and the environment. Soil, water, the atmosphere, and climate create the conditions necessary for growing plants, food production and, consequently, the livelihood of the human race.

- Social Values of the Environment:

Social values of the environment encompass the collective beliefs, attitudes, and principles held by a society regarding their natural surroundings. These values reflect the importance of preserving and respecting the environment for current and future generations. They include a commitment to conservation, sustainability, and responsible resource management. Social values of the environment also emphasize the intrinsic worth of biodiversity and ecosystems, as well as the ethical obligation to protect the environment to ensure human well-being. These values drive behaviours such as recycling, conservation efforts, and advocacy for policies that promote ecological health, reflecting a shared commitment to safeguarding the planet for the benefit of all.

- Cultural values of the environment:

Culture is defined as a way of life led by the communities of specific regions. It encompasses various aspects of life, such as dietary habits, agriculture, festivals, dress codes, belief systems, and values. Culture varies from place to place due to differences in environmental conditions. Environmental factors, such as climate, have a direct impact on the lifestyle of individuals. Our way of life, food choices, and festival celebrations are influenced by environmental conditions. Therefore, environmental conditions play a crucial role in shaping our culture, which serves as an indicator of factors like sunlight availability, rainfall, soil quality, food diversity, air quality, and atmospheric conditions.

- Aesthetic and recreational values of the environment:

Natural ecosystems, including lush greenery, picturesque landscapes, mountains, birds, animals, flowers, fragrances, and flowing water bodies, hold an aesthetic value. The experience of being in nature evokes strong emotions and reminds us of the beauty and wonder of the natural world. The enjoyment of seasonal flowers, fruits, beautiful birds, and animals, and the changing climate contribute to a harmonious life. Many poets, writers, and artists draw inspiration from the beauty of nature. The colours, soothing sounds, rainbows, the ever-changing sky, and the green environment all reflect the aesthetic and recreational values of nature and the environment.

In essence, the environment, nature, and climate consistently remind humans that their existence on this beautiful Earth is intertwined with these elements. To genuinely value nature, we must actively care for it. The responsibility for protecting the environment, utilizing resources economically, preventing pollution, and conserving soil and biodiversity lies with every student, individual, community, village, state, and nation. The environment

provides us with everything we need to thrive. Therefore, it is imperative that we work together to conserve water, soil, air, land, and biodiversity. Let us focus on initiatives like rainwater harvesting, effective waste management, and appreciating the beauty of nature as we collectively strive to preserve our planet.

6.1.3 Equitable Use of Resources

Equitable use of resources refers to the fair distribution of essential resources to ensure that all individuals, irrespective of their backgrounds or circumstances, have access to what they need for a decent standard of living. This principle is fundamental for achieving social and environmental sustainability and addressing issues of social justice and human rights. It emphasizes the need to consider and address disparities and inequalities in resource access, with the goal of promoting fairness and reducing social and economic inequities.

Each element of our planet has an inherent right to be accessed and utilized by all. This equity can only be achieved through a global consciousness that seeks to reduce unsustainable practices, rectify the unequal distribution of resources, and address population growth. Our environment generously provides an array of goods, materials, and resources for our daily needs. However, the challenge lies in the uneven distribution of essential elements such as soil, water, sunlight, forests, climate, and mineral resources across the world. This disparity fosters divisions among nations, resulting in differing levels of development and varying degrees of resource utilization.

Nature provides sustenance based on individual needs, without discrimination. It is humanity that imposes divisions, inflicts harm, and misuses the Mother Nature. Water, soil, minerals, forest products, agricultural yields, food, and clean air must be conserved and used equitably. The profound love and respect for nature serve as a powerful sentiment that underscores our sensitivity toward preserving the environment. Embracing a simple, self-sustainable lifestyle and the responsible conservation of nature's riches are imperative in the present time. This collective effort is crucial for ensuring a harmonious and balanced coexistence.

6.1.3.1 Environmental Resources

Environmental resources encompass air, water, soil, minerals, climate, and the flora and fauna found within ecosystems. These resources possess distinct characteristics and provide various contributions to humanity on different scales. Environmental resources can be categorized as follows:

1. Earth Resources
2. Renewable and Non-renewable Resources

1. Earth resources:

- Atmosphere: The atmosphere is a layer of gases surrounding Earth, consisting of primarily nitrogen and oxygen, which plays a crucial role in sustaining life, regulating climate, and protecting the planet from solar radiation. Thus, the atmosphere serves as a protective shield for life on Earth. The troposphere, the lowermost layer, extends to around 12 kilometres in altitude. Above that, the stratosphere is approximately 50 kilometres thick and contains a crucial sulphate layer essential for rain formation. Additionally, the stratosphere houses the ozone layer, which absorbs harmful ultraviolet rays from the sun. These atmospheric layers are indispensable for the survival of living organisms.
- Hydrosphere: The hydrosphere is the total amount of water on Earth's surface, including oceans, seas, rivers, lakes, and groundwater, playing a vital role in supporting life and influencing the planet's climate. The hydrosphere encompasses approximately three-quarters of Earth's surface. A substantial portion of the hydrosphere comprises marine ecosystems in the oceans, while a smaller part constitutes freshwater resources. Freshwater is vital for sustaining both vegetation and human life.
- Lithosphere: The lithosphere is the rigid, outermost layer of Earth, consisting of the solid crust and uppermost part of the mantle. It encompasses the planet's solid, rocky surface and tectonic plates. This layer includes soil, rocks and sediments. It also holds a wealth of minerals, ores, oil, coal, and gases extracted from the Earth's crust. The lithosphere stands as the primary source of Earth's mineral and energy resources.
- Biosphere: The biosphere is the global sum of all ecosystems on Earth, comprising all living organisms and the non-living factors that support them. It is the zone of life on Earth, a closed and self-regulating system with the capability to maintain life. The biosphere plays a critical role in providing essential resources such as food crops, domestic animals, components of the food chain, biomass, wood, energy, timber, and other construction materials.

2. Renewable and non-renewable resources:

Environmental resources can be classified as either renewable or non-renewable. Renewable resources, as the name implies, can be replenished by natural processes. Non-renewable resources, in contrast, are finite and cannot be naturally replaced once depleted. This category encompasses minerals and fossil fuels like oil and coal, which are extracted from the Earth's crust. Given their limited availability, it is imperative to use non-renewable resources judiciously and explore alternatives to meet our needs.

The preservation and responsible use of both renewable and non-renewable resources are of paramount importance. Food sources, energy supplies, minerals, and

land resources are invaluable contributions from the environment that must be conserved for the benefit of present and future generations. Every nation and individual on Earth has a shared responsibility to safeguard and prevent the over-exploitation of these resources.

It falls upon the younger generation to view this as a commitment to protect and ensure the responsible use of these resources, as they are essential gifts from the natural world that sustain human life and prosperity. Let us collectively strive to preserve these resources and use them equitably to promote the well-being of all.

6.1.3.2 The Role of Individuals in Conserving Resources for Future Generations

Human beings are an integral part of the environment, just like any other species. We are wholly dependent on natural resources such as soil, food, water, and air for our survival. Humans are intensively using the soil, extracting minerals, engaging in deforestation, cutting down trees for construction, polluting rivers, and heavily relying on fossil fuels, causing significant harm to the environment. All these activities lead to the destruction of the ecosystem to a large extent. Biological systems and other essential resources cannot be regenerated quickly enough to compensate for the overexploitation. The rapid depletion of natural resources and the rising demand for different resource types for a variety of uses are the two main causes of concern. These concerns directly affect the well-being of future generations. Unfortunately, we only concern about the present generation and we are not at all considering the needs of future generations.

As individuals, we must introspect and ask essential questions to ourselves:

1. What will we leave for our children? Are we leaving behind a world with depleted resources?
2. Can we recreate the resources that are being exhausted?
3. Are our actions driven by short-term or long-term gains?
4. Are we genuinely valuing nature, or are we exploiting it for immediate benefits?
5. Will the current path of development provide sustainable gains, or are we depleting resources without concern for the future?
6. What is our responsibility as individuals to protect the environment for future generations?
7. Are we actively creating awareness about the importance of protecting nature and conserving resources?
8. Are we breathing fresh, clean air, or are we contributing to air pollution that harms our health?
9. Are we living a disease-free life, or are our actions and choices leading to the degradation of our environment?
10. What legacy are we leaving for our future generations?

These questions should serve as a wake-up call for humanity. The ever-increasing global population and the widespread materialistic lifestyle have resulted in a concerning depletion

of resources. Every individual must reflect on these matters and strive toward a self-sustainable life with a responsible and limited use of resources. Natural resources are inherently limited; therefore, it is crucial to use them economically and adopt practices that conserve them for the benefit of future generations.

Make a habit of saving resources
Steps to save electricity
<ul style="list-style-type: none"> • Turn off lights and fans when leaving a room. • Prefer to use table lamps and energy-efficient bulbs (CFL and LED) over traditional (incandescent) ones. • Keep the bulbs and tubes clean. • Turn off televisions or radios once the program of interest is over. • Utilize a pressure cooker to save up to 75% of energy during cooking.
Steps to save water
<ul style="list-style-type: none"> • Regularly check for water leakage points in your home. • Take shorter showers to reduce water consumption. • Install water-saving showerheads with flow restrictors to minimize water wastage. • Turn off the tap while brushing your teeth. • When washing dishes, avoid letting the water run continuously. • Use a watering-can for gardening instead of a hose. • When cleaning the floor, use a bucket rather than running water continuously. • Remember, saving water ultimately saves lives.

As responsible individuals, it is our collective duty to implement these practices and advocate for the wise use and conservation of resources. By doing so, we can ensure a more sustainable and harmonious future for generations to come.

6.1.4 Bioethics-Genetic Manipulation in Plants

6.1.4.1 Bio-genetics

Human knowledge and scientific advancements have enabled to manipulate and modify the genetic makeup of living organisms. Bio-genetics is a branch of biology focused on altering the genomes of living beings, primarily concerned with Genetic Modified Organisms (GMOs). GMOs are created when genes from one organism are introduced into the DNA of another organism. These genetically modified (GM) plants produce foods and ingredients that now constitute a significant portion of our food supply.

Bio-genetics involves a technique where DNA from one organism is introduced into bacteria, which then produce biologically significant products. It's a scientific method for

changing the characteristics of original cells or plants. Bio-genetic procedures are applied to a variety of products, including the introduction of genes from soil bacteria like *Bacillus thuringiensis* (Bt) into crops, enabling these plants to produce toxins against specific insects. This has led to the creation of Bt-corn, Bt-potatoes, and Bt-tomatoes.

While bio-genetics represents a scientific revolution, it's essential to remember that nature has naturally perfected the attributes of plants, fruits, flavours, tastes, and colours over millennia. It's vital to preserve the innate beauty and complexity of nature's creations.

6.1.4.2 Bio-genetic Manipulation

Bio-genetic Manipulation is the modification and manipulation of an organism's genes using technology. It includes processes like the genetic makeup of cells, transfer of genes within and across the species boundaries to produce improved/ novel organisms, isolating and copying the genetic material or using the specific part of the genome. These techniques are applied to animals, plants, and even humans.

Bio-genetic manipulation has found application in various fields, including the production of hormones, vaccines, industrial products, and agriculture. The economic benefits derived from genetically modified crops are evident. Still, there remains a notable concern that these crops may pose greater risks to human health compared to natural foods. The scientific consensus acknowledges the potential health risks associated with genetically modified products. Therefore, it is vital to exercise caution and limit the application of genetic modification to those products that do not endanger humanity. The application of this technology should be pro-human and not employed against the human race. Natural products possess their own unique blend of nutrients, enzymes, antimicrobial properties, and inherent qualities that should be appreciated in our diets. Let us enjoy natural foods, seasonal crops and fruits.

6.1.4.3 Bioethics-Genetic Manipulation

Bioethics, within the context of genetic manipulation, pertains to the responsible and ethical application of biological sciences. The concern of ethical use of technology lies with many aspects of life. It's imperative to raise critical questions regarding the ethical implications of genetic manipulation:

- Can we distinguish between beneficial and harmful uses of this technology?
- Which traits are normal and which creates the disability order?
- Who has access to gene therapy, and is it equitable?
- How relevant is genome editing?
- Can we replace natural products with genetically modified alternatives?
- Are genetically modified products capable of fulfilling human needs?
- Who will bear the health costs resulting from the consumption of genetically modified foods?

Food fortification, germination and modification-related research should be carried out but not at the cost of human well-being. There is a great ethical concern regarding the use of Genetic Use Restriction Technologies i.e., GURTs. GURTs, or Genetic Use Restriction

Technologies, pertain to genetically modified plants deliberately engineered not to yield viable seeds during harvest, disrupting the natural germination process. Nature has evolved to allow plants to germinate from seeds, and sterilizing these seeds disrupts this natural process. This issue demands comprehensive ethical scrutiny and legal regulations.

Genetic manipulation should not pose a challenge to society. Instead, it should be harnessed to support nature, humanity, and the ecosystem. The development of such technology should be driven by a genuine desire to understand and appreciate the natural world, rather than manipulating its inherent characteristics. Stakeholders are responsible for creating rules and guidelines. When establishing new research laboratories, all ethical aspects should be rigorously evaluated. Bioethics in genetic manipulation techniques should be used for the betterment of society, humanity, animals, plants, and nature as a whole.

6.1.5 Animals for the Benefit of Society and Cruelty Against them

Animals are precious gifts from nature, and they play diverse and significant roles in benefiting human society. They are true companions and have earned the status of genuine friends to humanity. Animals enrich our lives in various ways, serving as:

1. Companionship Animals: These animals hold a special place in human homes and hearts, including dogs, cats, mongooses, rabbits, and ornamental fish. They are cherished as pets, bringing happiness and pleasure into the lives of those who care for them. Companionship animals become more than just pets; they become friends, showing loyalty, affection, and companionship.
2. Service Animals: Service animals are invaluable in assisting humans with various tasks. They serve us in diverse capacities:
 - Dogs assist individuals with disabilities, such as the visually or hearing impaired, providing vital support and enhancing their independence.
 - Dogs play a vital role in military and security operations, safeguarding nations and protecting lives.
 - Horses serve in police forces, armies, and even sports events.
 - Donkeys and camels transport goods from one place to another, easing the burden on human labour.
 - Merino sheep provide wool used for clothing.
 - Cows, buffalos, and other livestock species are vital for both sustenance and livelihoods, contributing to agriculture.
3. Pleasure Animals: Certain animals are kept for recreational purposes, often participating in sports, events, and entertainment. Horses, elephants, dogs, and even bullocks, in some regions, bring joy and pleasure to people's lives.

The benefits derived from animals are multifaceted. They provide services, bring happiness, offer companionship, and are integral to the agricultural industry. Livestock plays a crucial role in generating income and fostering self-sufficiency. Beyond these roles, animals significantly contribute to the conservation of soil and soil fertility. Grasses and legumes used

as livestock feed serve as soil-conserving crops, forming protective covers on the land to prevent wind and water erosion.

In summary, animals benefit society in various ways, including as a source of food and textiles, as contributors to labour and transportation, in scientific research, medicine, hunting, as pets, in sports, agriculture, livelihoods, and recreation. Some animals, like pigs, play a critical role in waste management by naturally cleaning up organic waste. They are not just assets but cherished members of the human family.

However, it is disheartening to acknowledge that for all the benefits we receive from animals, there exists a dark side—cruelty towards them. Animal cruelty refers to the intentional, malicious acts of abuse, neglect, and violence inflicted upon animals. Animals are not merely commodities; they are living beings intricately woven into the ecosystem and the food chain. Nature has crafted these creatures with unique characteristics that contribute to environmental harmony. Neglecting animals disrupts this balance and causes ecological imbalances.

Animals possess the inherent right to lead safe and healthy lives, and it is our responsibility as stewards of this planet to protect them. Domestic animals should be cared for and utilized for various purposes, serving as essential components of businesses and agriculture.

It is our duty as human beings to nurture, protect, and show love and compassion to animals. It is incumbent upon us to prevent their smuggling, slaughter, and ill-treatment. When treated with respect and care, animals become our allies and survivors. As humans, we must acknowledge the animal kingdom as an extension of our own family, protecting, caring for, loving, and not inflicting harm upon them. Animals are essential members of the earth's diverse ecosystem, and it is our responsibility to safeguard their well-being and honour the beauty they bring to our world.

6.1.6 Let us Sum up

- This chapter introduces the fundamental understanding of the importance of the environment in our lives. It emphasises our responsibility to raise awareness and consciousness about the environment. The beauty of nature is to be protected, cared for, and nurtured for a self-sustainable life.
- Key concepts related to the environment are explained, covering topics like the environment itself, nature, ecological values, etc.
- The chapter also discusses the equitable use of resources (renewable and non-renewable resources). It highlighted the role of individuals in resource conservation for the benefit of future generations and the importance of fair resource allocation.
- Bioethics and genetic manipulation in plants are explored, with an explanation of biogenetics, bio-genetic manipulation, and bio-ethics. Relevant ethical concerns are also discussed.
- The chapter also delves into the world of animals, emphasizing their significant roles in our daily lives, their importance in maintaining the ecosystem, and the issue of cruelty towards animals. It also discusses the ethical treatment of animals.

- The misuse, overuse, neglect, and destruction of natural elements could jeopardize the future of the human race. The time has come for humanity to take responsibility for the conservation of resources and prevention of pollution at an individual level in domestic life.

6.1.7 Keywords

- **Environment:** The term "environment" refers to the surroundings and conditions in which an organism, community, or system exists. It encompasses both the living (biotic) and non-living (abiotic) elements that interact within a specific area.
- **Ecosystem:** An ecosystem is a complex and interconnected community of living organisms (biotic components) interacting with their physical environment (abiotic components) within a defined geographical area. These interactions involve the exchange of energy and matter, leading to the regulation of ecological processes, the cycling of nutrients, and the maintenance of life within the system.
- **Food chain:** A food chain illustrates the flow of energy and nutrients in ecosystems, with producers, herbivores, and carnivores sequentially consuming each other, demonstrating predator-prey relationships in a linear manner.
- **Natural Resources:** These are the materials and substances found in nature that hold economic value.
- **Ecological Value:** Ecological value encapsulates the benefits that natural ecosystems provide. It is the significance of an organism, habitat, or ecosystem within the natural world, considering its role in supporting biodiversity, ecological processes, and overall environmental health.
- **Environmental Values:** These values encompass the diverse ways in which the environment contributes to human life. Economic, social, cultural, aesthetic, and recreational values are part of this array. Additionally, environmental values emphasize resource conservation, risk prevention, and concern for the survival of our planet.
- **Environmental Ethics:** Environmental ethics is a branch of philosophy that examines moral principles and values concerning the environment, addressing human responsibilities and relationships with nature, and advocating for sustainable and responsible behaviour.
- **Bio-genetics:** Bio-genetics is the field of biology dedicated to modifying the genomes of living organisms. It explores the fascinating world of Genetic Modification.
- **Bio-genetic manipulation:** This process involves the alteration of an organism's genes through technological means. It is a powerful and controversial area of scientific research.

- **Bioethics-genetic manipulation:** Bioethics in genetic manipulation focuses on the responsible application of medical and biological sciences. It grapples with the moral and ethical aspects of genetic research and its applications.
- **Termination technology:** Genetic Use Restriction Technology (GURT), also known as "suicide seeds," restricts the use of genetically modified crops by rendering second-generation seeds, sterile. This concept raises ethical concerns in the field of genetic modification.
- **Animal kingdom:** The animal kingdom is a diverse biological classification encompassing multicellular, eukaryotic organisms that lack cell walls and obtain nutrients through ingestion. It comprises all living and extinct animals. It illustrates the incredible diversity of life on Earth.
- **Animal cruelty:** Animal cruelty pertains to deliberate, malicious acts of abuse, negligence, and violence against animals. It is a dark aspect of human behaviour with profound ecological implications.

6.1.8 Check your Learning

Q1 Answer in Two or Three Sentences

- Define environment.
- Can you explain the concept of environmental ethics?
- What are the ecological values?
- What are the different environmental values?
- How do we value nature?
- What constitutes the economic value of the environment?
- How does the environment contribute to social values?
- What role do cultural values play in shaping our connection to the environment?
- Can you differentiate between aesthetic and recreational values in the context of the environment?
- What are environmental resources?
- What are different Earth resources?
- What is troposphere?
- What is hydrosphere?
- What is lithosphere?
- What is the biosphere?
- What distinguishes renewable resources from non-renewable resources?
- Why is the conservation of resources for future generations important?
- What is bio-genetics?
- How can we define bioethics?
- What is the concept of bio-ethics-genetic manipulation?
- What does Termination technology (GURT) mean?

- v) How do animals benefit society?
- w) What constitutes animal cruelty?
- x) What are service animals, and how do they assist humans?
- y) What is the difference between pleasure animals and recreational animals?

Q2 Answer in 50 Words

- a) How would you describe the environment and its multifaceted aspects?
- b) What are the various environmental values, and how do they shape our relationship with the environment?
- c) What is an ecosystem and how does it function within the environment?
- d) How do ecological values affect the balance of nature and the sustainability of ecosystems?
- e) What are environmental resources, and why should we be concerned about their utilization and conservation?
- f) Could you discuss the different spheres that comprise Earth's resources and their roles in our environment?
- g) What does the economic value of the environment encompass, and how does it impact our lives?
- h) In what ways can individuals contribute to the conservation of resources for the well-being of future generations?
- i) Can you explain the differences between renewable and non-renewable resources and their significance?
- j) What are the underlying principles of environmental ethics, and why is it a critical field of study?
- k) How is bio-ethic-genetic manipulation of plants carried out, and what benefits does it offer?
- l) What roles do animals play in benefiting society, and how do they influence the environment?
- m) How does animal cruelty relate to environmental ethics, and what ethical considerations are involved?
- n) What is terminator technology in bio-genetic manipulation, and what are its ethical implications?
- o) What are the primary ethical questions surrounding the environment, and why are they significant?

Q3 Answer in 250 Words

- a) Can you provide a comprehensive definition of the environment and delve into the different facets of environmental values?
- b) How do ecosystems function, and what are the ecological values that they bring to the environment?
- c) Explain the concept of environmental values and their role in shaping our interaction with the environment, along with the importance of valuing nature.

- d) Describe the array of environmental resources and their significance, and elaborate on the role of individuals in preserving resources for future generations.
- e) Why is the equitable use of resources vital in addressing the uneven distribution of environmental resources, and how can we achieve it?
- f) How is bio-ethics-genetic manipulation applied in the context of plants, and what benefits can it bring?
- g) Elaborate on the contribution of animals to society and how cruelty against animals affects the environment ethically.
- h) What ethical concerns does terminator technology raise in bio-genetic manipulation?
- i) What are the major ethical questions in the field of environmental ethics, and how do they impact our relationship with the environment?

6.1.9 Suggested Reading

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Unit-VI
Environmental & Techno Ethics
6.2. Promotion of Green Technology

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6.2.0 Objectives

- To raise awareness about the use of green technology.
- To foster an understanding of the environmental harm caused by conventional or traditional energy sources.
- To promote an ethical understanding of the application of green technology to protect the environment.

6.2.1 Introduction

The promotion of green technology has become a vital responsibility for humanity. The rapid expansion of the global population has given rise to increased production, industrialization, and consumption. Among all species, humans are unique in their requirements for shelter, clothing, food, and various other amenities essential to lead a happy and secure life. Consequently, the human race has established its dominance and cultivated crops to produce food, exploit land and water resources for agriculture and industrial purposes, and engage in deforestation to further developmental agendas. Regrettably, these activities have resulted in considerable harm to environmental resources, giving rise to issues like pollution, global warming, acid rain, carbon emissions, seasonal variations, and climatic changes.

The well-being of components of different ecosystems with diverse flora and fauna is intertwined with the welfare of the human race, emphasizing the critical need for responsible technology usage, scientific understanding, and resource management. Humanity must proactively embark on a journey to conserve resources through various means, with the primary approach being the safeguarding of the environment through green technology.

Climate change stands as an initial warning sign of the environmental imbalance. The 2007 assessment report by the Intergovernmental Panel on Climate Change (IPCC) underscored a significant rise in the Earth's surface temperature, directly linked to escalating levels of greenhouse gases. These gases are emitted due to human activities namely ecological mismanagement, cattle farming, industrial expansions and the burning of fossil fuels. Thus, the pivotal question arises: can the promotion and adoption of green technology be the saviour of humanity, nature, and environmental conditions?

The responsible utilization of green technology is imperative for enhancing human life and ensuring environmental preservation. However, the misuse or mismanagement of technology could exacerbate the existing problems and threaten the natural environment. It is essential to remember that we are the creation of nature, inextricably linked to the environment that sustains us. Therefore, it is our responsibility as human beings to protect and restore the natural environment.

6.2.2 Definition and Important Concepts

6.2.2.1 Green Technology

Green technology encompasses the application of scientific and technological innovations to safeguard the environment and mitigate environmental degradation. It entails the utilization of alternative fuels and cleaner technologies that have minimal adverse

impacts. A primary objective of green technology is to reduce the release of carbon dioxide and other greenhouse gases, mitigating the adverse effects of climate change.

In essence, products and services incorporating green technology enhance operational efficiency while simultaneously reducing costs, energy consumption, and environmental harm. Green technology strives to uphold environmental protection, ameliorate prior ecological damage, and preserve our finite natural resources. These technologies are characterized by their eco-friendliness, absence of harmful emissions, cost-effectiveness, and sustainability through renewable technology.

Furthermore, green technology plays a pivotal role in diminishing carbon dioxide emissions, thus mitigating global warming. In the face of the escalating threats posed by climate change, shifting towards green technology emerges as a paramount solution. It offers a shield against climatic fluctuations, extreme weather events, and natural disasters such as floods, cyclones, thunderstorms, etc. Embracing green technology is an imperative step towards safeguarding the Earth and its ecosystems, and securing the future of humanity in the face of environmental challenges.

6.2.2.2 Applications of Green Technology

Green technology finds its applications in various domains, encompassing energy, the atmosphere, agriculture, and scientific research. Its primary objective is to curtail the emissions of carbon dioxide and other greenhouse gases in order to combat climate change. Green technology represents environment-friendly solutions that utilize alternative fuels, clean energy production, and technologies that pose minimal harm to the environment. Its overarching mission is to safeguard the environment, remediate environmental damage, and preserve our precious natural resources. Green technology is effectively applied in the following ways to achieve these goals:

- **Renewable Energy Sources-** There are many other alternate sources of energy. These energies are known as 'Renewable Energy' or 'Clean Energy'. These include wind energy, solar energy, geothermal energy, low-impact hydroelectricity, tidal energy, and ocean thermal energy. Renewable means they are available and can be obtained from nature. Renewable energy has benefits. These resources are sustainable and have the advantage of emitting zero greenhouse gases and air pollutants.
- **Solar-Powered Systems:** Transitioning to solar energy sources not only reduces carbon emissions but also decreases electricity expenses. Solar power plants can replace traditional power-generating facilities, offering a sustainable alternative that minimizes the carbon footprint.
- **Energy-Efficient Lighting:** One common application involves the adoption of LED bulbs, which consume less electricity and boast a remarkable lifespan of around 10,000 hours. It saves energy and lowers the electricity bill.
- **Electric Vehicles:** Electric vehicles represent a more efficient and eco-friendly mode of transportation compared to gasoline vehicles. They produce little to no toxic fumes and have minimal carbon emissions. The electric engines convert the energy electrochemically.
- **Server Technology:** The server is used for data storage in data centers which requires a lot of instruments, consumes large amounts of electricity and costs a significant capital investment. These servers are of no use when they get defunct and subsequently become e-waste. So, there is a need for alternate virtual-based data

servers. Virtual-based data servers offer a greener alternative by reducing energy consumption, carbon emissions, and electronic waste.

- **Smart Power Strips:** Utilizing smart power strips enhances energy efficiency by minimizing standby power consumption. This, in turn, reduces electricity usage, lowers power bills, and diminishes carbon footprints.
- **Programmable Thermostats:** Programmable thermostats are low-cost and eco-friendly green technology solutions. It can be used for creating a scheduled temperature adjustment within the home. It also saves energy and money on utility bills.
- **Energy-Efficient Appliances:** The adoption of energy-efficient household appliances, including dishwashers, washing machines, and refrigerators, reduces overall energy consumption.
- **Telecommunication Software:** Telecommunication software is otherwise known as remote work. It is a type of work arrangement where employees no longer have to travel to the office to work. It promotes work-life balance. There are a lot of benefits of working from home which saves money, energy, fuel, and time. It reduces greenhouse gas emissions, reduces electricity consumption at office buildings.
- **Geothermal Heat Pumps:** These systems draw heat from underground pipes, taking advantage of the temperature differential between the ground and the air. This technology allows for efficient home heating and cooling while conserving energy.
- **Device Recycling:** Recycling electronic devices is a critical step in preventing the harmful disposal of materials containing toxic elements like lead, mercury, and cadmium. Many regions have enacted laws mandating electronic waste recycling to protect the environment.

These applications of green technology collectively contribute to environmental preservation and the pursuit of a safer and more sustainable future for our planet. We all live on this earth and each of us must do our part to take care of it.

6.2.2.3 Green Technology and the Environment

The concept of green technology and the environment are interrelated. Green technology's application is pivotal in both conserving natural resources and shielding the environment from the adverse effects of carbon emissions, global warming, and climate change. International organizations such as the World Bank, the Organization for Economic Cooperation and Development (OECD), and the United Nations Economics and Social Commission for Asia and the Pacific (UNESCAP) have intensified their focus on green growth due to the escalating global temperatures and their profound impacts on our planet. To address the environmental issues the Paris Agreement and 2030 Sustainable Development Agenda have renewed the actions toward a better environment.

Technological innovation, technological progress, and green industrial development have a remarkable impact on the environment. Green technology harnesses the power of science and technology to create products and systems that are less detrimental to the environment while also being environment-friendly. This encompasses a broad spectrum of areas, including infrastructure technology, clean energy production, waste recycling, water purification, the conservation of natural resources, etc.

Green technology plays a pivotal role in environmental conservation through three major contributions:

- **Assessment and Monitoring Technology:** This category includes tools and methods for measuring and monitoring environmental conditions, enabling us to gain insights into the state of our ecosystem.
- **Prevention Technology:** Technologies designed to prevent or minimize harm to the environment, ensuring that products and processes are as eco-friendly as possible.
- **Restoration and Remediation Technology:** These solutions are used to naturally improve ecosystems that have been degraded or damaged over time.

The environment and green technology are intricately linked, and their coexistence is crucial for the long-term sustainability of Earth's resources. Green technology is leveraged by following green initiatives to protect the environment:

- **Water Purification:** Employed to ensure pollutant-free water flows.
- **Air Purification:** Indoor green plants are kept to maintain fresh air, as plants absorb carbon dioxide and release oxygen.
- **Sewage Treatment:** Essential for treating contaminated water and ensuring safe water supply for irrigation purposes.
- **Environmental Remediation:** Involves the removal of pollutants and contaminants to safeguard the environment, accomplished through chemical, biological, and other methods.
- **Solid Waste Management:** Addresses the purification, recycling, and disposal of solid waste, managed by government entities.
- **Sustainable Energy:** The shift toward 'sustainable energy generation and conservation' reduces greenhouse gas emissions and restores the environment. The use of green technology will have a significant impact on the environment.
 - ❖ **Reducing air pollution and methane emissions from biomass:** To mitigate environmental damage, it is essential to reduce air pollution and methane emissions resulting from biomass.
 - ❖ **Eliminating fossil fuels for vehicles, heating, and electricity:** To combat climate change effectively, we must phase out the use of fossil fuels in transportation, heating systems, and electricity generation.
 - ❖ **Expanding wind, solar, and hydroelectric electricity generation:** To promote renewable energy sources, we should focus on increasing the production of electricity through wind, solar, and hydroelectric means.
 - ❖ **Reducing peak energy demands through carbon taxes:** To encourage energy efficiency and reduce peak demands, implementing carbon taxes can be an effective strategy.

In conclusion, policymakers, scientists, and engineers must continue to innovate and develop green technologies that focus on environmental protection, preservation, and conservation. These efforts are essential to secure a sustainable and harmonious coexistence with our planet.

6.2.3. Goals of Green Technology

The goals of green technology are outlined within the framework of the Sustainable Development Goals (SDGs) for 2030. These objectives are pivotal in shaping the direction and priorities of green technology adoption. Key goals and targets set within SDG Goal 7 are as follows:

- Ensuring universal access to affordable, reliable, and modern energy services by 2030.
- Substantially increasing the share of renewable energy: striving to substantially increase the global share of renewable energy sources by 2030.
- Enhancing international cooperation to facilitate access to clean energy by 2030.
- Expanding infrastructure and upgrading technology to supply modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing states and land-locked developing countries by 2030.

In summary, the goals of green technology encompass several key objectives such as:

- Protecting the environment: Green technology seeks to safeguard the environment from harm and degradation.
- Repairing environmental damage: It aims to remediate and restore ecosystems that have been damaged.
- Conserving natural resources: The conservation of Earth's finite resources is a central goal.
- Reducing the environmental footprint: By promoting sustainable practices and minimizing negative environmental impacts.
- Eco-friendly practices: Green technology prioritizes environmentally friendly practices.
- Promoting green economic growth: Fostering economic growth while maintaining environmental sustainability.
- Improving the quality of life in harmony with nature: Ensuring that human well-being is enhanced in a way that harmonizes with nature.
- Reducing carbon emissions: Mitigating the release of carbon emissions to combat climate change.
- Preserving resources for future generations: Green technology strives to conserve water, food, and natural resources for the benefit of future generations.
- Creating a green world: Ultimately, the overarching goal is to create a more sustainable and environmentally conscious world.

6.2.3.1 Reduce Reuse Recycle

Recycling transforms waste materials into new and useful resources, benefiting the environment immensely. It conserves energy, lowers air and water pollution, reduces greenhouse gas emissions, and preserves precious natural resources. Recycling safeguards ecosystems, conserves materials, saves energy, reduces the need for resource extraction, and minimizes waste sent to landfills, making it crucial for environmental protection. It offers the following multitude of benefits of recycling for both the environment and society:

- **Protect the Ecosystem and Wildlife:** Recycling helps minimize disruption to natural ecosystems, preserving forest resources and wildlife habitats.
- **Conserve Natural Resources:** Recycling papers, plastics, metals, and e-waste conserves a significant portion of our planet's natural resources.
- **Save Energy:** Recycled products require less energy in their production compared to new materials.
- **Reduce the Need for Harvesting Raw Materials:** By recycling, the need to extract raw materials from the environment is reduced.

- **Mitigate Carbon Emissions:** Recycling processes are energy-efficient, resulting in reduced carbon footprints and emissions, particularly in the reduction of release of methane and other greenhouse gases.
- **Minimize Incineration:** The recycling process helps in reprocessing the materials to make new products which leads to a reduction in the amount of waste sent for incineration.
- **Reduce Landfill Waste:** Recycling different products reduces the amount of waste which are used for landfilling. This landfilling procedure also damages the soil quality.

There are many products to recycle but it has also some impact on nature and humanity. Society, stakeholders and policymakers must focus on the 3Rs to protect nature i.e., Reduce, Reuse, Recycle

- **Reducing Waste Production:** Minimizing waste generation by reducing consumption and adopting more sustainable practices.
- **Reusing Items:** Extending the lifespan of products by reusing them whenever possible before considering disposal.
- **Recycle items whenever possible**

Embracing the "Reduce, Reuse, Recycle" mantra is crucial for sustainable living and environmental protection. In this 21st century, the concept of leading a simple life with minimum need is still relevant and essential for our planet's well-being.

The "**3 Rs** of Waste Management" are a widely recognized framework for promoting sustainable waste management practices. These 3 Rs stand for **Reduce**, **Reuse**, and **Recycle**.

R1- Reduce	R2- Reuse	R3- Recycle
How can we reduce the amount of waste we produce?	How can we reuse what we have?	How can we recycle the products we use?
It is all about creating less waste.	It is about how one has to use certain items again.	It is about making sure that separating the items can be recycled.
<ul style="list-style-type: none"> • Buy products with less packaging. • Buy in bulk • Avoid single-use items and look for items that we can reuse. • Be mindful of food waste • Implement energy-efficient practices to reduce energy waste. • Use the products that you require. 	<ul style="list-style-type: none"> • Repair and refurbish items to keep them functional. • Donate or sell items that are no longer needed. • Use reusable containers and bags instead of disposable ones. • Upcycle or repurpose materials to create new products. 	<ul style="list-style-type: none"> • Separate recyclable materials from non-recyclables at home and in public spaces. • Follow local recycling guidelines and ensure materials are properly cleaned and sorted. • Support recycling programs and initiatives in your community.

6.2.3.2 Chemical Waste Removal (RENEW)

The term "RENEW" stands for the Resource Exchange Network for Eliminating Waste. It is a materials exchange network for industries, businesses and governmental units that promotes reclaiming, recycling and reuse of materials. RENEW plays a crucial role in the proper management of chemical waste, ensuring that these hazardous materials are handled in an environmentally responsible manner. The Resource Exchange Network for Eliminating Waste is a free materials exchange network established by the Texas Legislature in 1987 to promote the reuse or recycling of industrial waste. This network is a collaborative effort between the Texas Commission on Environmental Quality (TCEQ) and the Zero Waste network, allowing for the listing of materials online and their exchange.

Numerous types of chemical waste are generated from laboratories and industries posing significant environmental risks. Some common categories of chemical waste include:

- Unused and surplus reagent-grade chemicals.
- Intermediates and by-products generated from research and educational experiments.
- Batteries.
- Items contaminated by chemicals.
- Various types of used oil.
- Spent solvents, including water-based variants.
- Items containing mercury.
- Photographic film processing solutions and chemicals.
- Pesticides.
- Non-returnable gas cylinders.
- Non-empty aerosol cans.
- Finely divided powders.
- Chemically contaminated sharps such as syringes, needles, GC syringes, razor blades, Pasteur pipettes, and pipette tips.
- Equipment and apparatus containing hazardous waste.
- Computer and electronic equipment.
- Toner cartridges.
- Ethylene glycol paints (both oil-based and latex).
- Fluorescent light bulbs.
- Light ballasts.
- Preserved specimens.
- Custodial and industrial cleaners.
- Uncured resins (Phenolic, Epoxy, Styrene, etc.).
- Dyes and glazes.
- Degreasing solvents.
- Brake, transmission, and power steering fluids.

These chemical wastes are generated across various sectors, and if not managed properly, they can have severe detrimental effects on the environment. Therefore, it is crucial to establish the following effective procedures for managing chemical waste:

- Identify the chemical waste: Recognize and categorize the types of chemical waste generated.
- Adhere to legislation and regulations: Stay informed about current laws, regulations, and rules pertaining to the use and disposal of chemical waste.
- Designate a hazardous waste storage area: Create a designated area for storing hazardous waste to prevent contamination and ensure safe handling.
- Proper storage: Ensure that chemical waste is stored in appropriate containers, labelled accurately, and kept in a secure location.
- Environmental considerations: Always prioritize environmental safety and the well-being of the ecosystem when dealing with chemical waste.
- Choose a responsible hazardous waste disposal partner: Partner with a reputable hazardous waste disposal service that specializes in the proper disposal and recycling of chemical waste.
- Promote waste recycling: Encourage the recycling of chemical waste materials whenever feasible, reducing the overall environmental impact.

6.2.3.3 Refuse and Responsibility

'Refuse' refers to the act of declining or abstaining from the use of materials, whether they are recyclable or non-recyclable, rendering them unusable. Essentially, 'refuse' means saying reject or a firm 'No' to waste materials. It serves as a fundamental strategy for reducing the burden on landfills. One can effectively practice 'refuse' through the following strategies:

- Refuse unnecessary consumption: Refuse items that you do not genuinely require.
- Bring your reusable containers: Carry your reusable Tupperware when dining out to avoid disposable containers.
- Carry reusable bags: Keep a reusable shopping bag in your vehicle or purse for shopping trips.
- Carry reusable bottles: Use a refillable water bottle and hot drink cup to avoid single-use containers.
- Opt-out of junk mail: Take steps to remove yourself from junk mail to reduce paper waste.
- Minimize plastic usage: When ordering takeout to enjoy at home, request no plastic utensils and minimize plastic waste.
- Choose versatile products: Choose products that serve multiple purposes to reduce unnecessary packaging and waste.
- Select minimal packaging: Look for items with minimal or eco-friendly packaging to reduce excess waste.
- Recycle leftovers: Practice recycling leftover items, when possible, to further reduce waste.
- Reuse packaging: Reuse shopping bags, boxes, wrapping papers, and gift bags to extend their lifespan and reduce waste.

In essence, 'refuse' embodies a conscious effort to limit the acquisition and use of materials that contribute to unnecessary waste, aligning with the broader goal of reducing our environmental footprint.

In reality, the trifecta of "Reduce, Reuse, and Recycle" is essential for mitigating environmental impacts. However, merely adopting these practices may not suffice to solve

the environmental challenges we face. It also necessitates a fundamental change in the way we consider, choose, and utilise items. Individuals must become more conscious of their consumption patterns, opt for eco-friendly products, and actively work towards conserving resources in their daily lives. This awareness should translate into daily routines, creating a collective effort to protect our planet.

Moreover, the youth have the potential to be a driving force for change. Young people can initiate and lead awareness movements to save the Earth by promoting responsible consumption, sustainable practices, and environmental consciousness. By advocating for and adopting these principles in daily life, they can become the change-makers needed to preserve our planet.

6.2.4 Green Technology in Relation to Green Energy

6.2.4.1 Meaning of Green Energy

Green energy, often referred to as green power, represents a category of energy derived from natural resources such as sunlight, water, or wind. Unlike conventional energy sources, green energy does not contribute to greenhouse gas emissions and is environmentally friendly. It stands as a remarkable innovation and solution to address the growing energy demands of both individuals and industries while preserving our planet's sustainability. Green energy encompasses various natural sources, including:

- Solar energy: Solar panels capture sunlight and convert it into electricity or heat for various applications.
- Wind energy: Wind turbines harness the kinetic energy of the wind to generate electricity.
- Hydropower: Hydropower plants use the energy of flowing water, such as rivers and dams, to produce electricity.
- Geothermal energy: Geothermal power plants tap into the Earth's internal heat to generate electricity and provide heating and cooling.
- Biomass: Generating energy from wood, crop residues, and organic wastes, etc.
- Tidal and wave energy: Tidal and wave energy systems capture the energy from ocean tides and waves to generate electricity.
- Ocean Thermal Energy Conversion (OTEC): OTEC systems use the temperature difference between warm surface water and cold deep water to generate electricity.
- Hydrogen energy: Hydrogen can be produced using renewable energy sources and used as a clean fuel for various applications, including fuel cells and transportation.
- Biodiesel and ethanol: These biofuels are derived from plant-based sources, such as corn and sugarcane, and can be used as alternatives to traditional fossil fuels.
- Advanced nuclear energy: Advanced nuclear reactors aim to provide a cleaner and safer form of nuclear energy with reduced waste and enhanced safety features.

Hence, green energy is a clean and sustainable alternative to conventional energy sources, offering environmental protection and an effective way to meet our energy needs.

6.2.4.2 Use of Renewable Energy

Renewable energy is derived from natural sources such as the sun and wind and can be harnessed for electricity generation, water heating, cooling, and transportation.

The adoption of renewable energy yields numerous benefits:

- Job creation within the renewable energy sector.
- Reduction in carbon emissions.
- Increased reliability in national power consumption.
- Cost-effectiveness.
- Expansion of clean energy usage.
- Preservation of energy resources for future generations.
- Natural availability.
- Environmental protection.
- Enhanced energy efficiency.

Renewable energy sources can be seamlessly integrated into our daily lives, offering sustainable alternatives to conventional energy. Consider the following practical applications of renewable energy:

- Using solar-powered lights: Choose solar-powered outdoor lighting to illuminate the pathways and gardens. Solar lights harness sunlight during the day and provide illumination at night, reducing electricity consumption.
- Powering homes and offices with solar and wind power: Install solar panels on rooftops and utilize wind turbines to generate electricity for residential and commercial buildings. These renewable sources can significantly reduce reliance on traditional power grids.
- Using bioethanol to power cars: Opt for vehicles that run on bioethanol, a renewable fuel derived from organic materials like corn or sugarcane. Bioethanol reduces greenhouse gas emissions.
- Utilizing renewable energy for water heating and cooling: Employ solar water heaters or geothermal heat pumps to heat and cool water for domestic or industrial purposes. These systems are energy-efficient and environment-friendly.
- Embracing solar cooking facilities: Solar cookers and ovens utilise sunlight to cook food, reducing the need for conventional cooking fuels. They are particularly useful in sunny regions.
- Switching to solar-powered electronic vehicle charging: Charging electric vehicles using solar energy can minimize the carbon footprint associated with transportation.
- Implementing passive solar systems in buildings: Design buildings with passive solar features that capture and store solar heat naturally, reducing heating and cooling requirements.
- Implementing wind energy in buildings: Install small-scale wind turbines on rooftops or in urban areas to generate clean electricity.
- Adopting hydrogen energy in buildings: Explore the use of hydrogen fuel cells for generating electricity and heat within buildings.

Do You Know about Hydrogen Energy?

- Green hydrogen is expected to play a substantial role in future energy production, accounting for approximately 12% by 2050, according to the International Renewable Energy Agency (IRENA).
- Hydrogen offers a cleaner alternative as a fuel source.
- **Green hydrogen** is produced through electrolysis of water using renewable energy sources such as solar and wind power, resulting in a lower carbon footprint compared to other methods.
- **Brown hydrogen** is produced from coal, releasing emissions into the atmosphere.
- **Grey hydrogen** is derived from natural gas, with associated emissions released into the air.
- **Blue hydrogen** is produced from natural gas, but emissions are captured and stored using carbon capture and storage (CCS) technologies.
- Hydrogen serves as an energy carrier rather than a primary energy source, offering the capacity to store and transport substantial amounts of energy.
- Fuel cells powered by hydrogen can efficiently generate electricity and heat for various applications.
- Hydrogen has high efficiency and can substantially reduce or eliminate emissions, making it a promising solution for mitigating greenhouse gas emissions in various sectors.
- These practical applications and insights into green hydrogen showcase the significant potential for incorporating renewable energy into our daily lives and addressing environmental challenges.

6.2.4.3 Ethical Aspects of Green Technology in Relation to Energy

The ethical aspects are the major concern for the use of green technology. The production and use of energy have become a major ethical issue worldwide. While sustainable energy sources such as solar, wind, and geothermal offer a cleaner, greener alternative, their higher costs compared to fossil and nuclear fuels present a significant ethical dilemma.

The ethical issue is exacerbated by the fact that wealthier nations can more readily afford the initial infrastructure investments required to harness these alternative energy sources. Meanwhile, developing countries like India face a daunting question: Can they afford this transition? The answer hinges on a dual challenge: minimising energy consumption by both industries and the general public. In a world where India has become the most populated nation. Thus, the conservation of energy and energy efficacy also raises an ethical challenge.

To address these ethical dilemmas, a concerted effort to raise awareness among the youth, the general population, and policymakers is imperative. Green technology adoption necessitates a collective commitment, starting with small yet impactful steps such as turning off lights and fans when leaving classrooms. These seemingly simple actions symbolise a broader ethical obligation to protect our planet and ensure equitable access to sustainable energy for all.

6.2.5 Net Zero

6.2.5.1 Concept

Net Zero means cutting greenhouse emission to as close as possible, with any remaining emission from the atmosphere, by oceans and forest. Net zero leads to carbon neutrality, meaning activities don't contribute to rising greenhouse gas levels. The transition involves adopting cleaner energy sources, global cooperation, and transparent reporting. It's a vital strategy for addressing climate change, limiting the increase in temperature, and building a sustainable, low-carbon economy.

Climate change remains one of the most pressing global challenges. Addressing this issue requires a coordinated effort from society, communities, and the younger generation. Implementing a Net-Zero approach across all aspects of life is crucial. Net zero involves reducing greenhouse gas emissions to zero levels. Currently, Earth's temperature is 1.1°C higher than it was in the late 1800s, with carbon emissions continuing to rise. To safeguard our planet and control climate change, adopting a Net-Zero approach is imperative.

Several countries, including the European Union, India and China have set Net-Zero targets, covering a significant portion of global emissions. Additionally, around 3,000 businesses and financial institutions are collaborating with science-based initiatives to reduce carbon emissions. Net Zero focuses on achieving carbon neutrality, which involves absorbing and removing greenhouse gases from the atmosphere. This necessitates the creation of carbon sinks, such as forests, and the development of futuristic carbon capture and storage technologies.

Steps have been taken by India to Achieve Net-Zero Emissions by 2070

- India has set ambitious renewable energy targets, including reaching 175 gigawatts (GW) by 2022 (as declared at the Paris Agreement), 450 GW by 2030 (announced at the UN climate summit), and a further increase to 500 GW by 2030 (announced at COP26).
- India has also announced the target of 50% installed power generation capacity from non-fossil energy sources by 2030, raising the existing target of 40%.

6.2.5.2 Net Zero Pledges by Universities and Colleges

Net Zero refers to achieving a balance between the amount of greenhouse gases produced and those removed from the atmosphere. Net Zero pledges are crucial steps in preventing an excessive concentration of carbon in the atmosphere, particularly from human-caused emissions generated by burning fossil fuels. These pledges represent a commitment to combat climate change resulting from elevated carbon levels in the environment.

Academic institutions worldwide, numbering approximately 1050 from 68 countries, have made significant commitments to achieve net-zero emissions by 2050. This collective effort signifies a major global initiative aimed at protecting the climate. These institutions have joined the UN's 'Race to Zero' campaign, pledging to eliminate their carbon emissions by 2050.

The Environmental Association of Universities and Colleges (EAUC) has played a leading role in driving the Net Zero initiative within the academic community. This cooperative endeavour marks a substantial stride toward addressing climate change and aligning with global climate goals.

Net Zero Commitments from Different Academic Institutions

- The Chiba University of Commerce to become the first University in Japan to run exclusively on renewable energy before 2025 as well as to establish the Renewable Energy University League of Japan
- The University of Glasgow, which has set a net-zero target of 2030 was the first University in the UK to declare that it would divest from fossil fuels within a decade.
- The University of Toronto has committed to develop a low-carbon action plan by 2030 in the UK to declare that it would divest from fossil fuels within a decade.
- Woxsen University pledges to become India's first net-zero campus by 2030.
- At 26th Cop (Conference of Parties) India would cut its emission to net zero by 2070.
- Around 20 Indian private universities and higher educational institutions pledge "better and improved" actions to achieve SDG and to strengthen India's net zero commitment.
- The All-India Council for Technical Education (AICTE) has launched initiatives focusing on the 'Carbon Neutrality Pledge for Educational Institutes' to achieve net-zero emissions.
- Notably, 43 cities in Maharashtra have joined the UN's global campaign to transition towards a neutral carbon footprint. Educational institutions must prioritize Net Zero initiatives as part of the green movement, reducing carbon footprints by raising awareness, restricting vehicle access within campuses, and adopting e-office practices.
- Every University and College should show leadership and sign up for the Race to Zero for Universities and Colleges as a global initiative for a zero-carbon world.

6.2.5.3. Carbon Footprints

A carbon footprint represents the total greenhouse gas emissions, including carbon dioxide and methane, resulting from various human activities. Calculating one's carbon footprint is a crucial step in climate change control and mitigation. The average carbon footprint for a person in the United States is approximately 16 tons, one of the highest rates globally. To avoid a 2°C rise in global temperatures, it is estimated that the annual carbon footprint per person must drop to under 2 tons by 2050. It is pertinent to mention here that, the average per capita carbon footprint in India is around 1.89 tons.

Carbon footprints primarily result from fossil fuel combustion in manufacturing, heating, transportation, and emissions of greenhouse gases like methane, nitrous oxide, and chlorofluorocarbons (CFCs). In developed countries, transportation and household energy consumption contribute significantly to individual carbon footprints.

To reduce carbon footprints, individuals, establishments, corporations, and offices can take several measures, such as:

- Using energy-efficient lighting, insulation in buildings etc.
- Adopting sustainable lifestyles and purchasing habits.
- Switching to electric vehicles.
- Preferring public transportation to own vehicles.
- Utilizing renewable energy sources.
- Planting trees and creating awareness about environmental conservation.

Lowering carbon emissions is achievable through the collective efforts of young generations, who can use public transportation, cycle within campuses, and engage in afforestation and awareness campaigns. These actions contribute to greener, cleaner, and carbon-free environments.

6.2.6 Green Technology in Relation to Construction

The construction industry, responsible for 39% of energy-related carbon dioxide emissions, faces significant challenges in reducing its carbon footprint. The adoption of green technology in construction is crucial to address this issue. Green construction involves sustainable building practices that minimize environmental impact. However, implementing green technology in construction poses challenges due to its higher costs as sustainable materials are highly expensive.

So, a lot of innovations, research and skilled engineers are required in the construction industry for the application of green technology. While constructing green buildings can be expensive, the long-term benefits in terms of reduced energy consumption and environmental conservation make it a worthwhile investment. Ethical considerations lie in the sustainability of green technology in construction and its ability to minimize environmental damage.

6.2.7 Let Us Sum Up

- **Introduction to Green Technology:** The chapter underscores the vital importance of green technology and its role in protecting the environment, emphasizing the need to educate the younger generation on this crucial subject.

- **Environmental Challenges:** Discusses the escalating concentrations of greenhouse gases, rampant deforestation, and ecosystem mismanagement as contributors to climate change, highlighting the urgency of promoting green technology.
- **Concepts of Green Technology:** Explains fundamental concepts such as renewable energy sources and their positive impact on the environment. Various green initiatives, including air and water purification, sewage treatment, and solid waste management, are enumerated.
- **Sustainable Energy Sources:** Explores sustainable energy sources like solar, wind, hydroelectric, tidal, geothermal, ocean-thermal, biomass energy, etc. elucidating their role in restoring the environment and reducing carbon emissions.
- **Alignment with Sustainable Development Goals (SDGs):** Aligns the goals of green technology with the 2030 SDG agenda, emphasizing their significance in environmental protection.
- **Role of Initiatives like RENEW:** Discusses the vital role of initiatives like RENEW in mitigating chemical waste's impact on nature. Introduces the principles of 'refuse' and 'responsibility' to raise awareness and reduce demand for wasteful products.
- **Net-Zero Concept:** Explores the crucial concept of achieving a net-zero carbon footprint to combat climate change. Highlights the role of Higher Education Institutions (HEIs) and universities in pledging to become net-zero campuses.
- **Understanding Carbon Footprint:** Explains the concept of a carbon footprint and provides practical insights into how individuals, including students, employees, employers and institutions can reduce carbon emissions within their campuses.
- **Green Technology in the Construction Industry:** Emphasizes the essential role of green technology in the construction industry, particularly in the context of changing environmental conditions and climate change. Industries should be encouraged to adopt sustainable practices and technologies.

6.2.8. Keywords

Green Technology: Green technology is a comprehensive term encompassing the utilization of scientific and technological advancements to minimize adverse impacts on the natural environment.

Renewable Energy: Renewable energy refers to energy derived from natural sources like wind, hydropower, tidal, geothermal, solar energy, etc. often referred to as green or sustainable energy.

Green Energy: Green energy is synonymous with renewable and sustainable energy, generated from renewable sources.

Net Zero: The concept of achieving a Net Zero state involves the mission to eliminate or offset carbon emissions on Earth effectively.

Carbon Footprint: A metric used to quantify the quantity of carbon dioxide released into the atmosphere as a result of specific activities or processes.

3R of Green Technology: The 3Rs refer to a trio of principles associated with green technology, namely Reduce, Reuse, and Recycle, aimed at minimizing waste and resource utilization.

RENEW (Resource Exchange Network for Eliminating Waste): RENEW represents a network facilitating the exchange of materials among industries, businesses, and governmental entities, promoting reclamation, recycling and reuse of materials.

Recycling: Recycling is the process of converting waste materials into reusable materials, contributing to environmental sustainability.

Incineration: Incineration involves the combustion and destruction of materials, particularly waste, often used for waste disposal purposes.

Refuse Waste: Refuse waste includes garbage and rubbish. These are referred to as non-hazardous solid waste which requires collection and transportation to processing or disposal sites.

Greenhouse Gases (GHGs): Greenhouse gases are atmospheric compounds, like carbon dioxide (CO₂), methane (CH₄), and water vapor (H₂O), that trap heat from the sun and prevent it from escaping back into space. This natural greenhouse effect is essential for maintaining Earth's temperature, but human activities have increased these gases, contributing to global warming and climate change.

Climate Change: Climate change pertains to long-term alterations in temperatures and weather patterns, often associated with shifts in the Earth's climatic conditions.

Net Zero Pledges: Net Zero signifies the equilibrium between greenhouse gas production and removal from the atmosphere. Numerous universities and higher education institutions have committed to achieving net-zero emissions, symbolizing their dedication to addressing climate change.

Reuse Waste: Reusing waste is a secondary waste management approach following waste reduction, involving the repeated use of materials, thus promoting sustainability and waste minimization.

6.2.9. Check Your Learning

Q.1. Answer in Two or Three Sentences

- What does green technology mean?
- What is renewable energy?
- What are the sources of renewable energy?
- What is a programmable thermostat?
- What is server technology?
- Enumerate different energy-efficient appliances.
- What is device recycling?
- Outline the goals of green technology.
- Explain the concept of reducing and recycling.
- What is RENEW?
- Explain the concept of refuse and responsibility.
- What is green energy?
- Outline different types of green energy.
- Outline the use of renewable energy.

- o) What is Net-Zero?
- p) What is Net-Zero pledges?
- q) What is a carbon footprint?
- r) Explain the impact of green technology on construction.

Q.2. Answer in 50 Words

- a) Explain the concept of green technology.
- b) Discuss the relationship between green technology and the environment.
- c) What are the different uses of green technology?
- d) Explain the goals of green technology.
- e) Explain the 3Rs of green technology.
- f) Briefly discuss the role of RENEW in chemical waste management.
- g) Outline the ethical aspects of green technology.
- h) What are the different uses of renewable energy?
- i) Explain the concept of a carbon footprint and its reduction strategy.
- j) What is the application of green technology in the construction industry?
- k) How can green technology be used for energy conservation?
- l) Outline the applications of green technology in the environment.
- m) Explain greenhouse gases.

Q.3. Answer in 250 words

- a) Define green technology and discuss different green initiatives to protect the environment.
- b) What are the various applications and uses of Green Technology?
- c) Define renewable energy and discuss the different types of renewable energy and their sources.
- d) Explain the goals of green technology.
- e) Explain the concepts of Reduce, Reuse, and Refuse.
- f) Define Net Zero and discuss the steps to reduce carbon footprint.

6.2.10 Suggested Readings

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Unit-VI

Environmental & Techno Ethics

6.3 Ethics, Science and Technology Interactions

6.3.0 Objective

6.3.1 Introduction

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6.3.1.2 Science, technology and ethics

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6.3.2 Ethics, Science and Technology Interactions

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6.3.0 Objectives

- To enable the students to understand the contribution of science and technology
- To educate the students to learn the ethics in use of various gadgets for betterment of the society
- To orient the students about judicious use of technology for a harmonious society
- To motivate the students ideate and innovate eco-friendly and viable technologies for sustainable development

6.3.1 Introduction

Human is the most rational creature on earth. For a happy and healthy life, the wants of human beings multiplied and each want paved the way for a new discovery and invention. The science and technology played a major role in the development of the human civilization. Scientists used their knowledge to develop technology and then used technology to develop Science; so, because of this reason science and technology are an integrated term in today's world. There are two concepts to understand the relationship between Science and Technology. These are contribution of science to technology and contribution of technology to science. Let us now understand how Science has contributed to Technology. Science serves as a direct source of new technological ideas. For example, innovation and development of medical instruments; nuclear technology, radar system, etc. science serves as a source of engineering. Most of the technical knowledge used in the designing and development of tools and techniques is actually an outcome of 'engineering science'. Science has also helped in the development of human skills. This is one of the fundamental contributions of science. Let us understand how technology contributed to science. Technology serves as a source of scientific challenges. The development in the field of technology paves way for research and development in the field of science. For example, space science is one of them. Technological development likewise indirectly stimulates basic research in the field of science. Development of advanced instruments facilitated scientists to measure the distance between sun and earth, the intensity of sun's rays, the revolution of celestial bodies, internal problems of human beings, life of a bridge, etc. Technological advancements have led to significant changes in society. The earliest known technology is the stone tool, used during prehistoric times, followed by the control of fire, which contributed to the growth of the human brain and the development of language during the Ice Age. The invention of the wheel in the Bronze Age allowed greater travel and the creation of more complex machines. More recent technological inventions, including the printing press, telephone, the Internet, have lowered barriers to communication and added up in the knowledge economy.

While technology contributes to economic development and improves human prosperity, it can also have negative impacts like pollution and resource depletion, and can cause social harms like technological unemployment resulting from automation. As a result, there are ongoing philosophical debates about the role and use of technology, the ethics of technology, and ways to mitigate its downsides. The evolution of science is like a boon to the world, as human beings come to know a lot about the world they are living in the activities they indulge into.

Furthermore, the development of technology along with the advancement in science helps to bring in a revolution in various fields such as medicine, agriculture, education, information and technology, and many more. In the present world, if we think of any sort of development, then the presence of science and technology cannot be ignored. But, at the same time the ethical use of technology is to be emphasized for a harmonious society.

6.3.1.1 Definition and Important Concepts

6.3.1.2 Science, Technology and Ethics

Science-

Science refers to a system of acquiring knowledge. This system uses observation and experimentation to describe and explain natural phenomena. The term science also refers to the organized body of knowledge people have gained using knowledge. Science is the dynamic, ever expanding knowledge, covering every new domain of experiences, whereas, Knowledge refers to the product of science, such as the concepts and explanations. Research being carried out in the field of science resulted in developing more knowledge at a faster pace sometimes by replacing old concepts, ideas or principles. Science encompasses the systematic study of the structure and behaviour of the physical and natural world through observation and experiment. Science is a systematic endeavour that builds and organizes knowledge in the form of testable explanations and predictions about the universe. In other words, science is the knowledge covering general truths of the operation of general laws, obtained and tested through scientific method and concerned with the physical world.

The branches of science also referred to as sciences, scientific fields or scientific disciplines, are commonly divided into three major groups:

- Formal sciences: the study of formal systems, such as those under the branches of logic and mathematics, which use an *a priori*, as opposed to empirical, methodology.
- Natural sciences: the study of natural phenomena (including cosmological, geological, physical, chemical, and biological factors of the universe). Natural science can be divided into two main branches: physical science and life science (or biology).
- Social sciences: the study of human behaviour in its social and cultural aspects.^[1]

Scientific knowledge must be based on observable phenomena and must be capable of being verified by other researchers working under the same conditions. This verifiability may well vary even within a scientific discipline.

Natural, social, and formal science make up the fundamental sciences, which form the basis of interdisciplinary- and applied sciences such as engineering and medicine. Specialized scientific disciplines that exist in multiple categories may include parts of other scientific disciplines but often possess their own terminologies and expertise.

Technology-

Technology is the application of scientific knowledge for achieving practical goals in a reproducible way. Technology (which is basically derived from the Greek word '*technologia*') is an art, skill or ability, which is used to create and develop products and acquire knowledge. The word technology can also mean the products resulting from such efforts, including both tangible tools such as utensils or machines, and intangible ones such as software. Technology plays a critical role in science, engineering, and everyday life. Technology is the product of transferring scientific knowledge to practical use. Different forms of technology are the result of efforts by human beings to find more efficient ways to do things and testing new ideas. Technology is constantly improving and generally aims to make processes easier for people. For example, the internet makes communication easier and more efficient.

Ethics-

Etymologically the term "ethics" correspond to the Greek word "ethos" which means character, habit, customs, and the ways of behaviour. Ethics is also called "moral philosophy". The word "moral" comes from Latin word "mores" which signifies customs, character and behaviour. Thus, ethics may be defined as the systematic study of human actions from the point of view of their rightfulness or wrongfulness, as means for the attainment of the ultimate happiness. These are moral principles that govern a person's behaviour or the conducting of an activity. Ethics as moral philosophy, concerned with what is morally good and bad and morally right and wrong. The term is also applied to any system or theory of moral values or principles. This subject consists of fundamental issues of practical decision making, and its major concerns including the nature of ultimate value and the standards by which human actions can be morally evaluated. The whole study of ethics can be divided into General Ethics (nature of moral activity, norm of morality, foundation of morality, and end of morality) and Special Ethics (applies the principles of general ethics to the various actions of human activity). The terms ethics and morality are closely related. It is now common to refer to ethical judgments or to ethical principles where it once would have been more accurate to speak of moral judgments or moral principles. These applications are an extension of the meaning of ethics. In earlier usage, the term referred not to morality itself but to the field of study, or branch of inquiry, that has morality as its subject matter. In this sense, ethics is equivalent to moral philosophy. Although ethics has always been viewed as a branch of philosophy, its all-embracing practical nature links it with many other areas of study, including anthropology, biology, economics, history, politics, sociology, and theology. Yet, ethics remains distinct from such disciplines because it is not a matter of factual knowledge in the way that the sciences and other branches of inquiry are. Rather, it has to do with determining the nature of normative theories and applying these sets of principles to practical moral problems.

6.3.1.3 Ethics and use of gadgets and machines

The gadget is a small mechanical, electrical or electronic device with a practical use. It is often thought of as a novelty. The gadgets are the products of science and technology. Each gadget is associated with one or more technologies. While a single piece of technology often overlaps into different areas, there are generally six different categories of technology: communication, electrical, energy, manufacturing, medical and transportation. We live in an age when just about any information under the sun is available to us at the click of a button. People are becoming more confident, because they are aware of the power of the internet. The gadgets associated with various technologies are discussed here with the ethics in use of these gadgets.

1. Communication technology, gadgets and ethics

Communication technology consists of any pieces of technology people use to communicate with one another. Some early examples of communication technology include Morse code and the telegraph. Below are some examples of more modern gadgets of communication technologies:

Television

Television sets transmit signals over which we can listen to and view audio and visual content. People use television for mass communication of important messages, advertisements, entertainment and more. Most televisions receive signals from a cable wire or over the internet, which relays signals that direct a television set on what content to display. Television is now deeply implicated in shaping our ethical sensibilities. This development makes trouble for the logic of tabloid moralism and its obsession with policing the boundaries between right and wrong, for when moralism gives way to ethics the role of television in governing populations becomes much more complex and multifarious. The different sections of the society has different taste, interest and need. The family members have to prepare a strict rule for watching television for the children. The programmes to be watched, the duration of the watching hour, the place of fitting of the television are to be decided well for ethical use of television, as it not only affects the moral values but also affects the physical health.

Internet

Many people consider the internet to be the most popular and powerful communication technology. It allows people from around the world to interact through written messages, as well as audio and video messages. With the internet, users can communicate almost instantaneously with anyone else and share information. This makes it a powerful tool for businesses, charities, governments and individuals among many others. The Internet is a pool of information. But all the information are not required for all the groups by age and occupation. Otherwise, there will be information pollution and the cognitive and motor development of the children will be affected. There must be monitoring system to assess the activities of the young minds in internet world and this is the moral responsibility of the students as well as parents and teachers to have a regulating system in using the internet.

Cell phones

Cell phones are a modern improvement over the telephone. With a cell phone, people have the ability to call other phones and have a conversation with people across the world. Many phones are also capable of connecting to the internet, which allows users to communicate in other ways, such as text messages or video chats. But the excessive use of cell phones may cut off the personal touch in communication and it may affect the physical and mental health of the users. There must be ethics in use of the cell phones. Excess use may create illusion of the reality vs. dream.

2. Electrical gadgets and ethics

Many pieces of modern technology use electricity in some form. A few examples of electrical technology include:

Computers

Computers operate through a rapid pulsing of electrical currents. Their core foundation of computers is binary code, which determines whether there is an electrical current. Depending on the order in which the device receives these currents, a computer performs different functions. People use computers to access the internet and print physical copies of digital content among other functions.

Circuitry

A collection of electrical components that perform a particular function is a circuit. An example of an electrical circuit is a computer processor, which is a small component that translates electrical signals into computer code. Electrical circuits exist in many modern-day items, such as computers, remote controls, cell phones, appliances and more. These gadgets made our life more comfortable. But the man should control the gadgets not the vice versa.

Artificial intelligence

Artificial intelligence is a computer system designed to make decisions and perform actions autonomously. There are varying degrees of artificial intelligence sophistication in many of our daily tasks. For example, online navigation apps use artificial intelligence to analyze the best route for a traveller based on traffic, road closures and more. Another example is search engines, which use artificial intelligence to determine the best results to display for each unique user. The Chat GPT

Audio and visual technology

Audio and visual technology consists of items such as cameras, microphones and projectors. Their purpose is to capture and display audio and visual mediums to users. Audio and visual technology often combines with other forms of technology, such as cell phones, to provide

camera functionality, for example. The use of all these gadgets is to be regulated by the ethical principles to make life easier and comfortable.

3. Mechanical gadgets and ethics

Mechanical technology is the application of engineering principles to achieve tasks more efficiently. People use this technology in a wide variety of machinery, with some common examples of mechanical technology including:

Manufacturing

Manufacturing technology aims to produce goods faster and in a more cost-effective manner. A popular example of manufacturing technology is an assembly line, which greatly improved the speed of production processes. Manufacturing technology's benefits also include product quality improvements, better tracking and systems analysis, faster shipping speeds and enhanced employee safety. The human and environment safety are the ethical components of these machineries.

Heavy engineering

Heavy engineering technology helps professionals perform tasks such as building bridges or digging tunnels. It helps transport heavy materials, dig holes into the ground and make construction processes more efficient. Other areas of heavy engineering include shipbuilding, mining, steel production and aerospace engineering. The use of these heavy machineries requires safety measures and the earth work is to be regulated for climate sustainability.

6.3.2 Ethics, Science and Technology Interactions

6.3.2.1 Interaction between ethics and technology

The world today is facing several ethical challenges. Ethics and technology are interrelated. Critical decisions have to be made to ensure we are using the technologies properly appropriately.

Misuse of Personal Information

One of the primary ethical dilemmas in our technologically empowered age revolves around how to use personal information. As we browse internet sites, make online purchases, enter our information on websites, engage with different businesses online and participate in social media, we are constantly providing personal details. The valuable data points are often exploited so that businesses or entities can make money or advance their goals. Therefore everyone is to be very careful while entering personal data in social media.

Misinformation and Deep Fakes

The internet is flooded with information. But these information's might be be misleading. Without logically analysing the fact, one should not decide the alternative. Similarly, we used to

believe the video telling a story that may not be rooted in truth. But deepfake technology now allows such a sophisticated manipulation of digital imagery that people appear to be saying and doing things that never happened. The potential for privacy invasion and misuse of identity is very high with the use of this technology.

Use of AI

Artificial intelligence certainly offers great opportunity to explore new areas. But there must be ethical boundary of operation. Use of software to find individuals can quickly become a less-than-ethical problem. The ability to track movements and activity quickly morphs into a lack of privacy. Facial recognition also isn't fool proof and can create bias in certain situations.

Autonomous Technology

Self-driving cars, robotic weapons and drones for service are no longer a thing of the future—they're a thing of the present and they come with ethical dilemmas. Robotic machines in place of human soldiers are a very real possibility, along with self-driving cars and package delivery via unmanned drone. It's a frequently mentioned ethical concern that we trust our technology too much without fully understanding it.

Ethical Practices in Technology

Unlike business ethics, ethical technology is about ensuring there is a moral relationship that exists between technology and users.

Moral Use of Data and Resources

Data protection measures and compliance procedures can help ensure that data isn't leaked or used inappropriately.

Responsible Adoption of Disruptive Tech

Digital growth is a business reality. Disruptive tech often isn't just a way to outpace the competition—it's the only way to break even. But embracing new technologies doesn't have to coincide with an ethical challenge.

Create a Culture of Responsibility

Ultimately, we need to create a culture of responsibility within technology. If the information technology workforce and industry giants believe they are responsible for the safe and ethical usage of technology, then we will see more governance and fair use of data.

Techno ethics -

Techno ethics is an interdisciplinary research area that draws on theories and methods from multiple knowledge domains (such as communications, social sciences, information

studies, technology studies, applied ethics, and philosophy) to provide insights on ethical dimensions of technological systems and practices for advancing a technological society. Technoethics views technology and ethics as socially embedded enterprises and focuses on discovering the ethical uses for technology, protecting against the misuse of technology, and devising common principles to guide new advances in technological development and application to benefit society. Technology is dynamic but ethics remains constant with one aim, to spread happiness.

6.3.2.2 Interactions between ethics and Science

The notion of truth is same in ethics and science. However, the data in science and ethics are different. In science we rely on observation, in ethics we rely on considered moral intuitions. The scientific innovations must be eco- friendly and must be used ethically for the greater cause of human happiness. S

6.3.2.3 Positive interactions between ethics, technology and science

The ethics, science and technology can coexist harmoniously; it all depends on how they are used for the benefit or detriment of human life. It is evident that although there are clear conceptions about morality and ethical behaviour, it is entirely up to individuals to choose how they will act in certain situations. In addition, it is convenient to point out that although the scientific method implies leaving aside prejudices, it does not mean that science and technology are exempt from ethics, especially because both have a relevant impact on the environmental and social sector. Science and technology in themselves do not represent threats to human life. Everything depends on how they are used by the people. For example, although the activities carried out in nuclear power plants are currently important, it is well known that they affect people's health. So why haven't effective solutions been proposed before implementing the use of such harmful technologies? On many occasions, these types of health or ecological problems are often minimized with the use of other technologies that also have harmful effects on life, or they are shown as inevitable consequences when in fact they could be prevented, prioritizing ethical behavior over other types of benefits.

6.3.4 Agricultural, Industrial, Digital Age

6.3.4.1 Ethics and agricultural innovations

Agriculture is the backbone of our country. The agriculture production system is interconnected with human and environmental dimensions. Therefore, ethics in agriculture and agricultural innovations is an important aspect. To cater to the need of the growing population and to maximize production, the natural resources like soil, air and water have been overused and also the ecosystem is being distorted. Researchers and academics have applied ethical concepts and tools to address several issue areas in the food system. The objective is to help practitioners and others interested in these issues to navigate through the topic of ethics as

applied to the world of agriculture. The research and academic analysis have focused on the following topics:

Farm Structure: This refers to the general social and economic features of agriculture in a given society. These features include the average size of farms, relative market shares of different-sized farms, numbers of people employed in farming, and whether or not farms are owner-operated. The situation and rights of farmworkers can also be included here.

Animal Ethics: It focuses on the use of animals, the intensive production of meat and poultry, extensive production of feedstuffs for animals, and impacts on the environment due to intensive and concentrated production. The “happiness” or welfare of animals would also be included here.

Food Safety : This is an issue because of modern food production-transportation-processing-marketing chains that expose consumers to chemical additives, microbial pathogens and other human health concerns. Inspection and transparency in how food is produced is included here.

Environmental Impacts: These are a great concern and raises many questions in how crop agriculture and livestock production is managed: locally, nationally and globally. Areas of concern include chemical residues on food, pesticide exposure on workers, wasteful use of soil and water resources, and untargeted yet obvious impacts on the natural ecosystem and wildlife.

International Trade: It is a question of fairness in how rules are set, who sets the rules and who benefits versus those who are pushed out of the market. The ethical questions revolve around human rights and the equitable distribution of benefits and harms.

Food Security: This is a broad term and covers many aspects of the global food system. The essential question deals with hunger and how to provide sufficient food for all. The ethical debate swirls around the balance of global trade (and food relief) with widespread agricultural development. Bioterrorism is also a concern here.

Agricultural Biotechnology: This is debated in terms of food safety and consumer consent, the broader environmental effects of its use in crop and livestock production, its impact on the structure of agriculture, and its potential to address problems of hunger on a global basis. The genetically modified food is found to be harmful for long term human consumption.

These ethical issues are to be addressed for sustainable development of agriculture and judicious management of natural resources.

6.3.4.2 Ethics and industrial development

The adoption of ethical practices and moral values such as ethical decision-making, recognition of rights, corporate governance and disclosure, as well as sustainable business practice, has emerged as a key component of corporate competitiveness and efficient industrial organization. The industry should follow the Corporate Social Responsibility (CSR) criteria. The CSR is a policy of corporate houses whereby the corporates promote certain developmental and environmentally sustainable activities for the benefit of the society and thereby increasing the brand image of the company. The corporates must monitor the waste management system. The waste must be disposed in proper method to avoid the health issues of the people residing in the vicinity and the environmental degradation. The plantation programme and soil amelioration activities are to be taken up by the industries to sustain the development.

6.3.4.3 Ethics and digital life

The digital life in Fourth Industrial Revolution (4IR) is fundamentally changing the world, and technological advances such as artificial intelligence (AI), machine learning (ML) and digitization are increasingly affecting how people live, work, communicate, learn and play. Accordingly, a new set of moral, ethical and legal values are being codified and become the global norm.

Although 4IR technologies undoubtedly offer immense benefits and opportunities, they also raise some profound ethical and moral questions like whether the human mind will control the AI or the AI will control the human mind. These technologies have ushered in a new era of disruption with uncertain, unintended and unforeseen global socioeconomic consequences. These disruptive technologies will have a profound effect on the future, and it would be irresponsible not to consider how these technologies are developed and deployed in real-life settings.

The term “Fourth Industrial Revolution” was coined by Klaus Schwab, the founder and executive chairman of the World Economic Forum. The Fourth Industrial Revolution, which has also been referred to as 4IR or Industry 4.0, has been described as a way of blurring the boundaries between the physical, digital and biological worlds. The fusion of these worlds is one of the hallmarks of the 4IR, along with the growing use of new technologies such as AI, cloud computing, big data, autonomous robots, 3D printing, the Internet of Things (IoT) and augmented reality. 4IR is unprecedented in its speed, its all-embracing nature and its global spread. Ethics and accountability play a crucial role in addressing the imbalances in society.

6.3.5 Globalized Age

6.3.5.1 Globalization- Meaning

Globalization is the process of interaction and integration among people, companies, and governments worldwide. Globalization has accelerated since the 18th century due to advances in transportation and communication technology.

6.3.5.2 Ethics and Globalization

Globalization has transformed the world from a collection of discrete communities interacting occasionally to an overlapping community of fate. As nations, peoples and communities across the globe become economically, socially and politically connected, the distinction between the global and the local becomes increasingly blurred and events and actions in one locale carries with it the potential to generate transnational and transgenerational consequences. It is closely linked with economic globalization that stands for the integration of national economies into the international economy through trade, foreign direct investment, capital flows, migration, the spread of technology and military presence. However, the phenomenon of globalization is usually driven by a combination of economic, technological, socio-cultural, political and biological factors. Globalization includes internationalization, liberalization, universalization and westernization, which crosses the boundaries of nations. Globalization has led to internationalization of business processes. Cross-border movement of people is becoming easier. So, it becomes important to deal with ethical issues in cross-cultural settings. The term business ethics should be understood from all angles. It is argued that it is unethical to resort profiteering on one hand and it is unethical to incur losses. For the simple reason that a company which cannot make profits and incurs losses is a liability on the system by wasting scarce resources creating the problem of unemployment etc. Thus instead of profits being contradictory to ethics, business ethics dictates that the first responsibility of the business is to remain profitable and generate revenue for all the stakeholders viz., shareholders, employees, government, customers, public etc., of the society. Business ethics is a form of applied ethics. It aims at inculcating a sense of value orientation within company's employee as to how to conduct business responsibly. Because the term 'ethics' can pose problems in the international context, i.e., the term does not translate well into action and it is difficult to find a common understanding.

6.3.5.3 Ethics and Universal goals

The Universal goals emphasize on promoting Sustainable development and happiness. Sustainable development has been defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Development calls for concerted efforts towards building an inclusive, sustainable and resilient future for people and planet. For sustainable development to be achieved, it is crucial to harmonize three core elements: economic growth, social inclusion and environmental protection. These elements are interconnected and all are crucial for the well-being of individuals and societies. Eradicating poverty in all its forms and dimensions is an indispensable requirement for sustainable development. To this end, there must be promotion of sustainable, inclusive and equitable economic growth, creating greater opportunities for all, reducing inequalities, raising basic standards of living, fostering equitable social development and inclusion, and promoting integrated and sustainable management of natural resources and ecosystems. The Sustainable Development Goals are a universal call to action to end poverty, protect the planet and improve the lives and prospects of everyone, everywhere. The 17 Goals were adopted by all UN Member

States in 2015, as part of the 2030 Agenda for Sustainable Development which set out a 15-year plan to achieve the Goals. This is a plan of action for people, planet and prosperity. These are no poverty, zero hunger, good health and wellbeing, quality education, gender equality, clean water and sanitation, affordable and clean energy, decent work and economic growth, industry, innovation and infrastructure, reduced inequalities, sustainable cities and communities, responsible consumption and production, climate action, life below water, life on land, peace, justice and strong institutions and partnership. Inclusive and sustainable development can be achieved by promoting value based ecosystem where each one is to give respect to each creation on earth and the habitat of each individual is to be protected for a better living and life.

6.3.6 Let Us Sum Up

The science and technology played a major role in the development of the human civilization. Scientists used their knowledge to develop technology and then used technology to develop Science; so, because of this reason science and technology are an integrated term in today's world. There are two concepts to understand the relationship between Science and Technology. These are contribution of science to technology and contribution of technology to science. While technology contributes to economic development and improves human prosperity, it can also have negative impacts like pollution and resource depletion, and can cause social harms like technological unemployment resulting from automation. As a result, there are ongoing philosophical debates about the role and use of technology, the ethics of technology, and ways to mitigate its downsides. The evolution of science is like a boon to the world, as human beings come to know a lot about the world they are living in the activities they indulge into. In the present world, if we think of any sort of development, then the presence of science and technology cannot be ignored. But, at the same time the ethical use of technology is to be emphasized for a harmonious society. The world today is facing several ethical challenges. Ethics and technology are interrelated. Critical decisions have to be made to ensure we are using the technologies properly appropriately. There are many issues related to misuse of personal information, misinformation and deep fake, use of artificial intelligence, use of autonomous technologies etc. The Universal goals emphasize on promoting Sustainable development and happiness. Sustainable development has been defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. development calls for concerted efforts towards building an inclusive, sustainable and resilient future for people and planet. For sustainable development to be achieved, it is crucial to harmonize three core elements: economic growth, social inclusion and environmental protection. These elements are interconnected and all are crucial for the well-being of individuals and societies. Eradicating poverty in all its forms and dimensions is an indispensable requirement for sustainable development. To this end, there must be promotion of sustainable, inclusive and equitable economic growth, creating greater opportunities for all, reducing inequalities, raising basic standards of living, fostering equitable social development and inclusion, and promoting integrated and sustainable management of natural resources and ecosystems. In this context a positive interaction between ethics, science and technology is required for a harmonious and inclusive society.

6.3.7 Key Words

- **Science**

Science refers to a system of acquiring knowledge. This system uses observation and experimentation to describe and explain natural phenomena. The term science also refers to the organized body of knowledge people have gained using knowledge. Science is the dynamic, ever-expanding knowledge, covering every new domain of experiences

- **Technology**

Technology is the application of scientific knowledge for achieving practical goals in a reproducible way. Technology (which is basically derived from the Greek word '*technologia*') is an art, skill or ability, which is used to create and develop products and acquire knowledge.

- **Gadget**

The gadget is a small mechanical, electrical or electronic device with a practical use. It is often thought of as a novelty. The gadgets are the products of science and technology. Each gadget is associated with one or more technologies.

- **Ethics**

Etymologically the term "ethics" correspond to the Greek word "ethos" which means character, habit, customs, and the ways of behaviour. Ethics is also called "moral philosophy". The word "moral" comes from Latin word "mores" which signifies customs, character and behaviour. Thus, ethics may be defined as the systematic study of human actions from the point of view of their rightfulness or wrongfulness, as means for the attainment of the ultimate happiness.

- **Technoethics**

Technoethics is an interdisciplinary research area that draws on theories and methods from multiple knowledge domains (such as communications, social sciences, information studies, technology studies, applied ethics, and philosophy) to provide insights on ethical dimensions of technological systems and practices for advancing a technological society. Technoethics views technology and ethics as socially embedded enterprises and focuses on discovering the ethical uses for technology, protecting against the misuse of technology.

- **Globalization**

Globalization includes internationalization, liberalization, universalization and westernization, which crosses the boundaries of nations. Globalization has led to internationalization of business processes.

- **Universal goals**

The Universal goals emphasize on promoting Sustainable development and happiness. Sustainable development has been defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Development calls for concerted efforts towards building an inclusive, sustainable and resilient future for people and planet. For sustainable development to be achieved, it is crucial to harmonize three core elements: economic growth, social inclusion and environmental protection

6.3.8 Check Your Learning

Q.1. Definitional type

- a. Science
- b. Technology
- c. Gadgets
- d. Innovation
- e. Ethics
- f. digital age
- g. Industrial age
- h. Agricultural age
- i. Universal goals
- j. Artificial Intelligence

Q.2. Analytical Type (Write short notes)

- a. Interaction between science and technology
- b. Interaction between science and ethics
- c. Interaction between technology and ethics
- b. Misuse of technology
- c. Ethical Use of Technology
- d. Role of family to prevent discrimination against third gender

Q.3. Essay type

- a. Discuss the interaction of science, technology and ethics.
- b. Describe ethics in use of gadgets and machines.
- c. Discuss ethics and agricultural innovations.
- d. Discuss the role of ethics in digital life.
- e. Enumerate the role of ethics in globalization.
- f. Discuss ethics and universal goals

Unit-VI

Environmental & Techno Ethics

6.4 Judicious Use of Technology

6.4.0 Objectives

6.4.1 Introduction

6.4.2 Mobile phones – our out-of-body brains

6.4.3 How do mobile phones work?

6.4.4 Cell phones and cancer risk/health hazards in humans

6.4.5 Organizations monitoring mobile phone use and health hazards in humans

6.4.6 Is there any device that can shield your body?

6.4.7 Television/Computers/Tablets/Electrical Machines

6.4.8 Light at night

6.4.9 Plastics – from miracle to menace

6.4.10 Ethics and Use of Digital Technology

6.4.10.1 Cyber ethics

6.4.10.2 Types of cyber crimes

6.4.10.3 Ethical hacking

6.4.11 Ethics of social media

6.4.11.1 Facebook, YouTube, WhatsApp, Instagram, and Twitter (X)

6.4.12 Digital detox

6.4.13 Safe mobile phone use advisory

6.4.14 Take-home message

6.4.15 Further reading

6.4.16 Abbreviations

6.4.17 Check your learning

6.4.0 Objectives

- To make the students aware of the functioning of digital technology
- To educate the students about the ethics associated with the usage of digital technology and social media platforms
- To familiarize the students with safe digital technology usage through a take-home message

6.4.1 Introduction

Let us begin with the question: What is Technology? Technology includes three important components, such as methods, systems, and devices. These are based on scientific knowledge. In other words, we can say that these are the outcomes of rigorous scientific research and research-based developments. The methods, systems, and devices are used to ameliorate the quality of life of each individual in human society. The technology is also developed and used for the welfare of non-human organisms, including plants, animals, and microbes.

Can we live without using technology in our day-to-day lives? In the present time, it is almost impossible to stay away from technology or technology-based products and services. However, it is unequivocal that technology has both positive and negative impacts on human society. Many technologies are like double-edged swords. Let us look at a few examples of positive and negative aspects of technology outlined in Figure 1. However, the aspects listed in Figure 1 are not complete. In the present time, we have made tremendous improvements in connectivity and communication systems. The process of learning techniques and the quality of imparting education have witnessed remarkable changes. Similarly, modern technology has brought remarkable advances in the domains of healthcare practices, and very important sectors, such as transport, agriculture, and energy production.

There are, however, many negative aspects associated with technology usage. For example, mobile phone addiction is a recent phenomenon that appears to be common among adolescents and youths of human society. The excessive use of smartphones and comparable devices makes users heavily dependent upon these gadgets. Addiction and dependency

together lead to distraction among the users. Excessive use of mobile technology may also lead to many health-related issues. The use of technology also has tremendous effects on the environment leading to climate change. Technology has also tremendously advanced tools that are often used in the events of conflicts and wars between and among nations.

In this chapter, the focus is on the judicious use of technologies, such as Mobile phones, Electrical machines, Television, Computers, Light at night, and Plastics. The probable

Technology

Illustrative examples of a few **positive** and **negative** aspects of technology

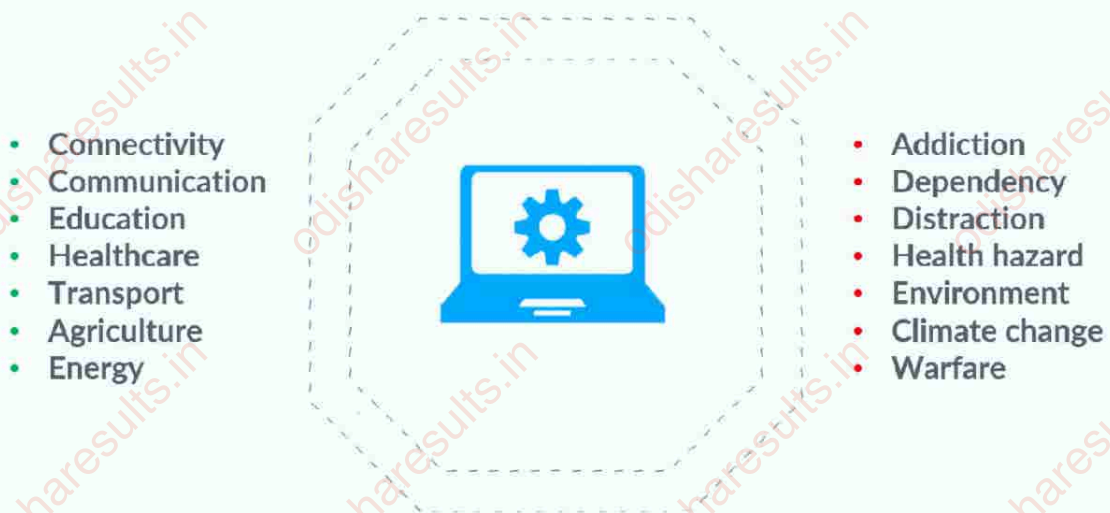


Figure 1: Technology – Positive and negative aspects

harmful effects of their usage are discussed based on supporting data that are available in the literature.

6.4.2 Mobile phones - our out-of-body brains

A mobile phone is nothing but an extension of your brain outside your body. It cannot be called an ectopic brain, but certainly, it is an additional brain that you carry around wherever you go. This is one of the most innovative inventions made by the *Homo sapiens*. It does almost everything for you, such as mobile banking, online shopping, entertainment, navigation, travel and vacation, health care, self-care, smart home control, communication, seeking and acquiring information, and whatnot.

Therefore, the use of mobile phones has skyrocketed in recent times. Figure 2 and Figure 3 depict the number of smartphone users by the top 10 countries in 2022 (in millions). The data were released by the <https://www.statista.com/statistics/748053/worldwide-top-countries-smartphone-users/> in May 2023. It should be noted that the figures include only smartphones, but not all mobile phones.

India is in the second position after China with a staggering number of 659 million smartphone users. It is beyond doubt that smartphone users in India are getting many benefits from using smartphones. However, it is not known with concrete evidence if these smartphones are producing any harmful impacts on the users.

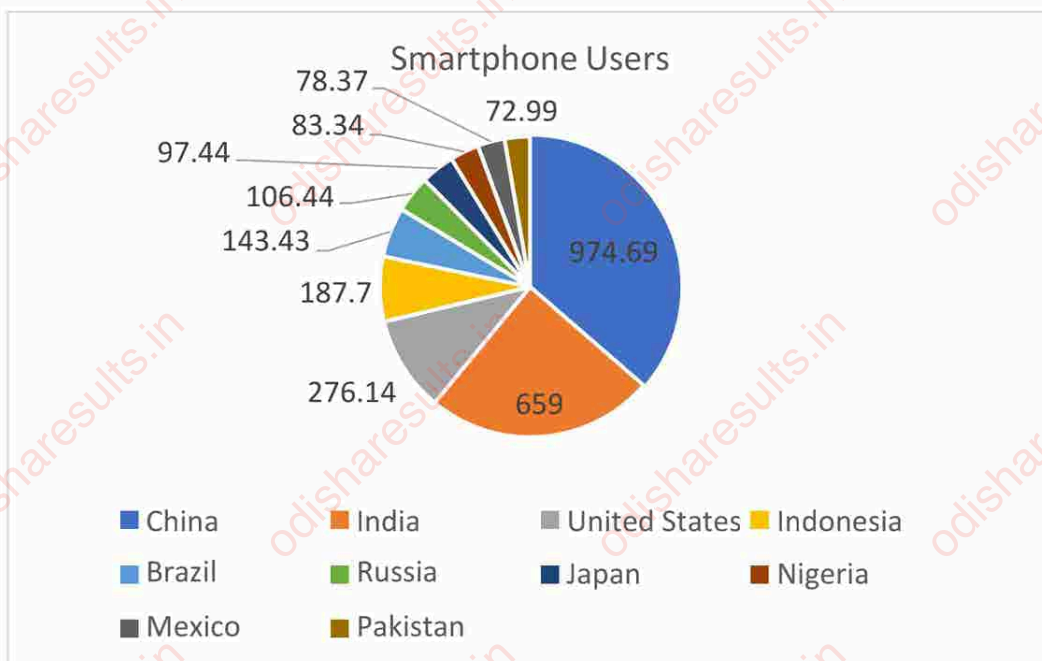


Figure 2: Number of smartphone users by the top 10 countries in 2022 (in millions)



Figure 3: A map comparing smartphone users across geographical regions

6.4.3 How do mobile phones work?

All mobile phones (= cell phones) communicate with each other using radio waves. The latter transports digitized voice or data in the form of oscillating electric and magnetic fields. Thus, the electromagnetic field (EMF) consists of oscillating electric and magnetic fields. The rate of oscillation is called frequency. Radio waves carry the information and travel in the air at the speed of light. Let us know a little more about the EMF. The following paragraph is excerpted from our article by Singh and Pati published in 2016.

“The electromagnetic fields (EMF) are ubiquitous in the environment that we live in. We are exposed to both natural and man-made EMF almost continuously in our day-to-day lives. The EMF is a combination of both electric and magnetic fields. According to the WHO Regional Office for Europe in 1999, ‘*Electric fields are created by differences in voltage: the higher the voltage, the stronger will be the resultant field. Magnetic fields are created when electric current flows: the greater the current, the stronger the magnetic field. An electric field will exist even when there is no current flowing. If current does flow, the strength of the magnetic field will vary with power consumption but the electric field strength will be constant*’ (Excerpted from EMF published by the WHO Regional Office for Europe in 1999; Local authorities, health, and environment briefing pamphlet series; 32). The electromagnetic spectrum (Figure-1, but in this chapter, it is renamed as Figure-4) includes electromagnetic waves of varied frequencies, i.e., from

zero frequency (static electromagnetic field) to very high frequency (Gamma cosmic rays). Of these, ultraviolet, X-ray, and Gamma Cosmic rays are potentially harmful and invariably lead to fatal health consequences in humans and other living organisms. Radiofrequency radiation and microwaves may also produce biological effects of immense concern, although it is debatable. Nonetheless, there has been a global hue and cry concerning the effects of BTS and mobile phones (MP) on human health and safety. The use of mobile phones has increased phenomenally in recent years so also the skepticism regarding its effects.”

Excerpted from Singh and Pati (2016). Biological Rhythm Research, Vol. 47, No. 3,353–388, <http://dx.doi.org/10.1080/09291016.2015.1116741>

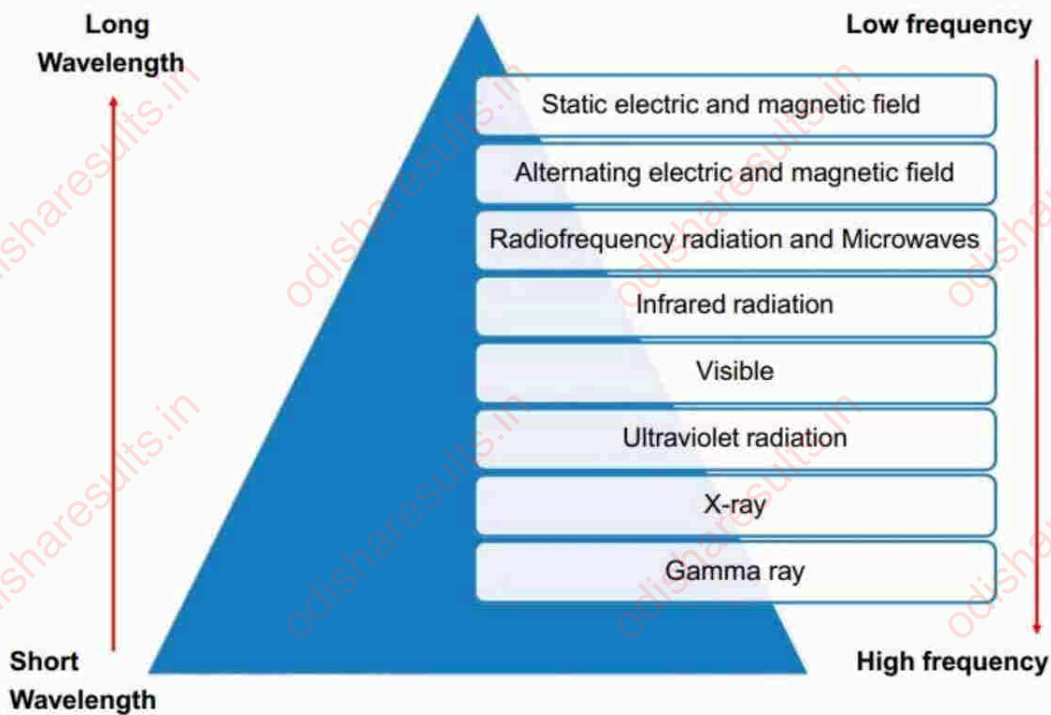


Figure 4: The electromagnetic spectrum – Excerpted from Singh and Pati (2016)

Wi-Fi technology is extensively used these days. We find Wi-Fi equipment almost everywhere – in our homes, campuses of schools, colleges, universities, and business

organizations. We also use Wi-Fi technology at railway stations and airports. We can say that this technology is omnipresent and helps us in connecting our smartphones, computers, and tablets to the Internet. However, all Wi-Fi equipment and other gadgets, like cordless phones, and Bluetooth devices emit radiofrequency electromagnetic fields (EMF). The EMF emitted by the Wi-Fi is in the category of non-ionizing radiations and therefore it should not have any harmful effects on humans provided radiofrequency EMF does not cross the recommended threshold limits. In contrast, many studies implicate mobile phones, and Wi-Fi equipment as producing harmful biological effects on human health.

6.4.4 Cell phones and cancer risks/health hazards in humans

On 31st May 2011, through a press release, the WHO/International Agency for Research on Cancer (IARC) classified radiofrequency electromagnetic fields as possibly carcinogenic to humans (Group 2B). There is some evidence in support of a link between increased risks of glioma and wireless phone use. However, many other studies refute the above findings. It appears that the duration of mobile phone use (less than equal to 15 years versus greater than 15 years) and intensity of use (light versus heavy) are some of the important determinants of brain tumor risks.

A review of the literature revealed many conflicting findings. While some reports indicated that EMF exposure might lead to impairment of sleep quality, cognition, and circadian rhythm, many other reports indicated that EMF exposure does not affect these variables. In summary, the effects of EMF exposure remain largely inconclusive. According to Singh and Pati (2016): “This could be attributed to inter-individual variability in tolerance, gender-, and age-dependent differences in response, latitudinal differences in efficacy, variability among employed methodologies and differences in specific absorption rate, frequency of the mobile phone usage, and interaction of EMF with other physiological and environmental factors, among others.” Therefore, we need to carry out in-depth research to resolve this controversy.

“What is Group 2B?

In the IARC Monographs, agents that have an association with the incidence of cancer were classified into four groups, namely Group 1, Group 2A, Group 2B, and Group 3. The first group includes 127 agents that are carcinogenic to humans. Group 2A includes 95 agents that are probable carcinogens to humans. Group 2B includes 323 agents that are possibly carcinogenic to humans. The last group includes 500 agents that are not

classifiable as to their carcinogenicity to humans. The classification of the agents is based on <https://monographs.iarc.who.int/agents-classified-by-the-iarc/>.

What is Glioma?

Glioma is a growth of cells that starts in the brain or spinal cord. The cells in a glioma look similar to healthy brain cells called glial cells. Glial cells surround nerve cells and help them function.

As a glioma grows it forms a mass of cells called a tumor. The tumor can grow to press on the brain or spinal cord tissue and cause symptoms. Symptoms depend on which part of the brain or spinal cord is affected.

There are many types of gliomas. Some grow slowly and aren't considered to be cancers. Others are considered cancerous. Another word for cancerous is malignant. Malignant gliomas grow quickly and can invade healthy brain tissue. Some types of gliomas happen mostly in adults. Others happen mostly in kids.

There are four types of gliomas, such as Astrocytoma, Ependymoma, Glioblastoma, and Oligodendroglioma. You have to help your healthcare team understand how serious your condition is and what treatments might work best. In general, glioma treatment options include surgery, radiation therapy, chemotherapy, and others.

Symptoms of Glioma

Common signs and symptoms of gliomas include:

- Headache, particularly one that hurts the most in the morning.
- Nausea and vomiting.
- Confusion or a decline in brain function, such as problems with thinking and understanding information.
- Memory loss.
- Personality changes or irritability.
- Vision problems, such as blurred vision, double vision, or loss of peripheral vision.
- Speech difficulties.
- Seizures, especially in someone who hasn't had seizures before.

The information on glioma has been excerpted from <https://www.mayoclinic.org/diseases-conditions/glioma/symptoms-causes/syc-20350251>.”

6.4.5 Organizations monitoring mobile phone use and health hazards in humans

- “U.S. Food & Drug Administration (8): <https://www.fda.gov/radiation-emitting-products/cell-phones/do-cell-phones-pose-health-hazard>
- National Cancer Institute (NCI): Cell Phones and Cancer Risk Fact Sheet
- Federal Communications Commission (FCC): Wireless Devices and Health Concerns
- World Health Organization (WHO): Electromagnetic fields and public health: mobile phones
- International Commission on Non-ionizing Radiation Protection (ICNIRP): Mobile Phones
- Directorate-General for Health and Food Safety, European Commission: Conclusions on Radio Frequency (RF) Fields
- Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR), European Union: Final opinion on potential health effects of exposure to electromagnetic fields (EMF)
- International Agency for Research on Cancer (IARC): Non-ionizing Radiation, Part 2: Radiofrequency Electromagnetic Fields
- National Toxicology Program (NTP): Cell Phone Radio Frequency Radiation”

See also Scientific Evidence for Cell Phone Safety for more details:

<https://www.fda.gov/radiation-emitting-products/cell-phones/scientific-evidence-cell-phone-safety>

6.4.6 Is there any device that could shield your body?

There is a company called Shield Your Body (SYB). This company has many products, such as the SYB Phone Pouch, SYB Laptop Pad, SYB Baby Blanket, and SYB Boxer Brief that protect against EMF radiation from modern technology.

SYB Phone Pouch – This pouch shields one’s body from up to 99% harmful radiation and is tested for 5G, up to 20 GHz– and low-frequency EMF. It is claimed that it deflects up to 99.9% of wireless EMF radiation. This pouch can conveniently carry your cell phone on your belt or in your pocket.

SYB Laptop Pad – This is for the people who use laptops on their laps.

SYB Baby Blanket – This has been developed for babies as they are more vulnerable to EMF radiation.

SYB Boxer Brief – This has been developed for men to protect their reproductive organs against EMF radiation emitting from cell phones kept inside their trouser pockets.

For more details, visit the site: <https://shop.shieldyourbody.com/products>.

6.4.7 Television/Computer/Tablet/Electrical Machines

Television, computers, tablets, and all kinds of electrical machines have one thing in common. All these products of technology emit EMF by default. However, our exposure to EMF in our homes is very low. All the wires carrying electric current do emit EMF. Many devices in power-off mode also emit EMF while plugged into electricity or on battery power. All wireless devices also emit EMF. Devices, such as computers, smart speakers, Wi-Fi routers, gaming consoles, cordless phones, cordless mouse, cell phones, and wireless security systems emit wireless (Figure 5). It is indeed a matter of concern.

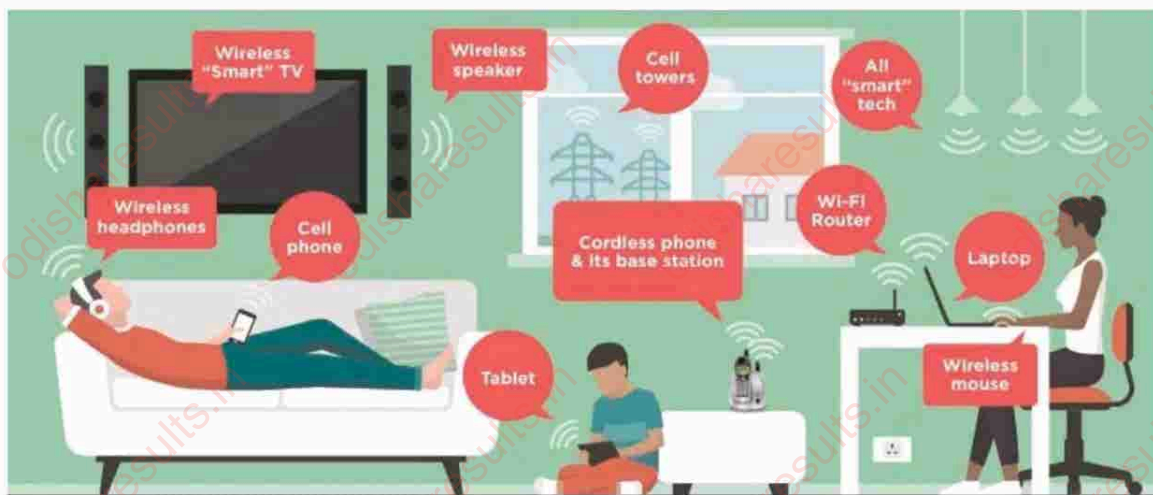


Figure 5: Excerpted from the website of the Environmental Health Trust: <https://ehtrust.org/> and depicts the sources that emit EMF in our day-to-day lives.

Television, computers, and tablets have also one thing in common. All of them emit blue light. However, blue light is not unusual. The maximum blue light comes from the sunlight. Further about 30% of all visible light is blue light. All artificial man-made devices using LEDs emit blue light. Should we be worried about our exposure to blue light? Is blue light harmful? It has been demonstrated that blue light elevates alertness and mood. It also ameliorates memory and brain function in humans. It regulates the biological clock in humans and maintains a normal pattern of sleep-wake cycle. However, too much exposure to blue light has been reported to be harmful. Exposure to blue light before the usual sleep onset time delays the actual sleep onset maximally by 96 minutes. Figure 6 explains the range of sleep delays depending upon the type of blue light-emitting devices.

Blue light inhibits the secretion of melatonin from the pineal gland thereby disturbing the normal pattern of the sleep-wake cycle. Constant exposure to blue light also damages retinal cells and creates problems associated with normal vision. Blue light vibrates within the 380 to 500-nanometer range and possesses the shortest wavelength with the highest energy. Bluelight exposure produces the maximum negative effects if your eyes are too close to the sources of emission of blue light. Two things are notably important, i.e., the exposure duration and the closeness of the exposure.

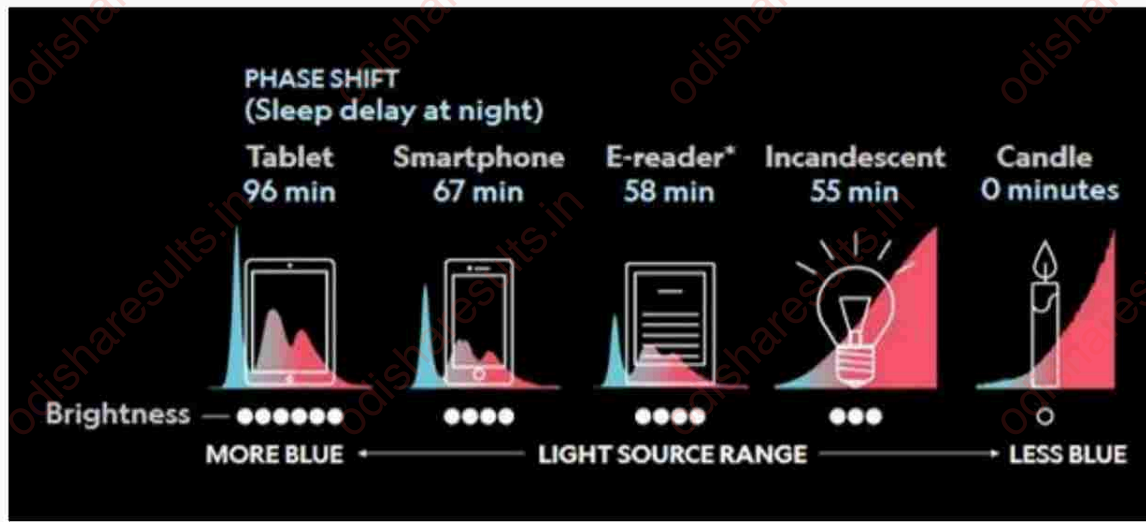


Figure 6: Source: While We Sleep, Our Mind Goes on an Amazing Journey; August 2018 issue of National Geographic magazine; author: Michael Finkel; Picture: Magnus Wennman

6.4.8 Light at night (LAN)

We experience the day/night cycle of nature every day. It implies that we experience natural daylight between the periods between sunrise and sunset. After sunset, we experience darkness till sunrise the next day. However, the advent of artificial light makes us exposed to light at nighttime.

In the past couple of decades, many studies assessed the effects of light at night on human health. People working in the service sectors, such as health care, security, transport, and others experience light at night routinely. The shift workers in industrial organizations and service sectors are regularly exposed to light at night while on the night shift.

Our study published in Current Science in 2007 revealed a longevity reduction of about four years in a sample of 312 shift workers. This finding was based on a large database of the employees of the South Eastern Central Railway (SECR), Nagpur, India, consisting of 3912

day workers (DW) and 4623 shift workers (SW). Data on all-cause mortality of 594 railway employees (282 DW and 312 SW) during a span of 25 years were analyzed to determine the longevity of the workers (Pati and Achari 2007).

We expose ourselves to LAN in two different ways, such as Indoor LAN and Outdoor LAN. It has been established that indoor light at night beyond threshold intensity could be detrimental to the sleep and physiology of humans.

Regarding outdoor LAN, a study conducted in Israel revealed that areas with high light intensity in the night had a strong positive association with breast cancer rates (Kloog et al. 2008). Interestingly they found no statistically significant correlation between LAN intensity and lung cancer rate (Kloog et al. 2008). Another study conducted by the same group of scientists revealed that population exposure to LAN led to a higher prevalence of prostate cancer among men. On the contrary, they did not notice any association with lung cancer or colon cancer (Kloog et al. 2009). It has been established that the LAN is interfering with the circulatory levels of a hormone called melatonin (see Figure 7 for Melatonin).

Melatonin is a hormone principally secreted by the endocrine gland - the Pineal. In humans, during the daytime melatonin in the circulation remains very low and it starts rising as soon as darkness sets in. Therefore, loosely melatonin is called a hormone of darkness. In both diurnal and nocturnal species, melatonin levels rise manyfold in the nighttime. Melatonin is a wonderful molecule that has been conserved among all living species. It is one of the best-known antioxidants. It promotes sleep. It is an anticancer and immune system booster.

Figure 7 explains how the light signal reaches the pineal gland through the retino- hypothalamic tract (RHT) and hypothalamic suprachiasmatic nucleus (SCN).

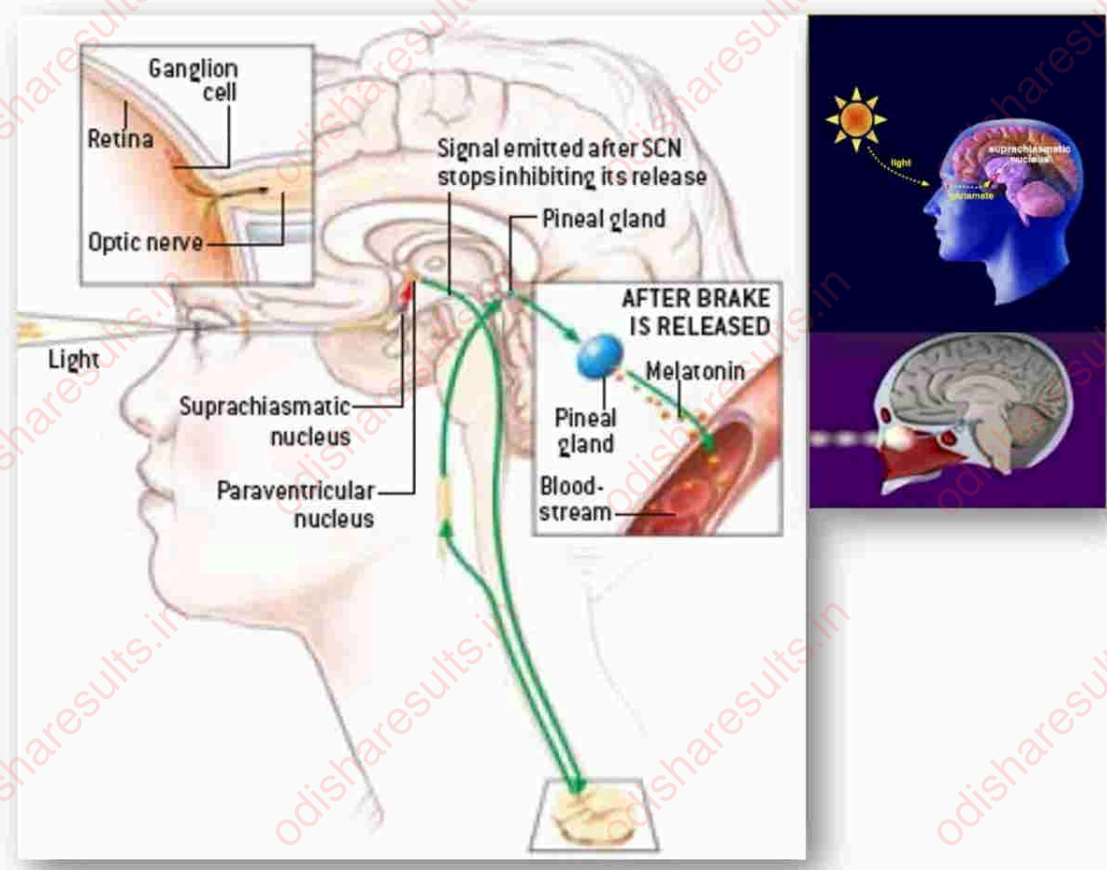


Figure 7: travels to the pineal gland through the eye and hypothalamic suprachiasmatic nucleus (SCN). Excerpted from Karen Wright (2006). Times of our lives. Scientific American - <https://www.scientificamerican.com/article/times-of-our-lives-2006-02/>

6.4.9 Plastics – from miracle to menace

Plastic, undoubtedly a miracle product of technology, is omnipresent. It helped us enormously in many useful domains. However, the miracle product became a menace. We find plastic in freshwater bodies, oceans, soil, air we breathe, and the food and drinks we consume daily. The plastic pollution that we face today is a real threat to human health and society. Let us examine how many different types of plastics exist and their recyclability (Table 1).

Types of plastic	Usage	Recyclability
Polyethylene terephthalate (or PET)	Used for packaging of food and drink.	Widely recycled

High-density polyethylene (HDPE)	Used for grocery bags, milk jugs, recycling bins, agricultural pipes, but also playground equipment, lids, and shampoo bottles.	Easily recyclable
Polyvinyl chloride (PVC) comes in two basic forms: rigid and flexible	In its rigid form, PVC is used in the building and construction industry to produce door and window profiles and pipes (drinking and wastewater). In softer and more flexible form, it is used in plumbing, wiring, electrical cable insulation and flooring.	Hardly recyclable
Low-density polyethylene (LDPE)	Used in plastic bags, six-pack rings, various containers, dispensing bottles, and plastic wraps.	Is not often recycled
Polypropylene (PP)	It can withstand high temperatures and is found in Tupperware products, car parts, thermal vests, yogurt containers, and even disposable diapers.	Recyclable
Polystyrene (PS)	Used in beverage cups, insulation, packing materials for egg cartons, and disposable dinnerware. It is inflammable and can leach harmful chemicals, especially when heated.	Not recycled
Plastics other than the above six types are included	Commonly used for eye protection in the creation of lenses for sunglasses, sports, and	Rarely recycled

in this group, for example, polycarbonates (PC).	safety goggles. But they can also be found on mobile phones.	
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Many different types of plastics are not recyclable. This poses a threat to the humans. Apart from the classifications of plastics outlined in Table 1, we can also classify plastics into two major categories, i.e., macroplastics and microplastics. This is based on size and all plastics <5.0 mm are called microplastics. Microplastics are further divided into two types, such as primary and secondary microplastics.

Microplastics are present everywhere from cosmetics to synthetic clothing to plastic bags and bottles. In a study conducted in 2018, microplastics were found in 114 aquatic species. Microplastics are found in the digestive tracts and tissues of many freshwater and marine organisms. Fish and birds also ingest microplastics floating on the water surface. Microplastics are also present in the plastic-coated cups that we use for drinking water and warm beverages.

Microplastics also occur as a consequence of plastic pollution. In many developing countries plastics are not disposed of using recommended procedures. The plastics are found in dumping sites on the sides of the roads that attract street cattle and dogs. Figure 8 illustrates the extent of plastic misuse that we experience every day. Cows wandering on the streets of urban areas eat plastic bags. These plastics get stuck in their stomach; for this reason, urban street cattle have oversized stomachs (Sahu et al. 2020). These cattle are called plastic cows and they secrete green-colored materials from their noses. The exact cause and consequences of these green-colored materials are not known. There is enormous scope to carry out research to determine the mechanisms of production of these green-colored materials.



Figure 8 (top and bottom): Roadside garbage dumping sites with huge quantity of plastics that give rise to the generation of microplastics. Source – Sahu, B.K. unpublished data

6.4.10 Ethics and Use of Digital Technology

6.4.10.1 Cyber Ethics

What is cyber? According to the Oxford Dictionary, it relates to or is characteristic of the culture of computers, information technology, and virtual reality. The current century could be called “the cyber age”. The latter is an epoch related to the extensive use of computers, virtual reality, or information technology. The term cyber is either used as an adjective or a prefix to several terms. As an adjective, we can have the following, for example, cyber space, cyber-attack, cyber-crime, cyber-sex, cyber bullying, etc. As a prefix, we can have the following: cyberspace, cyberattack, cybercrime, cybersex, and cyberbullying.

6.4.10.2 Types of Cyber Crimes

Cyber-attack involves deliberate actions to interfere with the computer system or computer network. Cyber attackers are called hackers who gain unauthorized access to the computer network of an organization or an individual. In summary, cyber crimes are unlawful activities using computers and the Internet. The hackers gain entry into organizations' and individuals' computer systems, networks, PCs, laptops, and tablets.

The most common cyber-crimes include (1) Phishing; (2) Identity theft; (3) Ransomware attacks; (4) Hacking computer networks; (5) Internet fraud; (6) Cyberbullying; (7) Cyberstalking; (8) Software piracy; (9) Social media frauds; (10) Online drug trafficking; (11) Electronic money laundering; (12) Cyber extortion; (13) Intellectual-property infringements; (14) Online Recruitment Fraud.

Phishing

The user is tricked through online messages and emails to obtain sensitive information about the user. Malicious software is sent to the computer systems of the users to extract information about the user.

Identity theft

Cybercriminals use another person's identity, pictures, and credentials without the permission of the user and commit crimes.

Ransomware attacks

Cybercriminals use a specific type of malware that can encrypt the personal data of a user and prevent the user from accessing their data on the system. Thereafter, the criminals ask for a ransom to give access to their encrypted personal data.

Hacking computer networks

Cybercriminals get unauthorized access to the private computer networks of an organization or an individual and vandalize the target computer systems or networks. Very often the target computer system or network is shut down or data are tampered with, altered, or modified.

Internet fraud

Internet fraud is a general terminology and it includes all different types of cyber-crimes that happen over the internet, such as spam, and banking fraud.

These are the most common types of cyber-crimes. For details about the other cyber-crimes please refer to the article by Tsakalidis and Vergidis (2019).

6.4.10.3 Ethical Hacking

Ethical hacking is nothing but an authorized attempt to obtain unauthorized access to a computer system or data. It is aimed at improving the security environment of the systems and networks by plugging the vulnerability holes discovered while testing the systems or networks. Ethical hacking is called ‘White Hat Hacking’ or ‘Penetration Testing’.

Certified ethical hackers improve the security environment of the systems and networks of an organization or country. They often use the identical techniques and tools that malicious hackers use. However, ethical hackers have the permission of the authorized persons of an organization.

There are different kinds of hacking, such as Network Hacking, Website Hacking, Computer Hacking, Password Hacking, and e-Mail Hacking. All these hackings are illegal and are considered crimes. However, ethical hackers also do the same thing, but with authorization from the authorities of the target organizations.

These days, organizations appoint ethical hackers to examine and fix security vulnerabilities in their systems, databases, and networks. There are many ethical hacking institutes in India. The EC-Council offers Certified Ethical Hacker (CEH) qualifications to those who demonstrate their knowledge and abilities to assess the security environment of computer systems and networks and to elucidate weaknesses and vulnerabilities in the target systems. The malicious hackers also do the same thing. However, certified Ethical Hackers do it within the framework of law using techniques but lawfully and legitimately to assess the security posture of a target system.

6.4.11 Ethics of social media

6.4.11.1 Facebook, YouTube, WhatsApp, Instagram, and Twitter (X)

As of April 2023, we have around 4.8 billion users worldwide (Figure 9). The average daily time spent on various types of social media is 2 hours 24 minutes. The prominent social

media platforms are Facebook, YouTube, WhatsApp, and Instagram. Each of these platforms has more than equal to 2.0 billion users worldwide (Figure 10). In summary, more than half of the world's population uses social media.

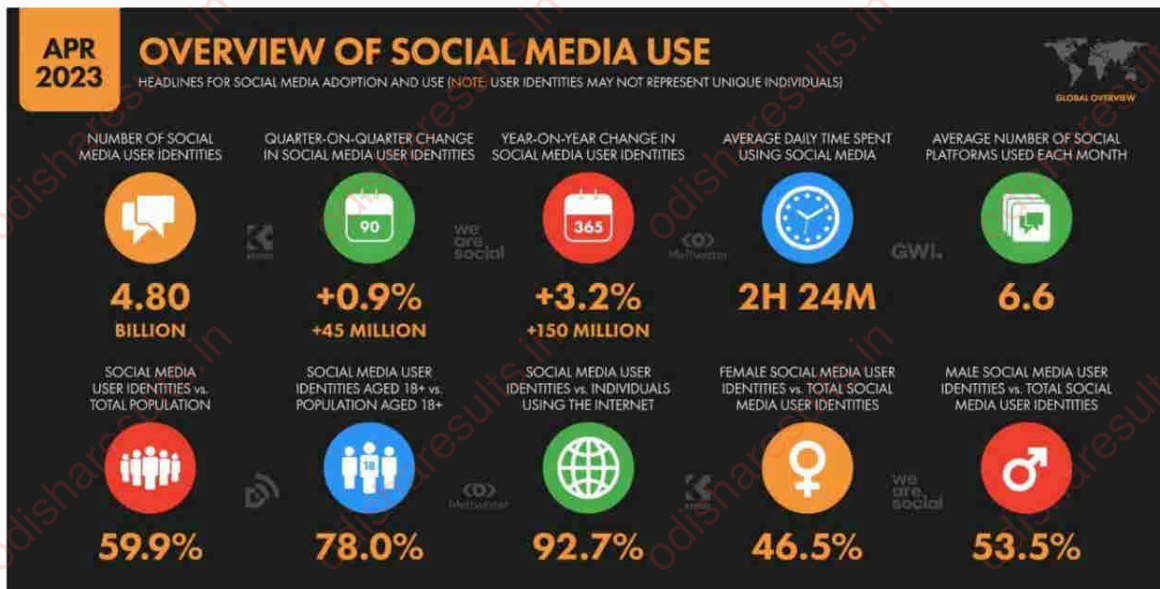


Figure 9: Summary statistics of social media use worldwide.

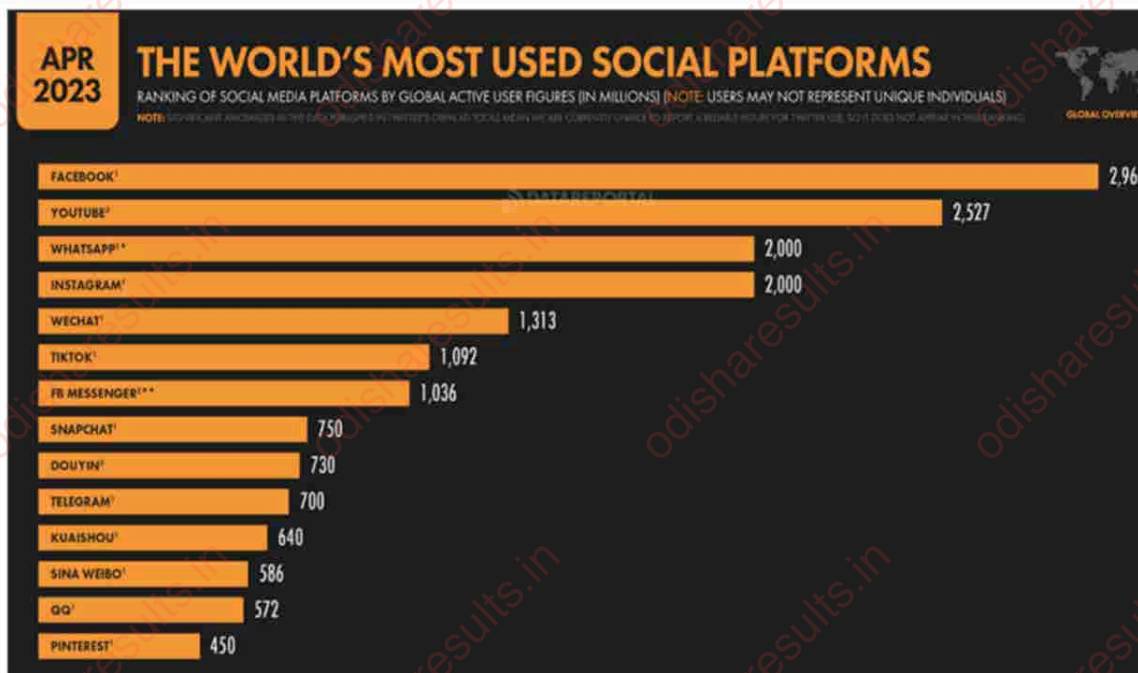


Figure 10: Worldwide users' statistics of top social media platforms.

The social networking apps are of immense utility to their users. The users of social media networks exchange information and share images, videos, ideas, and greetings almost instantly. Through many social networking sites, users can make voice and video calls. These calls can be held between two individuals or among a group of individuals. The users also create groups consisting of friends and/or family members. When a message is transmitted through these social networking sites it is received by other members of the group instantly and simultaneously.

Social media groups can be created either formally or informally. Many governments and private organizations create formal groups and transmit important official communications instantly to all members of the group. For example, the authorities can post a meeting notice in the morning and hold the meeting in the afternoon on the same day. Commercial organizations post product information on their official certified social media platforms. The users can make business queries on their social media platforms.

These days adolescents and young adults remain active most of the time on their social media pages. All social media platforms are extremely secure and many of them are end-to-end encrypted so that others cannot know about the exchanges taking place between two individuals or groups of individuals. Parents' surveillance of their ward's activity is almost impossible unless they know the passcodes. Young adults are highly skilled and they can learn and use any type of social media platform without much difficulties.

The social networking sites offer a multitude of benefits to individuals and human society. Humans are very sociable and they seldom want to live in isolation. They try to remain in contact with their friends, family members, and colleagues. They make new friends with identical ethos and temperaments. However, one has to be very careful while making new friends. Many profiles on social networking sites may be fake with impersonated profile pictures. A profile with a female picture may not be owned by a female individual. There is a likelihood that a fake female individual might collect vital information from you and misuse that information to get some benefits. There are chances of being blackmailed too. There are many other darker sides of social networking sites.

In the health sector, the use of social networking sites is common. You can instantly consult a doctor and get advice. Information about health and health-related issues is communicated easily through these social media platforms. A surgeon at a remote location

can observe and supervise a surgical procedure. Remote surgery or telesurgery has become common these days. A doctor can perform surgery from a remote location using both robotic technology and wireless networking. China became the first country to conduct 5G remote surgery in an animal model. Watch out for the following YouTube video: <https://www.youtube.com/watch?v=hAO8BUof9IM>

There are innumerable applications of networking sites in various other service sectors. It would be difficult to discuss all of them here in this chapter.

Excessive use of social media platforms has many negative repercussions. Social media addiction is one of the most problematic issues seen among teens and adolescents. They become victims of procrastination. They often get distracted from their responsibilities at work and the societal level. However, moderate engagement with social networking sites has a positive impact on the users. It alleviates stress, loneliness, and depression. In contrast, excessive social media use induces aggression, personality disorder, eating disorder, and tobacco/alcohol abuse among the young population of society.

Although the use of social networking sites has numerous benefits, overindulgence gives rise to many negative impacts on the users. Excessive indulgence in social media platforms compromises sleep quality, psychosocial behavior, academic performance, and circadian clock of young users (Figure 11). For more details, the review article by Swain and Pati (2021) may please be referred to. As of 15th September 2023, this article has been read 2607 times and has been cited 29 times on the ResearchGate platform.

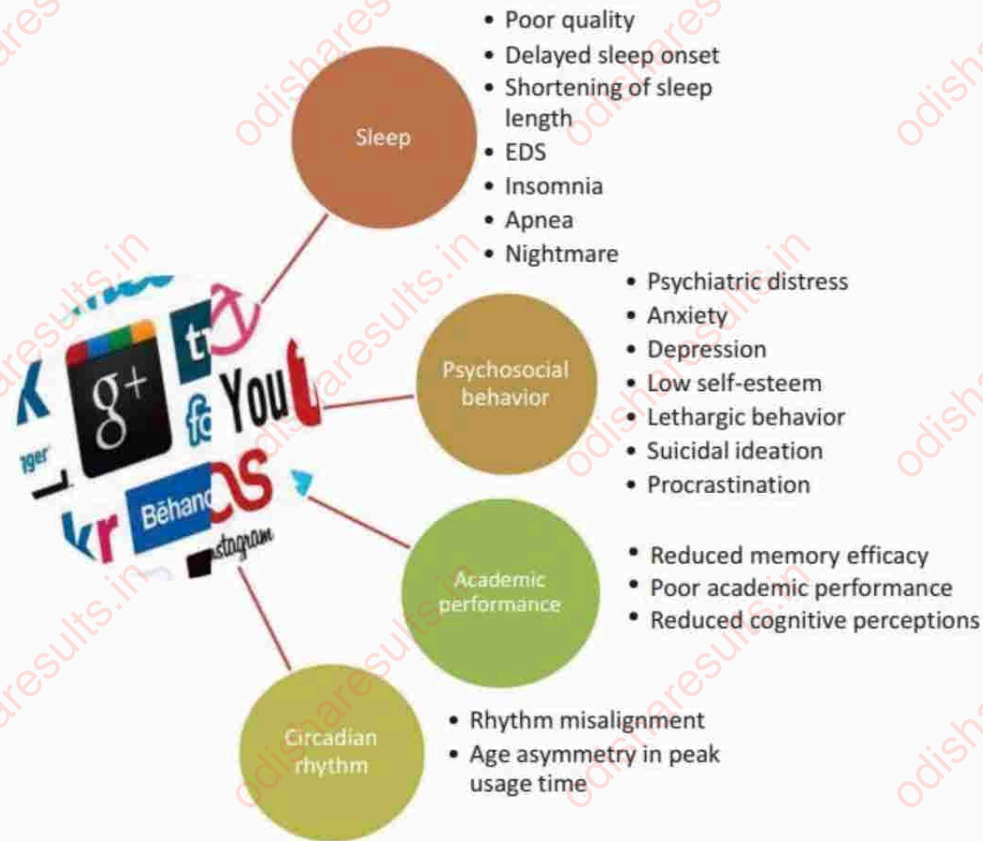


Figure 11: Excerpted from Swain and Pati (2021) and illustrates negative effects of social networking sites on various components of sleep, psychosocial behavior, academic performance and circadian rhythm.

6.4.12 Digital Detox

This is the period when an individual intentionally refrains from using digital devices. In other words, it is equal to taking a break from using digital technology or minimizing one's usage in the realm of the digital world for a specified period. This period may vary from a couple of days to a couple of months.

During digital detox, an individual remains away from checking email, playing video games, scrolling social media, text messaging, using smartphones/tablets, and watching news or other TV programs. Many studies have highlighted the positive effects of digital detox interventions on health and well-being, social relationships, self-control, and performance (Mohamed et al. 2023; Wood and Muñoz 2021; Schmuck 2020). Several studies did not find any positive effects of digital detox interventions on the above-mentioned variables.

Therefore, there is an urgent need to carry out more intensive research to resolve the controversy on the effective role of digital detox on human health and wellbeing.

6.4.13 Safe Mobile Phone Use Advisory

- We should lower our exposure to radio waves.
- Use mobile phones sparingly and make short calls only.
- Choose headsets or speakerphone options.
- Children should be advised to use smartphones only when it is necessary.
- Before buying a mobile phone, we should find out if the specific absorption rate (SAR) of the phone is below the recommended threshold SAR level.
- When not in use, keep your mobile phone away from your body.
- Avoid using mobile phones when the signal is weak.
- While driving, keep your mobile phone switched off. Even avoid hands-free devices while driving.
- Never keep your mobile phone beside your pillow while sleeping in your bedroom at night.

6.4.14 Take Home Messages

- In the 21st century, it is almost impossible to live without using modern technology prominently including digital technology.
- Mobile and smartphones are indispensable but use them parsimoniously.
- All mobile phones (= cell phones) communicate with each other using radio waves that transport digitized voice or data in the form of oscillating electric and magnetic fields, called the electromagnetic field (EMF).
- Although the negative effects of mobile phones on human health are debatable, The WHO/International Agency for Research on Cancer (IARC) in a press release (May 31, 2011) classified radiofrequency electromagnetic fields as possibly carcinogenic to humans (Group 2B).

- There is some evidence in support of a link between increased risks of glioma and wireless phone use.
- Refer to section 6.4.13 of this chapter to know more about the Safe Mobile Phone Use Advisory.
- Possibly use commercially available ‘shield-your-body’ devices against EMF radiations.
- Minimize your exposure to blue light.
- Stay away from television, smartphones, and tablets at least an hour before your habitual sleep onset time.
- Never keep your smartphones in switch-on mode beside your pillow while sleeping at night. It is always better to keep it on flight mode and is best if you could switch it off before going to bed.
- Do not install a television or other electrical machines in your bedroom. If it is unavoidable then unplug the TV and other electrical appliances during the period of your sleep. Unplug the mobile phone chargers too.
- Switch off the light in your bedroom before going to bed. If you want some light while sleeping, ensure that the light intensity is below 200 lux.
- Stop using plastic bags of any kind, instead use paper bags. Don't drink tea in a plastic-coated tumbler, rather insist on a metallic or glass tumbler. Plastics are polluting our land, water bodies, and air. Microplastics emerging from plastic pollution are omnipresent. Microplastic menace has become a big threat to human health and well-being.
- Maintain cyber ethics. Don't become abusive on social media platforms. Don't forward fake pictures, messages, and stories. Don't use someone else's picture on the profile picture holder of your social media accounts.

- Respect the confidentiality of others on the social media platform. Don't attempt to indulge in hacking others' accounts.
- Excessive indulgence in social media activities leads to stress, anxiety, and poor-quality sleep. Practice digital detoxification (Refer to Section 6.4.12 of this chapter).

6.4.15 Further reading

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6.4.16 Abbreviations

BTS – Base Transceiver Station

CEH – Certified Ethical Hacker

DW – Day Workers

EDS – Excessive Daytime Sleepiness

EMF – Electromagnetic Field

FCC – Federal Communications Commission

FDA – U.S. Food & Drug Administration

HDPE – High-Density Polyethylene

IARC – International Agency for Research on Cancer

LAN – Light at Night

LDPE – Low-density Polyethylene

LED – Light-emitting Diode

MP – Mobile Phone

NCI – National Cancer Institute

NTP – National Toxicology Program

PC – Polycarbonates

PCs – Personal Computers

PET – Polyethylene Terephthalate

PP – Polypropylene

PS – Polystyrene

PVC – Polyvinyl Chloride

RF – Radio Frequency

RHT – Retino-hypothalamic Tract

SCENIHR – Scientific Committee on Emerging and Newly Identified Health Risks

SCN – Suprachiasmatic Nucleus

SECR – South Eastern Central Railway

SW – Shift Worker

SYB – Shield Your Body

WHO – World Health Organization

6.4.17 Check your Learning

[A] Answer using two or three sentences

- a) Describe three positive aspects of technology.
- b) Describe three negative aspects of technology
- c) How do mobile phones communicate with each other?
- d) What is EMF?
- e) What is the electromagnetic spectrum?
- f) What is the full form of IARC?
- g) What is Glioma?
- h) What is ICNIRP?
- i) What is SYB?
- j) What is common among television, computers, and tablets?
- k) What is LAN?
- l) What is melatonin?
- m) What are microplastics?
- n) What type of plastic is widely recycled?
- o) What is cyberethics?
- p) Give three examples of cybercrimes.
- q) Which social media platform has the highest number of users as of April 2023?
- r) What are SNSs?
- s) Give three important negative effects of social networking sites.
- t) What are the different kinds of hacking?

[B] Answer using about 50 words

- a] What are the electromagnetic waves of varied frequencies?
- b] How does WiFi technology work?
- c] What are the common signs and symptoms of gliomas?
- d] What are the effects of exposure to blue light emitting from computers, mobile phones, and tablets?
- e] What is plastic pollution?
- f] What do you mean by the term, 'digital detox'?
- g] How does excessive indulgence in social networking sites influence psychosocial behaviors in humans?
- h] What is the impact of blue light on human health?
- i] What are the most common types of cybercrimes?
- j] What is white hat hacking?

[C] Answer using about 200-250 words

- a] Describe a few positive and negative aspects of modern technology.
- b] How does communication work in mobile phones?
- c] What are the organizations monitoring mobile phone use and health hazards in humans?
- d] Explain ethical hacking.
- e] Give your views on the following statement: 'use of modern technology is indispensable.'