Revised Edition

Fundamental Concepts in Environmental Studies

As per UGC Model Curriculum for Undergraduate Classes (All Streams) of All Indian Universities

Dr. D.D. MISHRA

S. CHAND

FUNDAMENTAL CONCEPTS
IN
ENVIRONMENTAL STUDIES

For B.A., B.Sc., B.Com., B.H.Sc., B.C.A., B.B.A.
and Other Undergraduate Classes of All Indian Universities

As per UGC Model Curriculum

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Dedicated to
My Father
Late Shri Ram Babu Mishra
Whose Inspiration is Always with Me

PREFACE TO THE REVISED EDITION

Environmental science is an interdisciplinary subject that integrates the Physical and Biological Sciences with other academic fields of study. Basically when Environmental Science as a subject was introduced in the undergraduate syllabus of all Indian Universities, this book "Fundamental Concepts in Environmental Studies" had been designed to meet the requirements. The book was liked by all including students and faculty members. It covers complete syllabus as per UGC curriculum for undergraduate students of all disciplines of various Universities.

Keeping in view the present syllabus, suggestions and questions papers of different Universities, the book is thoroughly revised, so that it will be more effective and useful for competitive exams also in view of the present scenario.

In addition to certain corrections, topics like Hydrologic Cycle, Air Pollution, Solar and Wind Energies are modified in the light of present requirement. Some new topics like Dissolved Oxygen, Biological Oxygen Demand, Chemical Oxygen Demand, Natural Geysers, Environmental Club, Green Accounting, Honey and Bee Keeping, Social Forestry are also introduced. With additional data, new topics and necessary diagrammes, the book will be of immense use and more popular among students and readers.

Criticism and suggestions from readers will be greatly acknowledged.

AUTHOR

SYLLABUS

Core Module Syllabus of Environmental Studies for Undergraduate Courses of All Branches of Higher Education Foundation Course

Environmental Studies

(Questions will be set from each Unit/Section)

(For B.A., B.Com., B.Sc. (Home Science), B.A. (Mang.), B.B.A., B.C.A. and Other Undergraduate Courses)

Theory 40 **Internal 10** **Total 70 marks**

UNIT-I: The Multidisciplinary Nature of Environmental Studies

Definition, scope and importance
Need for public awarencess (2 lectures)

UNIT-II : Natural Resources, Renewable and Non-renewable Resources

Natural resources and associated problems.

(*a*) Forest Resource : Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.

(*b*) Water Resources : Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

(*c*) Mineral Resources : Use and exploitation, environmental effects of extracting and using mineral resources, cases studies.

(*d*) Food Resources : World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problem, waterlogging, salinity, case studies.

(*e*) Energy Resources : Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies.

(*f*) Land Resources : Land as a resource, land degradation, man-induced landslides, soil erosion and desertification.

— Role of an individual in conservation of natural resources. (8 lectures)
— Equitable use of resources for sustainable lifestyles.

UNIT-III: Ecosystems

- Concept of an ecosystem.
- Structure and function of an ecosystem.
- Producers, consumers and decomposers.
- Energy flow in the ecosystem.
- Ecological succession.
- Food chains, food webs and ecological pyramids.
- Introduction, types, characteristic features, structure and function of the following ecosystems :
  (*a*) Forest ecosystem
  (*b*) Grassland ecosystem (6 lectures)
  (*c*) Desert ecosystem
  (*d*) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

UNIT-IV: Biodiversity and Its Conservation

- Introduction-definition : genetic, species and ecosystem diversity.
- Biogeographical classification of India.
- Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and other values.

- Biodiversity at global, national and local levels.
- India as a mega-diversity nation. (8 lectures)
- Hot-spots of biodiversity.
- Threats to biodiversity : habitat loss, poaching of wildlife, man, wildlife conflicts.
- Endangered and endemic species of India.
- Conservation of biodiversity : in-situ and ex-situ conservation of biodiversity.

UNIT-V : Environmental Pollution

Definition

- Causes, effects and control measures of :
  (*a*) Air pollution
  (*b*) Water pollution
  (*c*) Soil pollution
  (*d*) Marine pollution
  (*e*) Noise pollution
  (*f*) Thermal pollution
  (*g*) Nuclear hazards
- Solid waste management : causes, effects and control measure of urban and industrial wastes.
- Role of an individual in prevention of pollution.
- Pollution case studies.
- Disaster management : floods, earthquake, cyclone and landslides. (8 lectures)

UNIT-VI : Social Issues and the Environment

- From unsustainable to sustainable development
- Urban problem related to energy.
- Water conservation, rain water harvesting, watershed management.
- Resettlement and rehabilitation of people; its problems and concerns. Case studies.
- Environmental ethics : issues and possible solutions.
- Climte change, global warning, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.
- Wasteland reclamation.
- Consumerism and waste products.
- Environment Protection Act.
- Air (Prevention and Control of Pollution) Act.
- Wildlife Protection Act.
- Forest Conservation Act.
- Issues involved in enforcement of environmental legislation.
- Public awareness. (7 lectures)

UNIT-VII : Human Population and the Environment

- Population growth, variation among nations.
- Population explosion-Family Welfare Programme.
- Environment and human health.
- Human rights.
- Value education.
- HIV/AIDS.
- Women and child welfare.
- Role of information technology in environment and human health.
- Case studies. (6 lectures)

CONTENTS

UNIT
1

Multidisciplinary Nature of Environmental Studies

DEFINITION

The word 'environment' is derived from the French word '**environner**' means ''to encircle or surround.'' It is a composite word for the conditions/surroundings in which organism or group of organisms live. The environment is a very wide term. It includes total physical and biotic word, in which biological beings live, grow, get nourished and develop their natural characteristics. In otherwords, it concerns with the ''**Biosphere**'' which include all biotic parts of hydrosphere, lithosphere and atmosphere. The environment consists of both biotic and abiotic substances, i.e., consists of air water, food, sunlight, temperature, electricity, etc. Thus environment can be defined in a number of ways, but common definition is —

''Environment is the sum of all social, economical biological, physical or chemical factors which constitute the surroundings of men/living organism, who is both creator and moulder of this environment.''

The environment for any living organism is always been changing never constant or static. This change is sometimes slow, some times rapid or so. Some of these changes are irreversible (e.g. eutrophication of lake) while others are cyclic (e.g. the annual climatic cycle) or transient (i.e., droughts). Now because natural biogeographical environment fluctuate with time, it is not easy to distinguish change brought about by man.

Like other organisms, man is also affected by environment. These changes in environment may benefit or harm the man or other organisms living in it. Environmental science is multidisciplinary branch of science involving, chemistry, physics, life science, agriculture public health, botany, medical sciences, geography, and many other fields. Environmental science or studies is the study of the characteristics, composition functions and systematic study of different components of the natural environmental systems. The environment includes both physical or non living (abiotic) and living (biotic) environment. Economics, sociology, education and mass-communication do help in understanding the socio-economic aspects of environment. Mathematics, statistics and computer science also help in modeling and management of environment.

With increasing scientific knowledge, man is able to modify the environment to suit his immediate needs much more than any other organism. Since the very beginning of human

civilization man started interfering with the environment. He devastated forests for the use of tree as wood, land under cultivation. He had polluted the rivers and other water resources. The traditional concept that, natural resources are abundant for man to use or abuse has been responsible for massive degeneration of nature, natural systems, environment and wild life. The natural systems in which man exists along with all other species must maintained in a healthy and functional state.

The environmental science is, therefore, a mutidisciplinary science, which may require attention of experts from different branches of science when dicisions ragarding environmental matters have to be taken. In industrialized developing countries of the world, India occupies 7th place. India has good industrial infrastructure in several industries like chemical, power, nuclear energy, food, petroleum, pesticides, insecticides, plastic etc. A number of industrial effluents and emissions, especially toxic gases and spewed in to the air daily. A rapid increase in Atomic and nuclear energy has added a huge amount of radioactive substances in the atmosphere. Thus the environment is detoriated to such an extent that it has crossed the critical limit and has become lethal to all organisms, including men.

The craze of progress in agriculture, industry, transportation and technology is taken as the general criterian of development of any nation. Such activities of man has created adverse effects on all living organisms in the biosphere. Today environment has become foul, contaminated, undesirable, therefore, harmful for the health of living organisms (including man). So for as pollution is concerned, environment includes the air, the water, the soil, the noise, the building, the landscapes, the oceans, the lakes, the rivers, the parks, the vehicles and many other things. Not only addition of constituents in these adversely alter the natural quality of the environment but also removal of constituents caused pollution.

SCOPE AND IMPORTANCE

Environment consists of all living and non living things which surround us. Therefore the basic components of the environment are :–

1. Atmosphere or the air
2. Hydrosphere or the water
3. Lithosphere or the rocks and soil
4. The biosphere

Environment influence and shaped our life. It is from the environment that we get food to eat, water to drink, air to breathe and all necessities of day to day life are available from our environment. Thus it is the life support system. Hence the scope & importance of the environment can be well understand.

The basic concepts of environmental studies are interesting and important too not only to the scientists engagged in various fields of science and technology but also to the personnel involved in resource planning and material management. It is now universally realised that any future developmental activities have to be viewed in the light of its ultimate environmental impact. The tremendous increase in industrial activity during the last few decades and the release of obnoxious industrial wastes in to the environment, have been considerable concern in recent years from the point of view of the environmental pollution. Environmental pollution on one hand and deforestation, soil erosion, population explosion, global warming interence in ecosystem and biosphere on the other are threatening the very existence of life on the earth. According to Jantsch 1970 environmental science attempts to solve the major environmental problems with the help of interdisciplinary and transdisciplinary approaches i.e., the entire knowledge of all the disciplines of science such as Maths, Physics, Chemistry, Biology, Geology, Geography, Computer Science, Medical Science and Biotechnology, as well as of social sciences such as Economics Sociology

and Psychology. Because, environmental science is a subject which draws heavily from environmental biology, but depends more on transdisciplinary approach.

Since, ecology, environmental biology and environmental science can not be defined without reference to environment, they show too much overlapping which is inevitable and unavoidable. Some major problems and disciplines which provide input to environmental science are mentioned in fig.

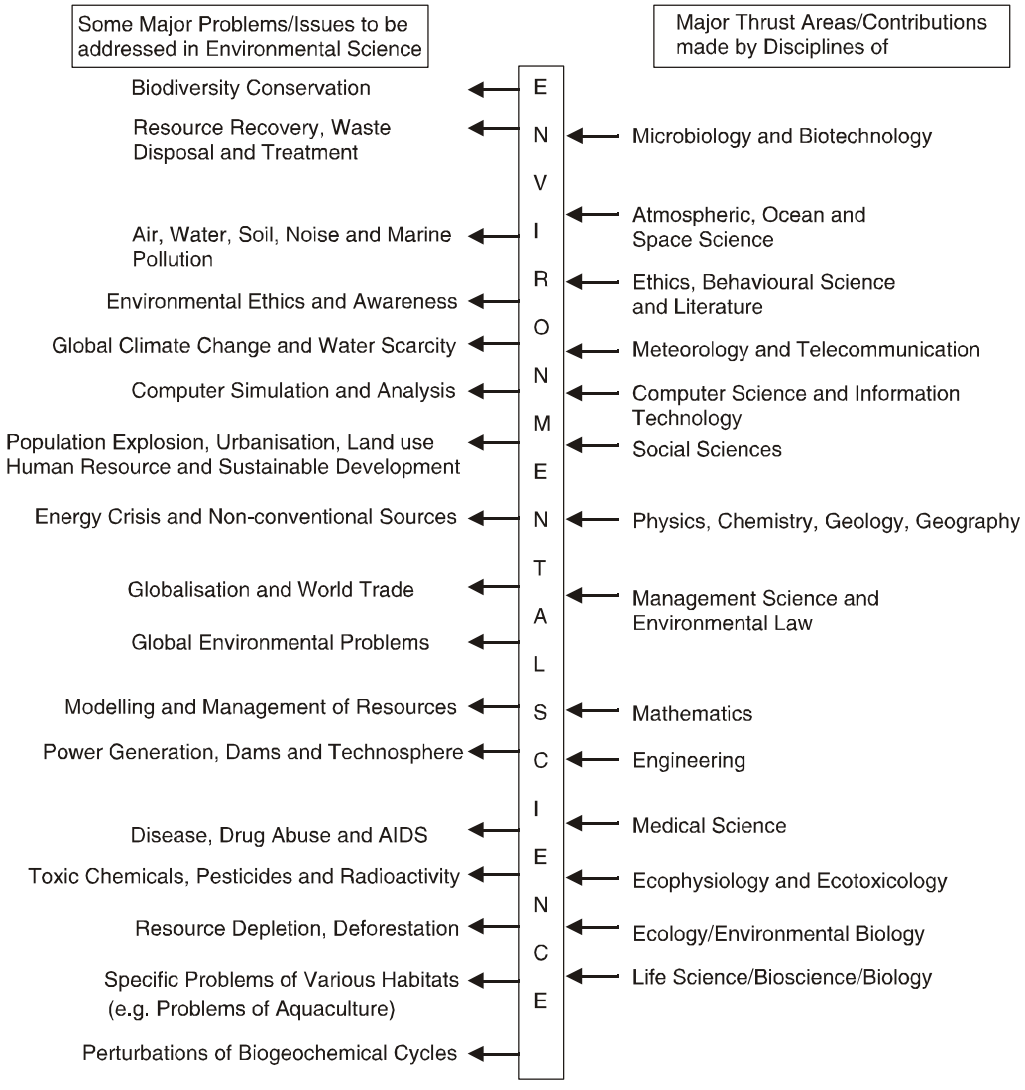


Fig. 1.1 Some major problems and issues and disciplines which provide input to solving these problems in environmental science.

Environment is responsible for creating conditions suitable for the existance of a healthy biosphere on this planet. The load of pollutant dicharged is also diluted and chemically modified. It regulates the temperature on earth where life activities are possible. Harmful ultraviolet radiations are absorbed in the stratosphere by the vital ozone layer. These rays can severely damage the

terrestrial life. The atmosphere of our environment is a quick and effective media for transfer, transport and dissemination of gaseous wastes.

There are some natural and spontaneous process in our environments, by which we get plentiful supply of clean, air, fresh water and fertile soils, which regrate endlessly by biogeochemical cycles. Our planet which is rich in biodiversity have millions of species including beautiful, intriguing, towering trees and other coral nets where all types of animals live together. All animals depend on plants for their food. Insects, bacteria, virus and other organisms are one hand harmful some where, but very helpful on the other. For example, pollination, regeneration etc. are some examples.

Since life is dependable upon the environment, its absence causes many adverse and harmful effects. Many countries are facing the problems of enviornmental pollutions. Without sustainable environment and natural resources, one can not survive.

Over-exploitation of natural resources and pollution of environment are corroding the vital life support systems on which all life depends. Air, water, soil, noise, marine pollutions, food adulterations, decreasing agricultural land, extinction of various plants of mammals global warming etc. are some factors which are making our life more and more difficult. The future of entire humanity is at stake. Instead of these some environmental problems are also there like, solid waste management mining impact, impacts of hydro-electric projects effects of nuclear hazards and effects of industrial effluents. These problems should also have some solutions, because their effects are very dangerous. Therefore, environmental aspect should be in mind while planning for industries, township and other research institutions/health centres. Modern technologies should be developed to reduce the pollution at every step. Modern technologies for effluent treatment and cleaning/washing should be used. Environmental studies is very important for getting clean drinking water, hygienic living conditions, clean and fresh air, fertile land, healthy food etc.

NEED FOR PUBLIC AWARENESS

After the scientific and industrial revolution in the recent past, there has been immense impact of man on his environment. Man has failed to realise that any new factor upsets the balance of the ecosystem as a whole/the environment. Huge industrial installations every year, introduction of the faster mode of transport, sprouting up large crowded cities (urbanisation), changing the food habits, deforestation and decreasing the agricultural land, the main outcomes of the modern civilization : wide spread use of insecticides, pesticides, improper use of fertilizers and chemicals in environment are some others contributing factors which challenged the life of man, animals specially birds and other organisms. Industries are causing much danger to man's life (causing air pollution). Similarly water pollution, soil pollution, marine pollution, noise pollution, global warming, effects of nuclear hazards etc. are some major factors for which public awareness is necessary.

The Active co-operation of every one, at every level of social organizations, scientists, educationists, social workers, politicians, administrators and public is needed for issues concerning environment. Individuals collectively make a society or a state. Movements, which begin at grass root levels, effects the ideologies and policies of a country or the nation as a whole more effectively, than the policies introduced from top to downwards. When the opinion of the public will change, it will effect the govt. policies, which transform in to actions. Therefore little efforts on the part of each individual shall add up to introduce significant improvements of the environment.

Over exploitation of natural resources is a basic concern for everybody. Food shortage will increase in frequency and severity if population growth, soil erosion and nutrient depletions will continue at the existing rate. Therefore, it is our duty and we can accept the family planning schemes. This will not only reduce the population but also solve the problems of food and

rehabilitation. By burning fossil fuels (oil, coal and natural gas), we release carbon-dioxide and other heat absorbing gases, that cause global warming and may bring about sea level rise and catastrophic climatic changes. Acid rain is the result of it. Chlorinated compounds such as chlorofluorocarbons used in refrigerator and air conditioner also contribute to global warming as well as damaging the stratospheric ozone that protect us from cancer causing ultraviolet radiations in sunlight.

Now a days every body talks about environment but how many of us are serious about it. How many of us (from all walks of life) have clear concepts of environment. There must be planning about the effects and control measures of environmental pollution. Govt. should initiate and help by awareness compaigns to save environment. There should not be the political propaganda but should be the integral part of our educational programmes. By writing on walls the word ''save water'', ''save oil'' is not enough for Govt. or people. We should opt some programmes relating to it. We should discourage to use fuel vehicles, until it is not necessary. For short routes, we should use bicycle; on foot. We should accompany the four seater or so with others over use of water, for cleaning and other purposes should be decreased. Rain water harvesting is another example for using the rain water instead flowing out. Any government at its own level can not achieve the goals of sustainable development until the public has a participatory role in it. It is only possible only when public aware about the ecological and environmental issues. For example ban the littering of polythene can not be successful until the public understands the environmental implications of the same. Public should understand about the fact that if we degrading our environment, we are harming ourselves. This is the duty of we educated people to educate the others about the adverse effect of environment.

For the first time, the attention of general public was attracted at global level when ''Earth Summit'' in 1992 was held in Rio de Janerio on environment and development. Later on another world summit on ''Sustainable Development'' at Johannesburg in 2002 was also held to discuss the environment and aware the public to save the environment. In this directions, United Nations has organised several conferences in different parts of the world (Stockholm 1972, Vienna 1985, Montreal 1987, Brazil 1992 etc) to work out the action plan from time to time for fighting with menace of environmental pollution. We should keep the earth green and alive as it provides shelter, food and protective cover. The soil degradation, soil erosion, deforestation, losing wetlands, land conversion etc. are the measure issues which force ourselves to think and aware the public in this regard. Because human himself is responsible for these environmental deterioration. Therefore, it is necessary to check all these destructive processes. Govt. also doing some efforts on national level but still much more has to be done.

The marine ecosystem includes, the oceans, seas, sea shores, bays and esmaries of the world. The physical factors like wares, tides, currents, salimities, temperature, pressures and sunlight dominate life in the ocean and determine the make up of biological communities. These communities have significant effect on biomass, leakage from oil tankers, oil drilling, catchment area (coastline) and rivers polluted the sea water, which effects sensitive flora and fauna, various species of invertibrate, mammals, coral reps, fishes and other organisms.

Diesel vehicles emits particles in their exhaust which have a diameter less than 10 microns (PH-10). It is easily inhaled. Any amount of these particles in the air are dangerous for health (particularly effects lungs). In India about 20 million people are asthmatics. Mine waste and effluents from mining and metallergical industries give a number of physical and chemical problems to human beings. Certain other industries like paper and pulp industries, fertilizer industries, explosive industries, soap and detergent industries, chemical industries, food processing industries, textile, tannery, leather, petroleum industries release/discharge undesirable and harmful constituents which are responsible for air and water pollution, causes great public concern.

Sewage begins to cause nuisance as it starts to become stale. It is therefore necessary to dispose it off as soon as possible. Proper methods of disposal and its treatment should be applied otherwise causes the chronic diseases. When sewage is applied continuously on a part of land, the pores or voids of the soil are clogged and free circulation of air is prevented. As a result anaerobic conditions are developed in place of aerobic conditions and the land is not capable of taking further sewage load. At this stage, decomposition of sewage takes place and offensive gases are produced. This is called the sewage sickness of land. People should aware of it.

The noise which is increasing pollution is one of the important factor of environment due to populations explosion, rapid industrializations and urbanisations. We should know the consequences of noise pollutions. Ear drum can be damage when exposed to very loud and sudden noise. Noise pollution affects human health, comfort and efficiency. It causes contraction of blood vessels, high blood pressure, mental distress, high cholesterol, heart attacks, neurological problems, birth defects, abortion etc. The department of environment realised the importance of creating a sound research base for scientific studies relating to environmental problems. Environmental protection act was introduced in 1976 as the 42nd amendment act in the constitution.

Only by celebrating "World Environmental Day" we can not get rid of this concern. Govt. along can not do any thing until unless every citizen is aware of the environmental pollution & their effects. This is the time to make aware and motivate each and every individual for environmental consciousness.

QUESTIONS

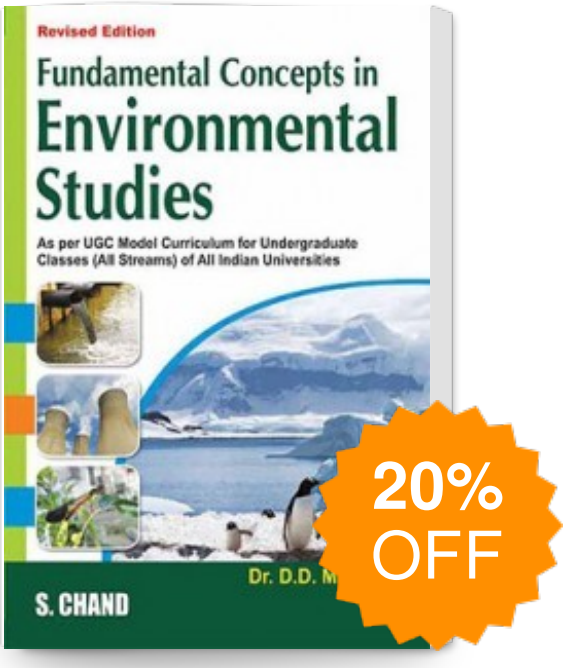
Short answer questions :–

1. Define environment.
2. Explain, ''Environmental science is a multidisciplinary science.''
3. Discuss some measure issues, which help in solving the problems in environmental science.
4. Define ecology.
5. What is synecology ?

Long answer questions :–

1. Discuss in details the scope and importance of environment.
2. Write an essay on ''public awareness to protect our environment''.
3. Give an account of role of public in Environmental protection.

Fundamental Concept In Environmental Studies



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