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Prelims Paper-I

Basics of
Energy & Environment

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PREFACE

The laws of nature are absolute, and if not given due respect while framing policies, programmes, and during execution of projects, can pose a serious threat to the very existence of human life. During his evolution, man stumbled upon various sources of energy. Starting from wood, coal, gasoline, nuclear energy to renewable energy, and every paradigm shift in energy brought about new challenges in limiting the damage caused to the environment.

This revised and updated edition of book **Basics of Energy & Environment** builds upon your understanding about the complexities in addressing environmental issues, bit by bit, through detailed diagrams, natural cycles, analysis, linkages, and statistics. Starting with the basic definitions of the fundamental units of environment, the book builds upon the complex web of ecosystem and ecology. Further, it goes on to map the ecological depletion, change in climate, and its impact on the various environmental processes.

No individual, country, or society howsoever powerful can survive the challenges of climate change on its own. This wisdom, arrived through various international conventions and treaties, has been beautifully constructed in a timeline while decoding and analysing every single move, which built upon our collective consciousness to this day.

The book organically builds upon the thought process, where you learn the complex interchanges of energy and environment in an effortless manner. Thus, you will be able to derive upon correct answers whatever be the spin given to the questions by UPSC in Engineering Services Examination (ESE). Energy and Environment is a hot topic, and this book ensures that you do not miss out on any question in the exam.

In this revised edition, some new topics have been added and a few existing chapters on subjects have been updated and elaborated; and have thus endeavoured to render it more complete and more worthy of the indulgent reception by ESE aspirants by whom it has been preferred so far.

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CONTENTS

Preface *(iii)*

CHAPTER 1 ECOLOGY AND BIODIVERSITY 1 – 49

1.1 Environment 1
1.2 Layers of Atmosphere 3
1.3 Levels of Ecological Organization 4
1.4 Nutrients Cycle and Geochemical Cycles 11
1.5 Ecosystem 16
1.6 Biodiversity 24
1.7 Biomes 29
1.8 IUCN 30
1.9 Environmental Conservation 32
1.10 IUCN Protected Areas 33
1.11 UNESCO Heritage Sites 36
1.12 Wildlife 36
1.13 Animal Welfare Board of India 38
1.14 Conservation of Biodiversity 38

CHAPTER 2 ENERGY AND ITS CONSERVATION 50 – 72

2.1 Introduction 50
2.2 Types of Energy 50
2.3 Type of Energy Resources 51
2.4 India's Three-Stage Nuclear Power Programme 60
2.5 Energy Governance 61
2.6 Energy Organizations 63
2.7 Management of Energy 64
2.8 Future Sources of Energy 65
2.9 Efficiency in Utilization of Energy 66

CHAPTER 3 POLLUTION 73 – 100

3.1 Introduction 73
3.2 Pollutants 73
3.3 Air Pollution 74
3.4 Water Pollution 80

3.5 Marine Pollution 84
3.6 Soil Pollution 85
3.7 Noise Pollution 87
3.8 Thermal Pollution 88
3.9 Radioactive Pollution 89
3.10 Food Contamination and Health 90
3.11 Pollution and Health Impact 90

CHAPTER 4 CLIMATE CHANGE 101 – 124
4.1 Introduction 101
4.2 Weather 102
4.3 Causes of Climate Change 103
4.4 Global Warming 105
4.5 Consequences of Climate Change 109
4.6 Humidity 112
4.7 Consequences of Global Warming and Climate Change in India 113
4.8 Adaptive Strategies for Mitigating Climate Change 113
4.9 Distribution of Fossil Fuels in India 115
4.10 The Economics of Ecosystems and Biodiversity 116
4.11 REDD & REDD+ 116
4.12 Government Initiatives to Mitigate Climate Change 116

CHAPTER 5 ENVIRONMENT : DEGRADATION AND CONSERVATION 125 – 144
5.1 Introduction 125
5.2 Natural Resources 125
5.3 Natural Resources: Degradation and Conservation 127
5.4 Atmosphere and Environment Conservation 132
5.5 Waste Management 133
5.6 Solid Waste Management in India 140

CHAPTER 6 ENVIRONMENTAL IMPACT ASSESSMENT 145 – 156
6.1 Introduction 145
6.2 Need for EIA 146
6.3 Objective of EIA 147
6.4 Categories of Development Projects in which EIA is Mandatory (MOEF 1994, MOEF 2001) 148
6.5 Characteristic Features of a Good EIA 149
6.6 Environmental Appraisal Committee (EAC) 151
6.7 Roles of Parties in EIA Process 151

	6.8	Benefits of EIA	152
	6.9	Limitations of EIA	152
	6.10	Environmental Impact Survey	152
CHAPTER 7	**CONVENTIONS AND PROTOCOLS**		**157 – 172**
	7.1	Introduction	157
	7.2	Time Line	158
	7.3	Major Conventions	158
CHAPTER 8	**MISCELLANEOUS AND CONTEMPORARY ISSUES**		**173 – 208**
	8.1	Green Glossary	173
	8.2	International Green Days	174
	8.3	Green Institutes/Initiatives	174
	8.4	Green Awards	165
	8.5	Red Events	176
	8.6	Green Parameters	176
	8.7	Contemporary Issues in Environment	177
	8.8	Sustainable Development	200
	8.9	Millennium Development Goals	200
	8.10	Sustainable Development Goals (SDGS)	201
	8.11	Various Indices Related to Environment	202

CHAPTER 1 Ecology and Biodiversity

1.1 ENVIRONMENT

INSIDE

1.1 Environment
1.2 Layers of Atmosphere
1.3 Levels of Ecological Organization
1.4 Nutrients Cycle and Geochemical Cycles
1.5 Ecosystem
1.6 Biodiversity
1.7 Biomes
1.8 IUCN
1.9 Environmental Conservation
1.10 IUCN Protected Areas
1.11 UNESCO Heritage Sites
1.12 Wildlife
1.13 Animal Welfare Board of India
1.14 Conservation of Biodiversity

- Environment is defined as, "the sum total of living and non-living components, influences and events surrounding an organism".
- German biologist **Ernst Haeckel** coined **'ecology'** in 1869. It is the scientific study of reciprocal relationship between living organisms with their environment namely abiotic and biotic components.
- Each and every living organism has a specific surrounding with which it continuously interacts, derives its sustenance and fully adapts. This surrounding is the **'natural environment'.**
- According to Environment Protection Act 1986, environment is sum of total water, air and land, inter-relationship among themsleves and also with human beings, other living organism and property.

Question 1

Statement (I): Training should be conducted among the line and low management for ensuring the importance of environmental protection plan.

Statement (II): Environmental science is a developing subject and the people implementing environment strategies should remain up to date with the environmental control process.

Codes:

(a) Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I).

(b) Both Statement (I) and Statement (II) are individually true but Statement (II) is not the correct explanation of Statement (I).

(c) Statement (I) is true but Statement (II) is false.

(d) Statement (I) is false but Statement (II) is true.

[ESE–2019]

Ans: (a)

Environmental science is the study of the effects of natural /unnatural processes, and the interactions of the physical components of the planet on the environment.

It is developing is nature and is still evolving. So the scientists, researchers and other people who are implementing various environment strategies and procedures should be given training; especially persons working in low management.

Training and guidance should be given about all the environmental control processes and the importance of environmental protection plan.

It will enhance the efficiency of the people implementing various environment protection plan and also improve its implementation.

1.1.1 Components of Environment

Atmosphere

- It is a layer of gases (air) surrounding the planet. Atmosphere is of vital significance to life as all components of air (except inert gases) serve as key metabolites for living organisms.
- According to temperature, the atmosphere contains four different layers:
  - The first layer is called the **troposhere** (8 to 16 kms)
  - The layer above troposphere is the **stratosphere** (varies from 11 to 50 kms). Ozone is found in the atmosphere at varying concentration between the altitudes of (10 to 50 kms). This layer is also called the ozone layer.
  - Above stratosphere, lies **mesosphere** (upto 80 kms)
  - The last atmospheric layer has an altitude greater than 80 kms and is called **thermosphere**.

Gases	Percentage by volume
Nitrogen	78.08
Oxygen	20.95
Argon	0.93
Carbon dioxide	0.03

Composition of Atmosphere

Lithosphere

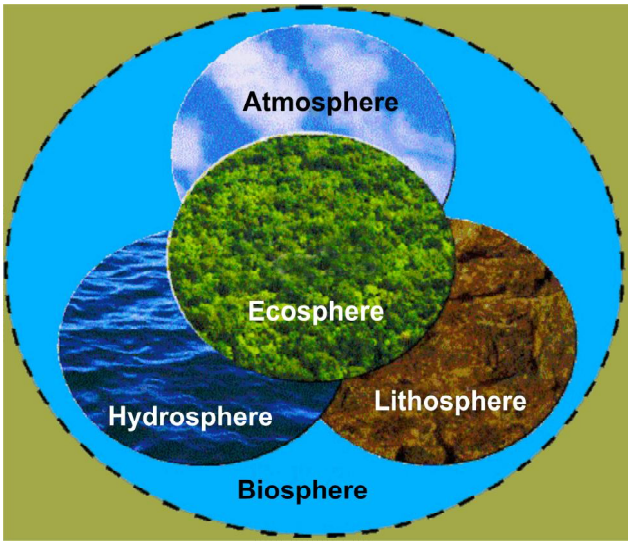
- It is the solid, outer part of the Earth and includes the brittle upper portion of the mantle and the crust (the outermost layers of Earth's structure). It is bounded by the atmosphere above and the asthenosphere (another part of the upper mantle) below. It is the most rigid of Earth's layers.
- The most well-known feature associated with Earth's lithosphere is tectonic activity. Tectonic activity describes the interaction of the huge slabs of lithosphere called tectonic plates.
- Most tectonic activity takes place at the boundaries of these plates, where they may collide, tear apart, or slide against each other. The movement of tectonic plates is made possible by thermal energy (heat) from the mantle part of the lithosphere. Thermal energy makes the rocks of the lithosphere more elastic.
- Tectonic activity is responsible for some of Earth's most dramatic geologic events: earthquakes, volcanoes, orogeny (mountain-building), and deep ocean trenches can all be formed by tectonic activity in the lithosphere.

Hydrosphere

- The hydrosphere is composed of all of the water on or near the earth.
- It ranges from 10 to 20 kms in thickness.
- Ninety seven percent of earth's water is salty. The remaining three percent is fresh water, three quarters of the **fresh water** is solid and **exists in ice sheets**.
- It includes water that is on the surface of the planet, underground, and in the air. A planet's hydrosphere can be liquid, vapour, or ice.
- Water moves through the hydrosphere in a cycle. Water collects in clouds, then falls to Earth in the form of rain or snow. This water collects in rivers, lakes and oceans. Then it evaporates into the atmosphere to start the cycle all over again. This is called the water cycle.

Biosphere

- The biosphere is composed of all living organism. The biosphere is responsible for the grand scale recyling of energy and matter on Earth.
- The mobilization of matter by biota is by no means restricted to small geographic regions.
- The periodic burning of forests and savannas, not only change the chemical form of matter, but also result in long-range atmospheric transport and deposition.



1.2 LAYERS OF ATMOSPHERE

- Basing on the temperature, the atmosphere can be divided into four layers: troposphere, stratosphere, mesosphere, and thermosphere.
- The temperature drops as we go up through the troposphere, but it rises as we move through the next layer, the stratosphere. The farther away from earth, the thinner the atmosphere gets.

1. Troposphere

- This layer of the atmosphere closest to the Earth's surface, extending up to about 10-15 km above the Earth's surface. It contains 75% of the atmosphere's mass.
- The troposphere is wider at the equator than at the poles. Temperature and pressure drops as we go higher up the troposphere.
- **Tropopause:** At the very top of the troposphere is the tropopause, where the temperature reaches a (stable) minimum. the tropopause is a **"thermal layer"** or **"cold trap"** because is this the maximum limit to which water vapour can rise, as it changes into ice and gets trapped. If there is no cold trap, Earth would lose all its water. Most of weather phenomena occurs in the troposphere.

2. Stratosphere

- This layer lies directly above the troposphere and is about 35 km deep. It extends from about 15 to 50 km above the Earth's surface.
- The stratosphere is warmer at the top than at the bottom. The lower portion has a near constant temperature, but in the upper portion the temperature increases with altitude because of absorption of sunlight by ozone.
- **The Ozone Layer:** The stratosphere contains a thin layer of ozone molecules which forms a protective layer shielding life on Earth from the Sun's harmful ultraviolet radiation.

3. Mesosphere

- Directly above the stratosphere, 50 to 80 km above the Earth's surface, the mesosphere is a cold layer where the temperature generally decreases with increasing altitude.
- Here in the mesosphere, the atmosphere is very rarefied nevertheless thick enough to slow down meteors hurtling into the atmosphere, where they burn up, leaving fiery trails in the night sky.

4. Thermosphere

- The thermosphere extends from 80 km above the Earth's surface to outer space. The temperature is hot, as high as thousands of degrees as the few molecules that are present in the thermosphere receive extraordinarily large amounts of energy from the Sun.
- The thermosphere corresponds to the heterosphere, a zone where there is no uniform distribution of gases, instead they are layered, in accordance to their molecular masses. In contrast, the gases in the homosphere (consisting of the troposphere, stratosphere and mesosphere) are uniformly distributed.
- The **ionosphere** is a region of Earth's upper atmosphere, from about 60 km to 1,000 km altitude, and includes the thermosphere and parts of the mesosphere and exosphere.
- It is ionized by solar radiation, plays an important part in atmospheric electricity and forms the inner edge of the magnetosphere.
- It has practical importance because, among other functions, it influences radio propagation to distant places on the Earth.