

Teachers Manual

ENVIRONMENTAL SCIENCES

For

Diploma Level Courses

**For Department of Technical Education
Govt. of Uttarakhand**



**ALTERNATE HYDRO ENERGY CENTRE
INDIAN INSTITUTE OF TECHNOLOGY, ROORKEE**

September 2007

About The Course

At the workshop held in October 2006 Under “Leveraging Rich Potential of Water and Hydro Resources in Uttarakhand”, at Indian Institute of Technology, Roorkee recommendation to introduce an Awareness Course in Environmental Science within ongoing Education Programmes, was made.

Subsequently it was felt that course material for the Teachers involved in teaching of the course is required. A Short Term Course was also held at Roorkee in May 2007 for Teachers of Polytechnics in Uttarakhand.

An effort was therefore made to prepare the course material as per defined syllabus and the same is presented here. The course material has been described in seven chapters as below:

- Chapter 1: Introduction to Environment
- Chapter 2: Introduction to Biological Systems
- Chapter 3: Fundamental of Ecology
- Chapter 4: Environmental Pollution
- Chapter 5: Natural Resources and Concept of Sustainability
- Chapter 6: Environmental Issues of Global Concern
- Chapter 7: Existing Policies and Regulations

Each chapter has been covered as per the requirement and the portion to be covered in every lecture has been indicated. The first page of every chapter defines the lecture details.

It is left to the teachers whether they teach in the conventional manner in the class or takes help of over head projection facilities or uses computer aided power presentation. The material for over head projection slides also have been indicated for one lecture in each chapter.

As the course is interdisciplinary, sustained effort is necessary to update the course.

The case histories required under the chapter eight has been left for the teachers to pick up from the vicinity. They may take students alongwith them to the sites to appraise them with the existing State of Environment. These projects could be of:

- Management of Lakes
- Management of Rivers
- Management of Slopes, Soil erosion and catchment basins
- Environment Impact Assessment of Industries, commercial/residential complexes/Roads
- Water Pollution Studies
- Air Pollution Studies
- Warmi Composting
- Management of biomedical wastes
- Low cost sanitation programmes
- Disposal of solid and liquid wastes

FOR ENGINEERING DIPLOMA LEVEL COURSE

1. Course Title: Environmental Science

2.* **Contact Hours:** L: 48 T: 0
P: 0

3.* **Examination Duration (Hrs.): Theory:**
Practical:

4.* **Relative Weightage :** CWS MTE
PRS ETE
PRE

5.* **Credit:**
Semester:

7.* **Autumn Spring Both**
Pre-requisite: NIL

8. **Details of Course:**

Sl. No.	Particulars	Contact Hours
1.	Introduction To Environment: Definition and scope, components of environment, atmosphere, hydrosphere, lithosphere and biosphere, structure and composition	5
2.	Introduction To Biological Systems: Life systems, pro and eukaryotic organizations, Metabolic principles; types of plants and animals. Producers, consumers and decomposers.	6
3.	Concept of Ecology: Terminology and approach, ecosystem, types of ecosystems; structure and function, mineral cycling, energy flow and trophic chains. Development and evolution.	8
4.	Environmental Pollution: Sources, causes, assessment, effect, prevention and control of water pollution, air pollution noise and land pollution.	7
5.	Natural Resources: Strategies of management, concept of sustainability. Energy and environment and their relationship with human activities. Water Resources and utilisation, forest resources.	6
6.	Global Environmental Problems: Human health, settlements, management of rivers, lakes, forests, wild life and catchments. Role of society, NGO and Govt. agencies. Concept of urbanization and green cities Global Warming, green house causes and effects, carbon sequestration.	3
7.	International agreements and protocols, National forest policy and Environmental laws and acts. EIA	4

8.	Some important case histories of environmental degradation.	3
9.	Suggested Field Work – Visit to local area to document to document environmental assets – river/grassland/hill/mountain. Visit to local polluted area (Industrial/agriculture/urban/rural).	

CONTENT

	Page No.
Preface	i.
About the Course	ii.
Course Syllabus	iii.
Content	iv. - v.
List of Figures	vi.
List of Tables	vii.
Chapter – 1	1
1.0 Introduction to Environment	1
1.1 Atmosphere	3
1.2 Hydrosphere	7
1.3 Lithosphere	11
Chapter – 2	16
2.0 Introduction to Biological Systems	16
2.1 Biological Spectrum	17
2.2 Cell Structure and Organisation	18
2.3 Molecular Organisation of Cells	21
2.4 Metabolism	23
2.5 Types of Animals and Plants	24
2.6 Basic Features of Production, Consumption and Decomposition	33
Chapter – 3	35
3.0 Fundamentals of Ecology	35
3.1 Concept of Ecosystem	36
3.2 Energy	38
3.3 Biogeochemical Cycles	40
3.4 Food Chains, Food Webs and Trophic levels	44
3.5 Development and Evolution	48
3.6 Development and Evolution (Ecological Succession)	50
Chapter – 4	53
4.0 Environmental Pollution	53
4.1 Air Pollution	53
4.2 Water Pollution	62
4.3 Land Pollution	68
4.4 Noise Pollution	70
4.5 Pollution Cycle	71
Chapter – 5	74
5.0 Natural Resource and Concept of Sustainability	74
5.1 Natural Resources	74
5.2 Forest Resources	76
5.3 Conservation of Water	80
5.4 Conservation of Energy	81
5.5 Sustainable Development	83

Chapter – 6	86
6.0 Environmental Issues of Global Concern	86
6.1 Population Explosion	86
6.2 Global Warming and Climatic Changes	87
6.3 Ecological Impact	90
6.4 Depletion of Ozone Layer	91
6.5 Acid Rain	93
Chapter – 7	95
7.0 Existing Policies and Regulations	95
7.1 International Policies	95
7.2 Existing Policies and Regulations in India	95
7.3 The Forest Policy, 1988	96
7.4 Policy Statement for Abatement of Pollution, 1992	97
7.5 National Water Policy, 2002	98
7.6 National Environmental Policy 2006	98
7.7 Legal Provisions of Environmental Protection	99
7.8 International Agreements	103
Suggested Readings:	109

LIST OF FIGURES

		Page No.
Fig. 1.1	Pyramid of Life	1
Fig. 1.2	Major Environmental Problems	2
Fig. 1.3	Structure of Atmosphere	4
Fig. 1.4	Fate of Incoming Solar Radiations	6
Fig. 1.5	Wind Rose Diagram	7
Fig. 1.6	Hydrologic Cycle	9
Fig. 1.7	Annual Water Resources of India	9
Fig. 1.8	Rock Cycle	12
Fig. 1.9	Soil Profile	14
Fig. 1.10	Soil Map of India	15
Fig. 2.1	Story of Life	16
Fig. 2.2	Principle of Ecology	17
Fig. 2.3	Cell Structure of E. Cole (prokaryotic cell)	18
Fig. 2.4	Generalised Diagram of a Eukaryotic (animal) cell	19
Fig. 2.5	Basics of Metabolism	24
Fig. 2.6 (a)	Five Kingdom Classification	26
Fig. 2.6 (b)	Classification of Plants	27
Fig. 2.6 (c)	Classification of Animals	28
Fig. 3.1	Pond as an Ecosystem	37
Fig. 3.2	Flow of Energy Through an Ecosystem	39
Fig. 3.3	Nitrogen Cycle	41
Fig. 3.4	Phosphorus Cycle	42
Fig. 3.5	Sulfur Cycle	43
Fig. 3.6	Generalised Concept of Nutrient Recycle	44
Fig. 3.7	Managed Fish Pond (Model)	45
Fig. 3.8	Ecological Pyramids	47
Fig. 4.1(a)	Production and Fate of Oxides of Nitrogen	56
Fig. 4.1(b)	Free Radical Chain Reactions	56
Fig. 4.2	Strategy of Emission Control	60
Fig. 4.3 (a)	Interaction of Atmosphere and Hydrosphere	72
Fig. 4.3 (b)	Interaction of Atmosphere and Lithosphere	72
Fig. 4.3 (c)	Interaction of Hydrosphere and Lithosphere	73
Fig. 5.1	Classification of Natural Resources	74
Fig. 5.2	Influence of Precipitation and Temperature on Vegetation	76
Fig. 5.3	Flow Chart Illustrating Various Initiatives for Sustainable Forest Management	79
Fig. 5.4	Water Availability	80
Fig. 6.1	Black Body Model	88
Fig. 6.2	Overview of Global Warming	89

LIST OF TABLES

		Page No.
Table 1.1	Type and Fate of Solar Radiations	5
Table 1.2	World's Water Resources (after Kalinin and Bykov, 1969)	8
Table 1.3	Common Rocks	13
Table 2.1	Estimate of Species in India	29
Table 4.1	Air Pollution Generation	54
Table 4.2	Important Air Pollution Sources and Emission	55
Table 4.3	National Air Quality (Ambient Air) Standards	57-58
Table 4.4	Few Industrial Sources of Water Pollution	63
Table 4.5	Process used to remove contaminants found in waste water	67
Table 4.6	Noise Quality Standards	71
Table 5.1	World's Forest Cover	77
Table 5.2	Global Electricity Generation (million kWh)	82
Table 6.1	Most Populous Countries (Population in 10 ⁶)	87
Table 6.2	Major Green House Gases	89
Table 7.1	Standards for Discharge of Environmental Pollutants	107-108

CHAPTER – 1.0

INTRODUCTION TO ENVIRONMENT

(Total Lectures Five)

Lecture No. 1 :	Concept and components of environment, atmosphere, hydrosphere and lithosphere. Pyramid of life (Fig. 1.1), major environmental problems (P ³ Syndrome) (Fig. 1.2) Composition of atmosphere, homosphere and heterosphere.
Lecture No. 2 :	Thermal structure of atmosphere (Fig. 1.3), Flow of energy through atmosphere (Table 1.1 and Fig. 1.4), Green house effect, Earths albedo, Wind rose.
Lecture No. 3 :	Hydrosphere, Global Water Resources (Table 1.2), Hydrologic Cycle (Fig. 1.6) and Annual Water Resources of India (Fig. 1.7).
Lecture No. 4 :	Water Quality, Important water quality parameters, National water quality criteria.
Lecture No. 5 :	Lithosphere, minerals, rocks (Rock Cycle Fig. 1.8), Soils, Soil profile (Fig. 1.9), Soil map of India (Fig. 1.10).