

Energy & Environment

*New Pattern
for UPSC IES/CSE*



IES MASTER PUBLICATION

Office : F-126, (Lower Basement) Katwaria Sarai, New Delhi - 110 016

Web : www.iesmasterpublication.org | Phone : 011-26522064 | Mobile : 8130909220, 9711853908



IES MASTER Publication

F-126, Katwaria Sarai, Lower Basement New Delhi-110016
Phone : 011-41013406, Mobile : 8130909220, 9711853908
Web : www.iesmaster.org E-mail : ies_master@yahoo.co.in

© No part of this booklet may be reproduced, or distributed in any form or by any means, electronic, mechanical, photocopying, or otherwise or stored in a database or retrieval system without the prior permission of **IES MASTER PUBLICATION**, New Delhi. Violaters are liable to be legally prosecuted.

First Edition : 2016

ISBN :

Preface

Preface to first Edition

Energy and Environment has been written mainly to cater for students appearing for union public service commission, ESE (Engineering Services Examination), State public service commission and other competitive examinations. It covers in detail the syllabi for these examinations. Questions typical of those set in the examinations have been included to practice and to discover the extent of their knowledge. Keywords are printed in bold type to assist the student further in assimilating the information.

In writing this book we have had in mind the needs and interests of students appearing for these competitive examinations, since most of the text books already available are written too extensively making most of it irrelevant to the demands of the examination. The discussion points focus on points of topical interest or on particular concept.

IES Master wishes to take this opportunity of thanking Dr. Ramji Annepu for his extensive contribution in generating, shaping, editing and production of this book. We also thank the staff at IES Master and all those who have assisted with information and advice in the production of this book.

IES Master Publication

New Delhi, 2016

CONTENTS

		Pages
Chapter-1	Ecology	01 – 36
Chapter-2	Ecosystem	37 – 56
Chapter-3	Biodiversity and Wildlife Conservation	57 – 110
Chapter-4	Climate Change	111 – 144
Chapter-5	Pollution	145 – 190
Chapter-6	Degradation and Conservation	191 – 226
Chapter-7	Environmental Conventions	227 – 258
Chapter-8	Environmental Impact Assessment	259 – 272
Chapter-9	Energy	273 – 302
Chapter-10	Miscellaneous	303 – 316
	Practice Work Sheets	317 – 444

TABLE OF CONTENTS

Section	Description	Page No.
	PREFACE	(iii)
	CONTENTS	(v)
CHAPTER-1	ECOLOGY	1 – 36
1.1	Environment	1
1.1.1	Components of Environment	2
1.1.2	Concept of Environment	2
1.2	Levels of Ecological Organization	3
1.2.1	Individual	3
1.2.1	Population	3
1.2.3	Community	4
1.2.4	Ecosystem	4
1.2.5	Biome	4
1.2.6	Biosphere	5
1.2.6.1	Division of Biosphere	5
1.3	Organism and Environment	8
1.3.1	Species	8
1.3.2	Evolution	8
1.3.1	Habitat	9
1.3.4	Niche	9
1.3.5	Adaptation	9
1.3.6	Biotic interaction	10
1.3.6.1	Mutalistic	10
1.3.6.2	Competition	10
1.3.6.3	Predation	11
1.3.6.4	Parasitism	11
1.3.6.5	Commensalism	11
1.3.6.6	Amensalism	11
1.3.7	Homeostasis	11
1.3.8	Ecotone	12

1.4	Community and Ecological Succession	13
1.4.1	Stages of Ecological Succession	14
1.4.1.1	Primary Succession	14
1.4.1.2	Secondary Succession	15
1.4.1.3	Climax Community	15
1.4.2	Succession in Terrestrial Community	15
1.4.3	Succession in Aquatic habitats	17
1.5	Ecosystem	18
1.5.1	Components of Ecosystem	18
1.5.1.1	Abiotic Components	19
1.5.1.2	Biotic Components	20
1.5.2	Trophic Levels	20
1.5.3	Food Chain	21
1.5.3.1	Autotrophs	21
1.5.3.2	Herbivores	21
1.5.3.3	Carnivores	22
1.5.3.4	Omnivores	22
1.5.3.5	Decomposers	22
1.5.4	Food Web	23
1.5.5	Ecological Pyramids	25
1.5.5.1	Pyramid's of Numbers	25
1.5.5.2	Pyramid's of Biomass	25
1.5.5.3	Pyramid's of Energy	26
1.5.6	Energy in Ecosystem	26
1.5.6.1	Flow of Energy in an Ecosystem	27
1.6	Nutrients Cycle and Geochemical Cycles	28
1.6.1	Geochemical Cycles	29
1.6.2	Gaseous Cycle	30
1.6.2.1	Water Cycle	30
1.6.2.2	Carbon Cycle	31
1.6.2.3	Oxygen Cycle	33
1.6.2.4	Nitrogen Cycle	33
1.6.3	Sedimentary Cycle	35
1.6.3.1	Sulphur Cycle	35
1.6.3.2	Phosphorus Cycle	36

CHAPTER-2	ECOSYSTEM	37 – 56
2.1	Biomes	37
2.1.1	Arctic Region	38
2.1.2	Tundra	38
2.1.3	Taiga / Boreal/ Coniferous forest	38
2.1.4	Temperate Deciduous Forest	39
2.1.5	Prairie (Temperate Grassland)	39
2.1.6	Savanna (Tropical/ Subtropical Grassland)	39
2.1.7	Chaparral (Mediterranean Scrub Forest)	40
2.1.8	Tropical Rainforest	40
2.1.9	Desert	41
2.2	Ecosystem	41
2.2.1	Aquatic Life Zones	41
2.3	Ecosystems of India	42
2.3.1	Trans-Himalayan Region	43
2.3.2	The Himalayan Region	43
2.3.3	The Desert	45
2.3.4	Semi-Arid Areas	45
2.3.5	The Northeast	46
2.3.6	The Western Ghats	46
2.3.7	Deccan Plateau	47
2.3.8	Gangetic Plain	48
2.3.9	Islands and Wetlands	48
2.3.10	Coasts	49
2.4	Aquatic ecosystem in India	49
2.4.1	Fresh water Ecosystem	49
2.4.2	Marine Ecosystem	50
2.5	Wet Land Ecosystem	50
2.5.1	Functions of Wetlands	50
2.5.2	Wetland Classification	51
2.5.3	India's Wetlands	52
2.5.4	National Wetlands Conservation Programme	53
2.5.5	Montreux Record	54
2.5.6	Mangroves	54
2.5.6.1	Characteristics of Mangroves	54

(x)

2.5.6.2	Major Mangroves of India	55
2.5.6.3	Mangroove conservation	56

CHAPTER-3 BIODIVERSITY AND WILDLIFE CONSERVATION 57 – 110

3.1	Introduction	57
3.2	Levels of Biodiversity	57
3.2.1	Genetic Diversity	58
3.2.2	Species Diversity	58
3.2.3	Ecosystem Diversity	58
3.3	Spatial Scales of Biodiversity	60
3.3.1	Alpha Diversity	60
3.3.2	Beta Diversity	60
3.3.3	Gamma Diversity	60
3.4	Distribution of Biodiversity	61
3.4.1	Latitudinal Gradients	61
3.4.2	Magnitude of Biodiversity	62
3.4.3	Indian Biodiversity	62
3.4.4	The Hottest of Hotspots	63
3.4.4.1	The Western Ghats and Sri Lanka	64
3.4.4.2	The Eastern Himalayas	65
3.4.4.3	Indo-Burma	66
3.4.4.4	Sundaland	67
3.5	Benefits of biodiversity	68
3.5.1	The narrowly utilitarian	68
3.5.2	The Broadly Utilitarian Values	69
3.5.3	Direct Utility	69
3.5.3.1	Provisioning Services	69
3.5.4	Indirect Utility	70
3.5.4.1	Regulating Services	70
3.5.4.2	Supporting Services	71
3.5.4.3	Cultural services	71
3.6	Threat to biodiversity	72
3.6.1	Major Causes/ Evil Quartet	73
3.6.1.1	Four Major Causes	73
3.6.1.2	Other Causes	73
3.7	Species Extinction	74

3.7.1	Types of Extinction	74
3.8	IUCN	75
3.8.1	The IUCN Categories	75
3.8.2	Animals threatened in India	76
3.8.2.1	Mammals	76
3.8.2.2	Reptiles	78
3.8.2.3	Amphibians	79
3.8.2.4	Pisces	80
3.8.2.5	Birds	81
3.8.2.6	Marine Animals	82
3.9	Environmental Conservation	82
3.9.1	Wildlife Conservation	83
3.9.2	Conservation of Biodiversity	83
3.10	Methods of conservation	83
3.10.1	Advantages of In-situ conservation	84
3.10.2	Advantage of Ex-situ Conservation	84
3.11	IUCN protected areas	85
3.11.1	National Park	85
3.11.2	Wildlife Sanctuary	90
3.11.3	Conservation Reserves	93
3.11.4	Community Reserves	93
3.11.5	Biosphere Reserve	94
3.11.5.1	Biosphere Reserve Concept	95
3.11.5.2	Zonation of BR	96
3.11.5.3	Functions of Biosphere Reserves	97
3.11.5.4	Biosphere Reserves of India	98
3.11.5.5	Conservation of Biodiversity	100
3.12	UNESCO Heritage Sites	101
3.12.1	Western Ghats as a World Heritage Site	101
3.13	World Heritage sites	102
3.13.1	Cultural Criteria	102
3.13.2	Natural Criteria	103
3.14	National Biodiversity Authority	104
3.14.1	Main objectives of NBA	104
3.15	Wildlife Conservation	105
3.15.1	Central Zoo Authority	105

3.16	Wildlife	105
3.16.1	Project Tiger	106
3.16.1.1	National Tiger Conservation Authority	107
3.16.2	Project Elephant	107
3.16.3	Rhinoceros Project	107
3.16.3.1	India-Rhino Vision 2020	108
3.16.3.2	Rhino Protected Areas	108
3.16.4	Gharial Project	108
3.16.5	Project Vulture	108
3.16.6	Great Indian Bustard	109
3.16.7	Snow Leopard	109
3.16.8	Ganges Dolphin	109
3.16.9	Project Hangul (Kashmiri-stag)	109
3.16.10	Project Red Panda (Cat-Bear)	110
3.16.11	Project Manipur thamin	110
3.16.12	Operation barasingha	110
3.17	Animal Welfare Board of India	110
CHAPTER-4	CLIMATE CHANGE	111 – 144
4.1	Introduction	111
4.1.1	Reconstruction of Past Climates	112
4.2	Heat Budget	114
4.3	Causes of Climate Change	117
4.3.1	Extraterrestrial impact	117
4.3.2	Solar Factors	117
4.3.2.1	Earth Elliptical Orbit	117
4.3.2.2	Earths Orbital/ Eccentricity Factor	118
4.3.2.3	Earths Axial Inclination/ Obliquity	118
4.3.2.4	Wobbling of Earths Axis/ Precision	119
4.3.2.5	The Sunspot Factor	120
4.4	The Geographical factors	120
4.4.1	Continental Drifting	120
4.4.2	Volcanic Dust Impact	121
4.4.3	Anthropogenic Factors	121
4.4.3.1	Increase in Air Temperature	121
4.4.3.2	Black Carbon	122

4.4.3.3	Green House Gases	123
4.5	Consequences of Climatic Change	129
4.5.1	Rising Global Temperatures	129
4.5.2	Rise in Sea Level	130
4.5.3	Ocean Acidification	131
4.5.4	Ecosystems and Biodiversity	132
4.5.5	Impact of Atmosphere and Wind Belts	133
4.5.6	Impact on Global Trade	134
4.6	Climate Change in Indian Context	134
4.6.1.1	Hydrological Cycle	134
4.6.1.2	Increased temperature	134
4.6.1.3	Soil Moisture	134
4.6.1.4	Forest Cover	135
4.6.1.5	Migration	135
4.7	Adaptive Strategies for Mitigating Climate Change	135
4.7.1	Carbon Sequestration	135
4.7.1.1	Carbon Sink	136
4.7.1.2	Green Carbon	136
4.7.1.3	Blue Carbon	136
4.7.2	Carbon Credit	136
4.7.2.1	Carbon Offsetting	136
4.7.3	Carbon Tax	137
4.7.4	Climate-Smart Agriculture	137
4.7.5	Green Economy	137
4.7.6	The Economics of Ecosystems and Biodiversity	137
4.7.7	REDD & REDD+	137
4.8	India's National Action Plan on Climate Change	138
4.8.1	National Solar Mission	138
4.8.2	National Mission for Enhanced Energy Efficiency	138
4.8.3	National Mission on Sustainable Habitat	138
4.8.4	National Water Mission	139
4.8.5	Sustaining the Himalayan Ecosystem	139
4.8.6	National Mission For a Green India	139
4.8.7	National Mission for Sustainable Agriculture	140
4.8.8	Strategic Knowledge For Climate Change	140
4.9	National Bio-energy Mission	140

(xiv)

4.10	Labelling Programme for Appliances	140
4.11	Energy Conservation Building Code	140
4.11.1	Green Building	140
4.12	Energy Audits of Large Industrial Consumers	141
4.13	Mass Transport	141
4.14	Clear Air Initiatives	141
4.14.1	Promotion of Energy Saving Devices	141
4.14.2	Promotion of Biofuels	142
4.15	Initiative on Climate Resilient Agriculture	142
4.16	Geo-engineering	142
4.16.1	Cool a Volcano	142
4.16.2	Shoot mirrors into space	142
4.16.3	Seed the sea with Iron	143
4.16.4	Whiten the clouds with wind-powered ships	143
4.16.5	Build fake trees	143
CHAPTER-5	POLLUTION	145 – 190
5.1	Introduction	145
5.1.1	Categories of Pollutants	146
5.1.2	Source and non-source pollutants:	146
5.1.3	Main types of pollution are	147
5.2	Air Pollution	147
5.2.1	Types of Air Pollutants	148
5.2.2	Major air pollutants Source and their Health Effects	148
5.2.3	Consequences of Air Pollution	151
5.2.3.1	Respirable Suspended Particulate Matter	152
5.2.3.2	Acid Rain or Acid Precipitation	152
5.2.3.3	Temperature inversion Phenomenon	154
5.2.3.4	Urban Heat Island	154
5.2.3.5	Smog	155
5.2.4	Various Control Measures	157
5.2.4.1	Sources Correction Methods	157
5.2.4.2	Pollution Control Equipment	157
5.2.4.3	Diffusion of Pollutants in Air	157
5.2.4.4	Vegetation	158
5.2.5	Legislative Measures	158

(xv)

5.2.5.1	The Air Act, 1981	158
5.2.5.2	State Government Initiatives	159
5.2.5.3	Supreme Court Guidelines and Orders	159
5.2.5.4	The National green tribunal directions	159
5.2.5.5	National Air Quality Index (AQI)	159
5.2.5.6	Safar Mobile Application	160
5.2.5.7	International Laws on air Pollution	161
5.3	Water Pollution	161
5.3.1	World Health Organization	161
5.3.2	Types of Water Pollutants	161
5.3.3	Water Quality Parameters	163
5.3.3.1	Biological Oxygen Demand (BOD)	163
5.3.3.2	Chemical Oxygen Demand (COD)	164
5.3.3.3	Dissolved Oxygen (DO)	164
5.3.3.4	Most Probable Number (MPN)	165
5.3.3.5	Total Dissolved Solids (TDS)	166
5.3.3.6	Eutrophication	166
5.3.3.7	Algal Bloom	167
5.3.4	Control Measures	168
5.3.4.1	Sewage Treatment	168
5.3.4.2	Effluent Treatment	168
5.3.4.3	New Technologies	168
5.3.5	Legislative Measures and Government Initiatives	168
5.3.5.1	Factories Act, 1948	168
5.3.5.2	The water Act, 1974	169
5.3.5.3	Water Cess Act, 1977	169
5.3.5.4	Biodigester Technology	169
5.3.5.5	Government Initiative to Clean Ganga	169
5.4	Marine Pollution	170
5.4.1	Sources of Marine Pollution	170
5.4.2	Effects of Pollutants of Marine Life	171
5.4.3	Marine Pollution Control	171
5.5	Soil Pollution	172
5.5.1	Sources of Soil Pollution	172
5.5.1.1	Natural pollutants	172
5.5.1.2	Man-Made Pollutants	173

5.5.2	Impact of Soil Pollution	174
5.5.3	Control Measures	174
5.6	Noise Pollution	175
5.6.1	Types of Sound	175
5.6.1.1	Continuous noise	175
5.6.1.2	Intermittent noise	175
5.6.1.3	Impulse noise	176
5.6.2	Effect of Noise Pollution on Human beings	176
5.6.3	Impact of Noise Pollution	177
5.6.4	Noise Control Techniques	178
5.6.4.1	Control at the source	178
5.6.4.2	Control in the transmission path/ medium	178
5.6.4.3	Using protective equipment at Receivers	178
5.6.5	Legislative measures to Control Noise Pollution	178
5.6.5.1	Air Act 1981	178
5.6.5.2	Noise pollution rules 2000	179
5.6.5.3	Real Time Ambient Noise Monitoring	179
5.6.5.4	Bureau of Indian Standard	180
5.6.5.5	MoEFCC	180
5.7	Thermal Pollution	180
5.7.1	Thermal pollution may be caused by	180
5.7.2	Major Consequences of Thermal Pollution	180
5.8	Light Pollution	181
5.8.1	Sources Include	181
5.9	Visual Pollution	182
5.9.1	Sources of visual pollution are	182
5.10	Radioactive Degradation	182
5.10.1	Types of Radiation	182
5.10.2	Types of Radiation Particles	183
5.10.3	Radio Isotopes and Their Half-Life	183
5.10.4	Sources or Radiation	184
5.10.5	Effects of Radioactive Pollution	184
5.10.5.1	Non- Ionizing Radiation's Effects	184
5.10.5.2	Ionizing Radiation's Effects	185
5.10.6	Control Measures	185
5.11	E-waste Pollution	185

(xvii)

5.11.1	Types of E-Waste	185
5.11.2	Sources and Health Effects	186
5.11.3	Environmental Assessment of Electronic Goods	187
5.11.4	Government Legislative Measures	188
5.11.4.1	MoEFCC	188
5.11.4.2	The SPCBs/ PCCs	188
5.12	Food Contamination and Health	188
5.12.1	Biological Contaminants	188
5.12.2	Chemicals in Food	189
5.12.3	Metal Contamination	189
5.13	Pollution and Health Impact	190
5.13.1	Dioxins	190
5.13.2	Minamata Disease	190
5.13.3	Itai-itai Disease	190
5.13.4	Methemoglobinemia	190
5.13.5	Fluorosis	190
CHAPTER-6	DEGRADATION AND CONSERVATION	191 – 226
6.1	Introduction	191
6.1.1	Environmental degradation	191
6.1.2	Environmental Conservation	191
6.1.3	Preservation	191
6.1.4	Anthropological Factors	192
6.2	Natural Resources	192
6.2.1	Renewable resources	193
6.2.2	Non-renewable resources	193
6.2.3	Pressure on Natural Resources	194
6.2.4	Consequences of resource exploitation	195
6.2.4.1	Socioeconomic consequences	195
6.2.4.2	Environmental consequences	195
6.2.4.3	Political consequences	195
6.3	Soil	195
6.3.1	Types of Soil Erosion	196
6.3.2	Soil Degradation	196
6.3.3	Soil Conservation	198

(xviii)

6.3.4	Conservation Initiatives of Indian Government	200
6.3.4.1	Major Programmes	200
6.3.4.2	Combating Desertification	200
6.3.4.3	IWMP	200
6.3.4.4	Drought Prone Areas Programme	200
6.3.4.5	Desert Development Programme	201
6.3.4.6	Prime Minister Krishi Sinchayee Yojna	201
6.3.5	Institutes Involved in Combating Desertification	201
6.3.6	Major policies having a bearing on desertification	201
6.4	Forests	202
6.4.1	Deforestation	202
6.4.2	Consequences	203
6.4.3	Conservation of Forest Resources	203
6.4.3.1	Regulated and Planned Cutting of Trees	203
6.4.3.2	Control over Forest Fire	204
6.4.3.3	Reforestation and Afforestation	204
6.4.3.4	Forest Clearance	204
6.4.3.5	Protection of Forests	205
6.4.3.6	Forest & Forests Products Utilisation	205
6.4.3.7	Role of Government & Forest Management	205
6.4.4	Conservation Initiatives of Indian Government	205
6.4.5	National Forestry Action Programme	206
6.4.6	Biological Diversity Act, 2002	207
6.4.7	73rd Amendment to the Indian Constitution	207
6.4.8	Indian Council of Forestry Research & Education	207
6.4.9	Research Institutions apart from ICFRE	208
6.4.10	Institutions: Forest Conservation in India	208
6.4.11	Chipko movement	208
6.4.12	Appiko Movement	208
6.5	Water	209
6.5.1	Resource Crisis	209
6.5.2	Conservation methods	210
6.6	Marine Conservation: Initiatives of Indian Government	210
6.7	Atmosphere and Environment Conservation	211
6.7.1	Environment Protection Act	211
6.7.2	The Factories Act	212

(xix)

6.7.3	The Atomic Energy Act	212
6.7.4	The Insecticides Act	212
6.7.5	The Public Liability Insurance Act	212
6.7.6	The National Environment Appellate Authority Act	212
6.7.7	Culture and Nature Conservation	212
6.8	Sustainable development	212
6.8.1	Characteristics of Sustainable Development	213
6.8.2	Principles of Sustainability	214
6.9	Waste Management	214
6.9.1	Waste	214
6.9.2	Types of Waste	214
6.9.3	Toxic Waste	215
6.9.4	Non-Toxic Waste	215
6.10	Sources of Waste	215
6.10.1	Domestic Waste	215
6.10.2	Industrial Waste	216
6.10.3	Agricultural Waste	216
6.10.4	Municipal Waste	217
6.10.5	Bio-Medical Wastes	218
6.10.6	Nuclear Waste	218
6.11	Impact of Waste Accumulation	218
6.11.1	Spoilage of Landscape	218
6.11.2	Pollution	219
6.11.3	Health Hazards	219
6.11.4	Effect on Plants	220
6.11.5	Effect on Aquatic Life	220
6.12	Management of Waste	220
6.12.1	Safe Disposal of Waste	221
6.12.1.1	Segregation	221
6.12.1.2	Dumping	221
6.12.2	Composting	221
6.12.3	Drainage and Treatment of Effluents	222
6.12.4	Incineration	222
6.12.5	Scrubber	222
6.12.6	Electrostatic Precipitators	222
6.12.7	Reduce-Reuse-Recycle (RRR) Strategy	223

	(xx)	
	6.12.7.1 Reducing the Waste	223
	6.12.7.2 Reusing the Waste	223
	6.12.7.3 Recycling of Waste	224
6.13	Solid Waste Management in India	224
	6.13.1 Salient Features of SWM Rules, 2016	224
	6.13.2 Municipal Solid Waste	226
	6.13.3 Proper solid waste management	226
	6.13.4 Problems of unscientific MSW disposal	226
CHAPTER-7	ENVIRONMENTAL CONVENTIONS	227 – 258
	7.1 Introduction	227
	7.2 Source of International Law	227
	7.3 Treaties/ Protocols/ Summits/ Declarations	228
	7.3.1 Treaties	228
	7.3.2 Protocols	228
	7.3.3 Declarations and Summits/ Conferences	228
	7.4 Principles of International Environmental Law	229
	7.4.1 Principle of State Responsibility	229
	7.4.2 Principle of Good Neighbourliness	229
	7.4.3 Principle of Cooperation	229
	7.4.4 Principle of Sustainable Development	230
	7.4.5 Principle of Polluter Pays	230
	7.4.6 Principle of Common but Differential Responsibility	230
	7.4.7 Principle of Precaution	230
	7.4.8 Principle of Intergenerational Equity	231
	7.4.9 Principle of Preventive Action	231
	7.5 Development of International Environmental Law	231
	7.6 Environmental Conventions after UN	232
	7.6.1 Stockholm Declaration 1972	234
	7.6.2 The World Conservation Strategy, 1980	235
	7.6.3 World Charter for Nature, 1983	235
	7.6.4 World Commission on Environment & Development	236
	7.6.5 Caring for the Earth Strategy for Sustainable Living	237
	7.6.6 Earth Summit 1992	237
	7.6.6.1 Rio Declaration	238
	7.6.6.2 Agenda 21	238

(xxi)

7.6.6.3	Rio Declaration	238
7.6.6.4	The Forest Principles	239
7.6.6.5	Cartagena Protocol	240
7.6.7	UN Commission on Sustainable Development	240
7.6.8	RIO +5, 1997	241
7.6.9	Malmö Declaration, 2000	241
7.6.10	WSSD Johannesburg Declaration or RIO +10	241
7.6.11	Rio +20, 2012	242
7.7	Timeline of UNFCCC	242
7.7.1	IPCC Established	242
7.7.2	UN General Assembly Framework Convention	243
7.7.3	UNFCCC at Rio Earth Summit	245
7.7.4	UNFCCC Enters into Force	245
7.7.5	Berlin Meet	245
7.7.6	UNFCCC Secretariat Moves to Bonn	245
7.7.7	Kyoto Protocol	245
7.7.8	Marrakesh Conference	246
7.7.9	EU Launches Emissions Trading	246
7.7.10	Kyoto Protocol	246
7.7.11	Nairobi Conference	246
7.7.12	Bali Conference	246
7.7.13	Poznan Conference	246
7.7.14	Copenhagen Conference	247
7.7.15	Cancun Conference	247
7.7.16	Durban 2011 (CoP-17)	247
7.7.17	Doha Conference	247
7.7.18	Warsaw Conference	247
7.7.19	Lima 2014 (CoP-20)	247
7.7.20	Paris Agreement	248
7.8	Other Major International Environmental Conventions	249
7.8.1	World Heritage Convention	250
7.8.2	Aarhus Convention	250
7.8.3	Espoo Convention	250
7.8.4	Vienna Convention & Montreal Protocol	250
7.8.5	Basel convention	251
7.8.6	Hazardous and Noxious Substances Convention	251

7.8.7	Minamata Convention on Mercury	251
7.8.8	Ramsar Convention	251
7.8.9	CITES	252
7.8.10	UN Convention to Combat Desertification	252
7.8.11	UN Convention on the Law of the Seas	252
7.8.12	London Convention	254
7.8.13	Marpol Convention	254
7.8.14	Convention on Nuclear Safety, Vienna	255
7.8.15	Comprehensive Nuclear-Test-Ban Treaty	255
7.9	Government Organisations : India	255
7.9.1	Central Pollution Control Board	256
7.9.2	Indian Institute of Forest Management	256
7.9.3	Wildlife Institute of India	256
7.9.4	Wildlife Protection Society of India	256
7.9.5	Wildlife Trust of India	256
7.9.6	Centre for Science and Environment	256
7.9.7	India Environmental Society	256
7.9.8	World Wildlife Fund	257
7.9.9	EPTRI	257
7.9.10	NEERI	257
7.9.11	The National Green Tribunal	257
CHAPTER-8	ENVIRONMENTAL IMPACT ASSESSMENT	259 – 272
8.1	Introduction	259
8.1.1	Broader Aspects of EIA	260
8.2	Development/ Evolution of EIA	260
8.3	Objectives of EIA	261
8.3.1	Immediate Objectives	261
8.3.2	Long-Term Objectives	261
8.4	Environmental Conventions	261
8.4.1	Identification	262
8.4.2	Screening	262
8.4.3	Scoping and Consideration of Alternatives	262
8.4.4	Impact Prediction	263
8.4.5	Mitigation	263
8.4.6	Reporting To Decision-Making Body	264

8.4.7	Public Hearing	264
8.4.8	Review	265
8.4.9	Decision-Making	265
8.4.10	Post Project Monitoring	265
8.5	Benefits of EIA	265
8.6	Characteristic Features of a Good EIA	266
8.7	Environmental Impact Assessment in India	266
8.8	Environment Action Plan	268
8.9	Sequential Process Involved on EIA in India	269
8.10	Drawbacks in Indian System	270
8.11	Role Of Whistle Blowers	270
CHAPTER-9	ENERGY	273 – 302
9.1	Energy	273
9.1.1	Energy Efficiency	274
9.1.2	Types of Energy Sources	274
9.2	Coal	276
9.2.1	Environmental Issues with Fossil Fuel	277
9.2.2	Coal Consumption and Development in India	278
9.2.3	Coal-bed Methane	279
9.3	Petroleum	279
9.3.1	Crude Oil Reserves, Production and Consumption	279
9.3.2	Petroleum-Rich Countries	280
9.3.3	Petroleum Products	280
9.3.4	Liquefied Petroleum Gas	281
9.4	Natural Gas	281
9.4.1	Reserves, Production and Consumption	281
9.5	Oil Shale	282
9.5.1	Definition of Oil Shale	282
9.5.2	Origin of Oil Shale	283
9.5.3	Reserves	283
9.5.4	Uses	284
9.6	Shale Gas	284
9.6.1	Technology	284
9.6.2	Resources	284
9.6.2.1	Advantages	284

9.6.2.2 Drawbacks	284
9.7 Nuclear Fuel	285
9.7.1 Distribution and Production of Uranium	285
9.7.2 Thorium	286
9.7.3 Challenge of Nuclear Energy	286
9.8 Hydroelectric Energy	287
9.8.1 Types of Hydropower	287
9.8.3 Advantages and disadvantages	288
9.8.4 Environmental Issues of Hydropower	288
9.9 Solar Energy	288
9.9.1 Distribution of solar radiation	288
9.9.2 Solar Thermal Applications	289
9.9.3 PV Systems	289
9.9.4 Solar Energy Storage Systems	289
9.9.5 Environmental Issues of Solar Power	290
9.10 Wind Energy	290
9.10.1 Most attractive regions for Wind Energy	290
9.10.2 Offshore Wind Farms	292
9.10.3 Wind Energy Costs	292
9.10.4 Environmental Issues of Wind Energy	292
9.11 Bio Energy	292
9.11.1 Potential of Biomass Resources	292
9.11.2 Bio Fuels	293
9.11.3 Biogas	293
9.11.4 Microbial Fuel Cell (MFC)	293
9.11.5 Energy Crop	293
9.12 Geothermal Energy	294
9.12.1 Geothermal Energy Uses	294
9.12.2 Technical Potential	294
9.12.3 Resource Distribution	295
9.13 Tidal Energy	295
9.14 Wave Energy	295
9.15 Energy storage technologies	295
9.15.1 Batteries	296
9.15.2 Hydrogen Storage	296
9.15.3 Fuel Cells	296

(xxv)

9.16	Energy and Environment	297
9.16.1	Energy Demand	297
9.16.2	Energy Demand and Industrialisation	297
9.16.3	Energy Demand in Developing Economies of Asia	297
9.16.4	The Carrying Capacity of the Earth	298
9.16.5	Estimating Sustainable Carrying Capacity	299
9.17	India's Energy Outlook 2015 Factsheet	299
9.17.1	Indian energy demand	299
9.17.2	Indias Ambitious plans	300
9.17.3	National Bio-diesel Mission	301
9.17.4	GRIHA	301
9.17.5	Bureau of Energy Efficiency	302
CHAPTER-10	MISCELLANEOUS	303 – 316
10.1	Green Glossary	303
10.1.1	Earth Hour	303
10.1.2	Green Index	303
10.1.3	Bio-Fertiliser	303
10.1.4	Bio-Pesticides	304
10.1.5	Oil Zapper – The Oil Eating Bacteria	304
10.1.6	Bioremediation	304
10.2	International Green Days	304
10.2.1	International Tiger Day	304
10.2.2	World Environment Day	304
10.2.3	World Forestry Day	304
10.2.4	World Habitat Day	305
10.2.5	World Ozone Day	305
10.3	Green Institutes/ Initiatives	305
10.3.1	Namami Gange	305
10.3.2	Environmental Information System	305
10.3.3	Ecomark Scheme	306
10.3.4	Haryali Yojana	306
10.3.5	National Bureau of Plant Genetic Resources	306
10.3.6	National Lake Conservation Plan	306
10.3.7	Forest Research Institute	306
10.3.8	National Institute of Ayurveda	306

(xxvi)

10.3.9 National Botanical Research Institute	307
10.3.10 Institute of Forest Genetics and Tree Breeding	307
10.3.11 Tropical Forest Research Institute	307
10.4 Green Awards	307
10.4.1 Rajiv Gandhi Environment Award	307
10.4.2 Champions of the Earth	307
10.4.3 Indira Gandhi Paryavaran Puraskar	308
10.4.4 Amrita Devi Bishnoi Award	308
10.5 Red Events	308
10.5.1 Bhopal Gas Tragedy	308
10.5.2 Agent Orange	308
10.6 Green Concepts	308
10.6.1 Deep Ecology	308
10.6.2 ENSO Modoki	309
10.6.3 Lake Zonation	310
10.6.4 Soil Horizons	311
10.6.5 Marine Zonation	311
10.6.6 Atmospheric Layers	313
10.7 Green Parameters	315
10.7.1 Millennium Ecosystem Assessment	315
10.7.2 Dobson Unit	315
10.7.3 Diatoms	315
10.7.4 Diamond Dust	316

INDEX OF TABLES

Table 1.1	Components of Environment	2
Table 1.2	Atmospheric Gases by Percentage	6
Table 1.3	Biotic interaction	10
Table 1.4	Chemical Elements or Mineral Nutrients that make up Living Beings	28
Table 2.1	Major Wetlands of India	53
Table 2.2	Major Mangroves of India	55
Table 3.1	Mammals Species	76
Table 3.2	Reptile Species	78
Table 3.3	Amphibians Species	79
Table 3.4	Fish Species	80
Table 3.5	Birds Species	81
Table 3.6	Marine Species	82
Table 3.7	Important Endangered Species of India	82
Table 3.8	Marsupials	82
Table 3.9	Difference between In-situ conservation and Ex-situ Conservation	84
Table 3.10	Major National Parks of India	87
Table 3.11	Major wildlife Sanctuaries of India	92
Table 3.12	Biosphere Reserves of India	98
Table 4.1	Geologic Time Chart	113
Table 4.2	Rise in atmospheric CO ₂ since 1700 AD	124
Table 5.1	Major air Pollutants, Sources and their Effects	149
Table 5.2	Air Quality Index	160
Table 5.3	Water Pollutants and their Impact	162
Table 5.4	Health Consequences of Noise Pollution	176
Table 5.5	Noise Levels in Various Zones	179
Table 5.6	Radioactive Isotopes and their radiation	183
Table 5.7	E-Waste toxic Components and their Damage to Human Health	186
Table 5.8	Health consequences of E-waste	186
Table 9.1	Uses of Petroleum Products	280
Table 9.2	Petroleum Products	281

INDEX OF DISCUSSION POINTS

Section	Discussion point	Description	Page No.
Chapter 1	1	Population Growth rate and Population density	4
	2	Chemosynthetic bacteria	6
	3	Natural selection	3
	4	Pioneer Species	14
	5	Bioaccumulation and Biomagnification	24
Chapter 2	6	Aquatic zones	42
	7	Himalayas	44
	8	Tropical rain forests	46
	9	Tropical deciduous forests	46
	10	Tidal Forests	49
	11	Grasslands	49
Chapter 3	12	Flagship species	58
	13	Charismatic mega fauna	59
	14	Keystone species	59
	15	Umbrella species	59
	16	Indicator species	59
	17	Foundation species	59
	18	Spatial Scales of Biodiversity	61
	19	Species-area relationship	61
	20	Migration of birds	63
	21	Endemic species	67
	22	Endangered species	68
	23	Bio Prospecting	69
	24	Sanctuary and National Park	90
	25	Reserved Forests & Protected Forests	94
26	Preservation plots	94	
27	Biosphere reserve Vs natural World Heritage site	102	
Chapter 4	28	Weather Vs Climate	111
	29	Heat Budget 1	15
	30	Link with General circulation	116
	31	Greenhouse/ glasshouse	124
	32	Ozone	127
	33	Thermal Expansion	131
	34	The Blue Carbon Initiative	136

(xxix)

Chapter 5	35	Effects of Acid Rain on Ecosystems	153
	36	Ganga Conservation	169
Chapter 6	37	Metallic and Non-metallic Resources	193
	38	Diseases due to contamination	218
Chapter 7	39	North-South Divide	230
	40	World Commission on Environment & Development	236
	41	Global environment facility	239
	42	UNCLOS	253
Chapter 8	43	Impact assessment of coal-based thermal power plants	271
	44	EIA and its Ambit	271

