

**B.Sc. Environmental Science Course Structure under CBCS  
(For the candidates admitted from the academic year 2018-2019 onwards)**

**ELIGIBILITY :** Any science group at Higher Secondary School level.

Sem	Part	Course	Title	Inst. Hours/ Week	Credit	Exam Hours	Marks		Total	
							Int	Ext		
I	I	Language Course–I (LC) – Tamil*/Other Languages ** #		6	3	3	25	75	100	
	II	English Language Course - I (ELC)		6	3	3	25	75	100	
	III		Core Course–I (CC)	Concepts of Environment	6	6	3	25	75	100
			Core Practical – I (CP)	Environment and Ecology	3	-	-	-	-	-
			First Allied Course–I (AC)	Biology – I	4	4	3	25	75	100
			First Allied Course–II (AP)	Biology	3	-	-	-	-	-
	IV	Value Education	Value Education	2	2	3	25	75	100	
<b>Total</b>				<b>30</b>	<b>18</b>				<b>500</b>	
II	I	Language Course–II (LC)– Tamil*/Other Languages ** #		6	3	3	25	75	100	
	II	English Language Course–II (ELC)		6	3	3	25	75	100	
	III		Core Course–II (CC)	Ecology	6	6	3	25	75	100
			Core Practical – I (CP)	Environment and Ecology	3	3	3	40	60	100
			First Allied Course–II (AP)	Biology	3	3	3	40	60	100
			First Allied Course–III (AC)	Biology – II	4	2	3	25	75	100
	IV	Environmental Studies	Environmental Studies	2	2	3	25	75	100	
<b>Total</b>				<b>30</b>	<b>22</b>				<b>700</b>	
III	I	Language Course – III (LC)– Tamil*/Other Languages ** #		6	3	3	25	75	100	
	II	English Language Course-III (ELC)		6	3	3	25	75	100	
	III		Core Course – III (CC)	Environmental Pollution	6	6	3	25	75	100
			Core Practical – II (CP)	Environmental Resource and Management	3	-	-	-	-	-
			Second Allied Course – I (AC)	Chemistry – I	4	4	3	25	75	100
			Second Allied Course-II (AP)	Chemistry	3	-	-	-	-	-
	IV	Non Major Elective I - for those who studied Tamil under Part-I a) Basic Tamil for other language students b) Special Tamil for those who studied Tamil upto +2 but opt for other languages in degree programme		2	2	3	25	75	100	
<b>Total</b>				<b>30</b>	<b>18</b>				<b>500</b>	

IV	I	Language Course –IV (LC) - Tamil*/Other Languages ** #		6	3	3	25	75	100	
	II	English Language Course – IV (ELC)		6	3	3	25	75	100	
	III	Core Course – IV (CC)	Natural Resources		5	5	3	25	75	100
		Core Practical – II (CP)	Environmental Resource and Management		3	3	3	40	60	100
		Second Allied Course - II (AP)	Chemistry		3	3	3	40	60	100
		Second Allied Course - III	Chemistry – II		3	2	3	25	75	100
	IV	Non Major Elective II- for those who studied Tamil under Part I a) Basic Tamil for other language students			2	2	3	25	75	100
		b) Special Tamil for those who studied Tamil upto +2 but opt for other languages in degree programme								
			Skill Based Elective - I		2	2	3	25	75	100
	<b>Total</b>				<b>30</b>	<b>23</b>				<b>800</b>
V	III	Core Course – V (CC)	Environmental Microbiology and Biotechnology	5	5	3	25	75	100	
		Core Course – VI (CC)	Environmental Toxicology	5	5	3	25	75	100	
		Core Course – VII (CC)	Sustainable Development	6	5	3	25	75	100	
		Core Practical – III (CP)	Environmental Monitoring and Assessment	3	3	3	40	60	100	
		Major Based Elective – I	Global Warming and Climate change	5	5	3	25	75	100	
	IV	Skill Based Elective – II	Skill Based Elective - II		2	2	3	25	75	100
		Skill Based Elective – III	Skill Based Elective - III		2	2	3	25	75	100
		Soft Skills Development	Soft Skills Development		2	2	3	25	75	100
	<b>Total</b>				<b>30</b>	<b>29</b>				<b>800</b>
VI	III	Core Course – VIII (CC)	Waste Management	6	6	3	25	75	100	
		Core Course – IX (CC)	Environmental Health and Safety Management	6	6	3	25	75	100	
		Core Practical – IV (CP)	Environmental Remediation and Restoration	5	4	3	40	60	100	
		Major Based Elective II	Ecotourism	6	6	3	25	75	100	
		Major Based Elective III	Disaster Management	6	6	3	25	75	100	
	V	Extension Activities	Extension Activities		-	1	-	-	-	-
		Gender Studies	Gender Studies		1	1	3	25	75	100
	<b>Total</b>				<b>30</b>	<b>30</b>				<b>600</b>
<b>Grand Total</b>				<b>180</b>	<b>140</b>				<b>3900</b>	

## List of Allied Courses

### Allied Course I

(First Year)

Biology

Language Part – I	-	4
English Part –II	-	4
Core Paper	-	9
Core Practical	-	4
Allied Paper	-	4
Allied Practical	-	2
Skill Based Elective	-	3
Major Based Elective	-	3
Environmental Studies	-	1
Value Education	-	1
Soft Skill Development	-	1
Gender Studies	-	1
Extension Activities	-	1

### Allied Course II

(Second Year)

Chemistry

(Credit only)

\* for those who studied Tamil upto 10<sup>th</sup> +2 (Regular Stream)

+ Syllabus for other Languages should be on par with Tamil at degree level

# those who studied Tamil upto 10<sup>th</sup> +2 but opt for other languages in degree level under Part I should study special Tamil in Part IV

\*\* Extension Activities shall be out side instruction hours

Non Major Elective I & II – for those who studied Tamil under Part I

- Basic Tamil I & II for other language students
- Special Tamil I & II for those who studied Tamil upto 10<sup>th</sup> or +2 but opt for other languages in degree programme

### Note:

	Internal Marks	External Marks
1. Theory	25	75
2. Practical	40	60
3. Separate passing minimum is prescribed for Internal and External marks		

### FOR THEORY

The passing minimum for CIA shall be 40% out of 25 marks [i.e. 10 marks]

The passing minimum for University Examinations shall be 40% out of 75 marks [i.e. 30 marks]

### FOR PRACTICAL

The passing minimum for CIA shall be 40% out of 40 marks [i.e. 16 marks]

The passing minimum for University Examinations **shall be 40% out of 60 marks** [i.e. 24 marks]

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## **Core Course I**

### **CONCEPTS OF ENVIRONMENT**

#### **General objectives**

- To know the physical environment encompassing atmosphere, hydrosphere, lithosphere and biosphere.
- To realize the importance of interactions among various spheres and appreciate the inter- relationships among them.

#### **Unit I**

Environment: Definition and importance; Principles and Scope; Continents; landmasses. Earth and Sun relationship: earth in the solar system, earth's planetary motions – rotation and revolution, seasonality, solstices and equinoxes.

#### **Unit II**

Atmosphere: Composition of air- Layers of Atmosphere, Ozone layer – Radiation balance, Spectrum - Horizontal distribution of temperature and pressure, Global Circulation.

#### **Unit III**

Hydrosphere: Sources of water – importance of water, hydrologic cycle - Precipitation and types of precipitation, ocean currents – generation of ocean currents, types of ocean currents; Distribution of fresh water.

#### **Unit IV**

Lithosphere: Earth's crust and its composition-Internal structure of the earth- Soil texture, types of rocks- Types of soil, process of soil formation and soil nutrients.

#### **Unit V**

Biosphere: Concept and definition; Types of Biomes and their distribution. Biogeographic zones: Phytogeographic zones, Zoogeographic zones.

#### **References**

1. Botkin, D.B. and Keller, E.A., Environmental Science: Earth as a Living Planet, John Wiley and Sons, New Delhi, 2011.
2. Cunningham, W. P. and Saigo, B.W., Environmental Science – A Global Concern, Eighth Edition. WCB/McGraw Hill, New York, 2007.

3. McKinney, M.L., Schoch, R. and Yonavjak, R.M., Environmental Science Systems and Solutions, Jones & Bartlett Publishing Inc., Delhi, 2007.
4. Sharma, P.D., Ecology and Environment, Seventh Edition, Rastogi Publication, Meerut, 2004.
5. Santra, S.C., Environmental Science, Second Edition, New Central Book Agency (P) Ltd., Kolkata, 2010.
6. Joseph, K. and Nagendran, R., Essentials of Environmental Studies, Pearson Education Publisher, Delhi, 2004.
7. Purohit, S.S., Shammi, Q.J. and Agarwal, A.K., A Textbook of Environmental Science, Students Edition, Jodhpur, 2004.
8. Reddy, A.M., Textbook of Environmental Science and Technology, BSP Books Pvt. Ltd., Hyderabad, 2005.
9. Anjaneyulu, Y., Introduction to Environmental Science, BSP Books Pvt. Ltd., Hyderabad, 2009.
10. Lal, D.S. Climatology, Sharda Pustak Bhawan, Allahabad, 2003.
11. Chapin III, F.S., Matson, P.A. and Vitousek, P.M., Principles of Terrestrial Ecosystem Ecology, Springer, New Delhi, 2012.
12. Bloom, A.L., Geomorphology – A Systematic Analysis of Late Cenozoic Landforms, Third Edition, Pearson Education, Singapore, 2003.
13. Dayal, P., A Textbook of Geomorphology, Shukla Book Depot, Patna, 2001.
14. Singh, S., Environmental Geography, Prayag Pustak Bhawan, Allahabad, 2002.

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## **Core Practical I**

### **Environment and Ecology**

#### **General objectives**

- To understand the major ecological concepts and complex interrelationships in nature
  - To expose the students in Estimation of species diversity and to compute biodiversity indices for understanding the ecology.
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1. Determination of requisite size of the quadrant for vegetation analysis.
  2. Determination of the frequency distribution of plants in a piece of vegetation by quadrat method.
  3. Estimation of chlorophyll content in the given plant material.
  4. Study of flora and fauna through charts and maps
  5. Comments on life cycle of some economically important insects.
  6. Identification of museum specimens of some economically important fishes
  7. Preparation of field report based on the survey of local flora
  8. Temporary wet mount technique for the observation of living organism.
  9. Identification of Soil texture – clay, sand, loamy.
  10. Identification of Soil types – red soil, black soil.
  11. Diagrammatic representation of solar, lunar eclipses, day and night.
  12. Submission of 10 herbarium sheets with proper field note book
  13. Estimation of species diversity by Shannon - Weiner diversity index method.

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## First Allied Course I (Biology – I)

### PLANT DIVERSITY AND PHYSIOLOGY, MUSHROOM TECHNOLOGY AND PLANT BIOTECHNOLOGY

#### Objectives

- To expose the diversity of plant kingdom and their salient features
- To acquire skills for engaging themselves in self-employment especially in the broad field of Mushroom Culture.
- To expose various avenues of opportunities in the field of plant biotechnology considering its recognition, importance and utility value.

#### Unit I Algae and Fungi

**Algae:** General characteristics of algae and its importance. Structure, reproduction and life cycle of *Nostoc*, *Chlorella*, *Oedogonium*, *Ectocarpus* and *Polysiphonia*.

**Fungi:** General characteristics of fungi and its importance. Structure of *Albugo* and *Penicillium*.

#### Unit II Bryophytes, Pteridophytes and Gymnosperms

**Bryophytes:** General characteristics of bryophytes. Structure, reproduction and life cycle of *Riccia* and *Polytrichum*.

**Pteridophytes:** General characteristics of pteridophytes. Structure, reproduction and life cycle of *Lycopodium*.

**Gymnosperms:** General characteristics of gymnosperms and its importance. Structure, reproduction and life cycle of *Cycas*.

#### Unit III Plant Physiology

Absorption of water. Photosynthesis – Light and dark reaction (C<sub>3</sub> cycle only). Respiration. Plant movements.

#### Unit IV Mushroom Technology

Mushroom: Introduction, nutritive value and importance of mushrooms. Cultivation of Oyster mushroom - spawn preparation, preservation of mushrooms, and mushrooms recipes.

## Unit V      Plant Biotechnology

Plant tissue culture - basic principles, M.S. medium preparation, Callus culture and regeneration

### Books:

1. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. (1996). *Introductory Mycology* (4th edition). John Wiley and Sons (Asia), Singapore.
2. Alice, D., Muthusamy and Yesuraja, M. (1999). *Mushroom Culture*. Agricultural College, Research Institute Publications, Madurai.
3. Dubey, R.C. (2013). *A Textbook of Biotechnology*. S. Chand & Company Ltd., New Delhi.
4. Ganguly A.K. (1971). *General Botany*, Vol. I. The New Book Stall, Calcutta.
5. Gupta, P.K. (1994). *Elements of Biotechnology*. Restogi Publications, Meerut.
6. Ignacimuthu, S. (1997). *Plant Biotechnology*. Oxford & IBM Publishing Co., New Delhi.
7. Jain, V.K. (1990). *Fundamentals of Plant Physiology*. S. Chand & Co., New Delhi.
8. Kalyan Kumar De. (1997). *Plant Tissue culture*. New central Book Agency, Calcutta.
9. Kumar, H.D. (1991). *A Textbook on Biotechnology*. East west press, New Delhi.
10. Marimuthu, T. (1991). *Oyster Mushroom*. Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
11. Nita Bhal (2000). *Handbook on Mushrooms Vol. I and II* (2nd Ed.). Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
12. Noggle, R. and Fritz (1989). *Introductory Plant Physiology*. Prentice Hall of India.
13. Pandey, B.P. (2001). *College Botany Vol. I: Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta*. S. Chand & Company Ltd., New Delhi.
14. Pandey, S.N. (1991). *Plant Physiology*. Vikas Publishing House (P) Ltd., New Delhi.
15. Parihar, P. (2014). *A Textbook of Biotechnology*. Argobios Publications, Jodhpur
16. Pathak, V.N. and Yadav, N. (1998). *Mushroom Production and Processing Technology*. Agrobios, Jodhpur.
17. Rao K.N. Krishnamurthy K.V. and Rao G. (1979). *Ancillary Botany*. Viswanathan Pvt. Ltd., Chennai.
18. Sethi, I.K. and Walia, S.K. (2011). *Text book of Fungi & Their Allies*. MacMillan Publishers Pvt. Ltd., Delhi.
19. Suman B.C. and Sharma V.P. (1990). *Mushroom Cultivation and Uses*. Agrobios (India), Jodhpur. Tripathi, D.P. 2005. *Mushroom Cultivation*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

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## **First Allied Course II (Biology- Practical)**

### **PLANT DIVERSITY AND PHYSIOLOGY, MUSHROOM TECHNOLOGY AND PLANT BIOTECHNOLOGY & MORPHOLOGY, TAXONOMY, ANATOMY, EMBRYOLOGY AND HORTICULTURE**

1. Micro preparations of algae, fungi, bryophytes, pteridophytes, gymnosperms and demonstrating their description and identity included in the syllabus.
2. Micro preparations of stem, root and leaf of dicot and their identification.
3. Micro preparation of anther and observation of ovules (permanent slides).
4. Description of the plants and salient features of the families included in the syllabus.
5. Dissection flower and construction of floral diagram.
6. Comment on simple experimental setups in plant physiology included in the syllabus.
7. Propagation techniques.

### **Biology of Invertebrates & Chordates and Commercial Zoology**

#### **Objectives:**

To impart training on the techniques of dissecting the animals and to understand the various systems present in their body. To demonstrate the technique of in silico dissection of invertebrate and chordate animals. To make them aware of commercially important animals.

#### **Dissection:**

Cockroach and Fish: Digestive system and Nervous system/Demo/CD/ Virtual.

#### **Mountings/Slide:**

Mouth parts - Honey bee, Cockroach, Mosquito, (slides).

Earthworm –Body setae (slide).

Identification of Cycloid, Placoid and Ctenoid scales – (slides).

#### **Spotters**

**Invertebrates:** Amoeba, Paramecium, Entamoeba, Euglena, Sycon, Leucosolenia, Aurelia, Obelia, Planaria, Liver fluke, Tapeworm, Neries, Leech, Crab, Cockroach, Honey bee, Mosquito, Scorpion, Scolopendra, freshwater mussel, Octopus, Sepia, Oyster, Star fish, Sea urchin, Sea cucumber.

**Chordates:** Shark, Teleost, Frog, Ichthyophis, Calotes, Chameleon, Cobra, Viper, Pigeon, Parrot, Rat and Rabbit.

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## Core Course II

### ECOLOGY

#### General objectives

- To understand the ecological principles governing the environment.
- To understand and appreciate the interrelation existing between Abiotic and Biotic environment.

#### Unit I

Importance and scope of ecology – Ecosystem and its components – Abiotic factors – climate – temperature – light – humidity – edaphic - wind. Biotic factors and its interactions – inter-specific and intra-specific relationships.

#### Unit II

Ecosystems – Characteristics of ecosystems- Structure of the ecosystem food chain – herbivorous and detritus food chains - trophic levels; and food web - Function of ecosystem- Energy Pyramid, Energy flow in an ecosystem- productivity – biogeochemical cycles – Carbon, nitrogen, phosphorus.

#### Unit III

Population Ecology: Definition, Characteristics of Population: Density- Natality – Mortality – Age distribution – Growth - Population Equilibrium – Biotic potential – Carrying capacity – Dispersal – Dispersion – Population fluctuations and Population regulation.

#### Unit IV

Community Ecology: Characteristics of a Community; Physical structure – stratification, Biological characteristics – Species richness, diversity indices, abundance, dominance, frequency, Importance value, guild, niche, Ecotone, Edge effect, Ecological equivalents, Ecotypes, and Ecophenes; Ecological succession.

#### Unit V

Habitat Ecology: **Freshwater** – lentic, Swamp, wetlands, lotic – streams, rivers; **Marine** – neritic, pelagic, benthic, shores - estuarine, lagoons, mangrove, intertidal, tidal flats, seagrass bed, coral bed; **Terrestrial** habitat - Tundra, Forest, Desert and mountain biomes.

#### References

1. Agarwal, K. C., Environmental Biology, Agro Botanica, 1999.

2. Beck, W.S., Liem, K. F. and Simpson, G. G., Life – Introduction to Biology, Harper Collins Publications,1991.
3. Chapman, J. L. Reiss, M. J., Ecology – Principles and Applications, Cambridge University Press,1995.
4. Dash, M. C., Fundamentals of Ecology, Tata McGraw-Hill Publishing Co.,2001.
5. Kormondy, E. J., Concepts of Ecology, Prentice Hall of India,1996.
6. Odum, E.P., Fundamentals of Ecology, W.B. Saunders Co.,1971.
7. Ricklefs, R. E. And Miller, Ecology, W.H. Freeman and Co.,1999.
8. Raven.P.H. and Johnson, G.B., Biology, Wm. C. Brown Publications,1995.
9. Smith, T.M. and Smith, R.L., Elements of Ecology, Pearson Education,2007.
10. Taylor, T.J., Green, N.P.O. and Stout, G.W., Biological Science, Soper, R (ed.). Cambridge University Press,1998.
11. Wallace, R.A., Biology-The World of Life, Harper Collins Publications,1990.

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## First Allied Course III

### Biology II

#### Biology of Invertebrates and Chordates

##### Objectives:

To enlighten the students about the diverse forms of Invertebrate and Vertebrate animals present around us. To help our students to distinguish various animals and to know the evolutionary sequence of them.

##### UNIT I

General characteristics and classification of Nine Invertebrate Major Phyla up to Class level with examples. Type study: Protozoa: *Paramecium-Paramecium caudatum*; Porifera: Canal System in Sponges; Coelenterata: *Aurelia-Aurelia aurita*; Platyhelminthes: Liver fluke *Fasciola hepatica*; Nematelminthes: Parasitic adaptations in helminthes.

##### UNIT II

Type study: Annelida: Earthworm- *Lampitoma mauritii*; Arthropoda: Mouthparts and their modifications in Insects and Insect Pests of Crops (Paddy, Cotton, Coconut and Brinjal) and their management, Mollusca: *Pila*; Echinodermata: Water vascular system in Echinoderms.

##### UNIT III

General characteristics and classification of Chordates up to class level with examples. Type study: Pisces: Shark- *Scoliodon sorrakowah*. (except Endoskeleton); General essay: Migration in fishes.

##### UNIT IV

Type study: Amphibia: Frog- *Rana hexadactyla*, (except Endoskeleton); Reptiles: Poisonous and non- poisonous snakes in India; Aves: Pigeon - *Columba livia*. (Except Endoskeleton).

##### UNIT V

Type study: Mammals: Rabbit - *Oryctolagus cuniculus*. (Except Endoskeleton); General essay: Prototherian mammals, Metatherian mammals.

##### Text book.

1. Manual of Zoology (Invertebrata), Ekambaranatha Ayyar and T.N. Ananatha Krishnan (1992) Part-I & II Vishwanathan Pvt.Ltd.
2. Manual of Zoology (Vertebrata), Ekambaranatha Ayyar and T.N. Ananatha Krishnan (1992) Part-I & II Vishwanathan Pvt.Ltd.

##### References

1. Jordon EL and Verma P.S. (1995), Invertebrate Zoology, S Chand and Co, Zoology Delhi.
2. Kotpal, R.L, S.K. Agarwal, R.P.R. Khetarpal 1998. Modern text Book of Zoology. Rastogi Publication,
3. N. Arumugam, Invertebrata, Saras Publication, Nagercoil.

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**Core Course III**  
**ENVIRONMENTAL POLLUTION**

**General objectives**

- To understand the various forms of pollution their causes, effects and control.
- To acquire the knowledge of chemical reactions taking places in the environment

**Unit I**

Air pollution – Introduction – classification of air pollutants – primary and secondary, particulate and gaseous; Sources of air pollution – vehicles, industries – Cement plant, Limestone mining, volcanoes, dust storm; Effects of air pollution on – Man – Plants and Materials; green house effect – global warming – ozone depletion; Bhopal Gas disaster; Acid rain.

**Unit II**

Water Pollution: Introduction – sources – point and non- point ; Oxygen demanding waste, industrial effluents and domestic sewage and its effects; Eutrophication, Bioaccumulation, Bioconcentration, Biomagnification, Ground water – Surface water – lake water – sea water; Water Quality standards.

**Unit III**

Soil pollution: Sources of soil pollution - Effects of soil pollution; Pesticides in soil environment and their effects; Sediments; Biological magnification, pollution through mining; Control of soil pollution.

**Unit IV**

Thermal pollution – Introduction; sources of thermal pollution – Nuclear power plants, Hydro electrical power plants, coal power plants; Effects of thermal pollution. Oil pollution – sources and effects – oil pollution and marine biota; flora and fauna, bio indicators.

**Unit V**

Noise pollution: Sources – natural and manmade; Characteristics of sound – frequency, intensity, time of exposure, Intermittence; Effects of noise pollution – Man and materials; Control of noise pollution. Radiation pollution- radioisotopes, sources and effects.

**References**

1. De, A. K., Environmental Chemistry, Wiley Eastern Ltd., New Delhi,1987.
2. Kannan, K., Fundamentals of Environmental Pollution, S. Chand and Co., Delhi,1991.
3. Rao, M. N and Rao, H.V.N., Air Pollution, Tata McGraw HillPublishing Co. Ltd., New Delhi, 1989.
4. Sharma, B,K and Kaur, H., Soil and Noise Pollution, Goel Publishing House, Meerut,1994.
5. Sharma, B,K and Kaur, H., Water Pollution, Goyal Publishing House, Meerut,1994.
6. Brady, N.C. The nature and properties of Soils, Tenth Edition. Mac Millan Publishing Co., New York, 1990.

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## **Core Practical II**

### **Environmental Resource and Management**

#### **General objectives**

- To make the students understand the importance of ecosystem services
  - To identify the factors affected by conflicts and the needs for protecting the biological resources
1. Identification of rocks and minerals on the basis of physical characters.
  2. Preparation of field report based on the survey of local flora.
  3. Study of diversity of plants from maps.
  4. Preparation of field report based on the visit to a Wild Life Sanctuary/National Park/Zoo/Biosphere Reserve
  5. Demonstration of use of solar devices, photo-cells, wind-mills.
  6. Demonstration of Biogas plant
  7. Study of local sources and types of industrial waste.
  8. Preparation of report on the effect of local industrial activities on human health.
  9. Visit to Local Polluted Site –Observations and Remedial Measures

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## **Second Allied Course I**

### **ChemistryI**

#### **OBJECTIVES**

- To understand the various theories of coordination chemistry.
- To study the various concepts of resonance and halogen compounds.
- To study the properties of aromatic compounds and organic reactions.
- To learn the concepts of solid state chemistry.

#### **UNIT I COORDINATION CHEMISTRY AND INDUSTRIAL CHEMISTRY**

- 1.1 Coordination Chemistry: Nomenclature – Werner’s, sidgwick and Pauling’s theories. Chelation - industrial importance of EDTA, Biological role of heamoglobin and Chrophyll.
- 1.2 Industrial Chemistry: Fuel gases – Water gas, producer gas, LPG gas, Gobar gas and natural gas. Fertilizers – NPK and mixed Fertilizers- soaps and detergents.

#### **UNIT- II ELECTRON DISPLACEMENT EFFECTS AND HALOGEN COMPOUNDS**

- 2.1 Polar effects: Inductive effect – Relative Strength of Aliphatic monocarbocyclic acid and aliphatic amines. Resonance – Condition for resonance. Consequences of resonance – resonance of energy. Basic property of aniline and acidic property of phenol. Hyperconjugation – Heat of hydrogenation - Bond length and dipole moment. Steric effect.
- 2.2 Halogen containing compounds: Important chlorohydrocarbons used as solvents. Pesticides – Dichloromethane, chloroform, carbon tetrachloride, DDT and BHC Types of solvents: - Polar, Non polar.

#### **Unit III AROMATIC COMPOUNDS AND ORGANIC REACTIONS**

- 3.1 Aromatic compounds: Structure, stability resonance and aromaticity of benzene. Substitution reaction: Nitration, Halogenations, Alkylation. Naphthalene – Isolation, properties and uses.
- 3.2 Organic reaction: Biuret, Decarboxylation, Benzoin, Perkin, Cannizaro, Claisen and Haloform reactions
- 3.3 Chemotherapy: Explanation with two examples each for analgesics, antibacterial, anti-inflammatory, antibiotics, antiseptic and disinfectant, anesthetics local and general (Structures not necessary)

## **UNIT IV SOLID STATE, ENERGETICS AND PHASE RULE**

- 4.1 Solid state: Typical crystal lattices - unit cell, elements of symmetry, Bragg's equation, Weiss Indices, Miller indices, simple body centered and face centered lattices
- 4.2 Energetics: First law of thermodynamics – state and path function – need for the second law – Carnot's cycle and thermo- dynamic scale of temperature, spontaneous and Non – spontaneous processes – entropy – Gibbs free energy.
- 4.3 Phase rule: Phase, component, degree of Freedom, phase rule definitions - one component system– water system.

## **UNIT V: CHEMICAL EQUILIBRIUM AND CHEMICAL KINETICS**

- 5.1 Chemical equilibrium: Criteria of homogeneous and heterogeneous equilibria, -decomposition of HI,  $\text{N}_2\text{O}_4$ ,  $\text{CaCO}_3 + \text{Pd}_5$ .
- 5.2 Chemical Kinetics: Order of reaction and their determinations - activation energy, effects of temperature on reaction rate.

## **REFERENCES**

1. Gopalan R, Text Book of Inorganic Chemistry, 2<sup>nd</sup> Edition, Hyderabad, Universities Press, (India), 2012.
2. Morrison R.T. and Boyd R.N., Bhattacharjee S. K. Organic Chemistry (7<sup>th</sup> edition), Pearson India, (2011)
3. Puri B.R., Sharma L.R. and Pathania M.S. (2013), Principles of Physical Chemistry, (35<sup>th</sup> edition), New Delhi: ShobanLalNagin Chand and Co.

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## ALLIED COURSE II

### PRACTICAL

#### VOLUMETRIC AND ORGANIC QUANTITATIVE ANALYSIS

##### I Volumetric Analysis

###### 1. Acidimetry and alkalimetry

(a) Strong acid VS strong base (b) Weak acid VS strong base (c) Determination of hardness of water.

###### 2. Permanganometry

(a) Estimation of ferrous sulphate (b) Estimation of oxalic acid

###### 3. Iodometry

(a) Estimation of potassium dichromate (b) Estimation of potassium permanganate

##### II. Organic Analysis

Analyse the following organic Compounds.

1. Carbohydrate, 2. Amide, 3. Aldehyde, 4. Ketone, 5. Acid & 6. Amine

The students may be trained to perform the specific reactions like tests for elements (nitrogen only), aliphatic or aromatic, saturated or unsaturated and functional group present and record their observations.

##### REFERENCES

1. R. Gopalan, Elements of analytical chemistry, S. Chand, New Delhi, 2000.
2. N. S. Gnanapragasam and G. Ramamurthy, Organic Chemistry lab manual, S. Viswanathan and Co. Pvt. Ltd. Chennai-1998

##### Note: Scheme for Practical Evaluation.

##### Organic Qualitative Analysis - 20

##### Volumetric Estimation -35

Record - 5

Internal Assessment - 40

Total : 100

##### Volumetric Analysis :35

Procedure 5 marks

Results

< 2 % - 30 marks

2-3 % -20 marks  
3-4 % - 10 marks  
> 4 % - 5 marks

**Organic Qualitative Analysis :20**

Identification of Nitrogen - 4 marks  
Saturated and unsaturated - 3 marks  
Aliphatic or Aromatic - 3 marks  
Preliminary reactions with  
Procedure - 5 marks  
Functional group identified  
Correctly - 5 marks  
Total: 20

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## **Core Course IV**

### **NATURAL RESOURCES**

#### **General objectives**

- This course explains about the natural resources which influences quality of life, and the functioning of natural environment.
- The course is designed to understand the importance of resources in the nature.

#### **UNIT I : Water Resources**

Characteristics of Water Bodies, Utility of Surface and Ground Water, Fresh Water and Marine Water Resources. Water Storage Systems and their Importance. Watershed Management - Aquifers, Rain Water Harvesting System.

#### **UNIT II : Land Resources**

Introduction to Land Resources and their Types. Land Degradation and Soil Erosion - Causes and Impacts - Desertification, Deforestation, Mineral Resources: Minerals on the Geosphere, Types of Minerals, Mining - Metal and Non - Metal Resources, Exploitation of Mineral Resources, Use of Mineral Resources.

#### **UNIT III : Biological Resources**

Forest Types and their Resources, Carbon Sequestration, Use and Over-Exploitation – Timber and their Resources, Effects on Forest and Tribal People – Social and Cultural Forest. Agricultural resources and practices, Green revolution, White revolution and Blue revolution. Livestock Resource.

#### **Unit IV Non – Renewable Energy Resources**

Fundamentals of energy and measurements: Types – fossil fuels :coal, oil, natural gas,– Non-fossil fuels: nuclear energy, Indian Energy Scenario

#### **Unit V Renewable Energy sources**

Sources and applications of Solar, Wind, Biomass, Hydropower, Tidal, waves and Ocean thermal energy conversion system, Geothermal energy and gas hydrates. Bio hydrogen as a source of energy.

#### **References**

1. Ecology of Natural Resources, FerancoisRamade (1991), John Wiley.

2. Text book of Environmental Studies, EranchBharucha (2005), Universities Press.
3. Environmental Studies, Kumarasamy K, Alagappa Moses A and Vasanthi M (2004), Bharathidasan University Publishers.
4. Environmental Science and Technology, Stanley E. Manahan (2007), Taylor & Francis, CRC Press.
5. Instant notes Ecology, Aulay Mackenzie, Andy S.Ball and Sonia R.Virdee (2002), Bios Scientific Pub. Ltd.,
6. Environmental Science, Physical Principles and Application, Egbert Boeker and rienk van Gondelle (2001), John Wiley & Sons.
7. Environmental Science, Santra, S.C (2005), New Central Book Agency (P) Ltd.,
8. Forest Economics and Management, Sharma, L.C (1998), M/S Bishen Singh Mahendrapal Singh, Dehradun.
9. G.D. Rai, Non Conventional Energy Sources, Khanna Publishers, New Delhi,1999.
10. R.K. Rajput, Non Conventional Energy Sources and Utilisation, S.Chand& Company Ltd., 2012.
11. Twidell, J.W. and Weir, A., Renewable Energy Sources, EFNSpon Ltd.,1986.
12. B.H.Khan, Non-Conventional Energy Resources, Tata McGraw Hill, 2nd Edn,2009.
13. Bent Sørensen, Renewable Energy Conversion, Transmission and Storage, Elsevier Inc, 2007.
14. Demirel and Yaşar, Energy-Production, Conversion, Storage, Conservation, and Coupling, Springer Link,2012.

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## **Second Allied Course III**

### **Chemistry II**

#### **OBJECTIVES**

- To learn the basics of nuclear chemistry and metallic bond.
- To understand the properties and applications of carbohydrates, amino acids and proteins.
- To study the basic concepts of polymers, heterocyclic compounds and stereoisomerism.

#### **UNIT I : NUCLEAR CHEMISTRY AND METALLIC BOND**

- 1.1 Nuclear Chemistry : Fundamental particles of nucleus- isotopes, isobars, isotones and isomers – differences between chemical reactions and nuclear reactions, nuclear fusion and fission- radioactive series.
- 1.2 Metallic bond : Electron gas, Pauling and band theories, semiconductors – intrinsic, extrinsic n-type and p-type semi conductors.
- 1.3 Compounds of sulphur and sodium thiosulphate

#### **UNIT II: CARBOHYDRATES, AMINOACIDS AND PROTEINS**

- 2.1 Carbohydrates: classification – glucose and fructose – preparation and properties –structure of glucose – Fischer and Haworth cyclic structures.
- 2.2 Amino acids and proteins : Amino acids – Classification based on structure. Essential and non – essentials amino acids – preparation, properties and uses – peptides (elementary treatment only) – proteins – Classification based on physical properties and biological functions. Structure of proteins – primary and secondary (elementary treatment).

#### **UNIT III: POLYMERS, HETEROCYCLIC COMPOUND AND STEREOISOMERISM**

- 3.1. Synthetic polymers: preparation, properties and uses of teflon, epoxy resins, polyester resin.
- 3.2 Heterocyclic compounds: Furan, pyrrole and pyridine – preparation, properties and uses – basic properties of pyridine and pyrrole.
- 3.3 Stereoisomerism: Optical isomerism – Lactic and tartaric acid – racemic mixture and resolution. Geometrical isomerism – maleic and fumaric acids.

#### **UNIT IV: SURFACE AND PHOTO CHEMISTRY**

- 4.1 Surface Chemistry: Emulsions, gels – preparation, properties - Electrophoresis and applications, chromatography – Column, paper and thin layer Chromatography.
- 4.2 Photochemistry : Laws of photochemistry and applications.

## **UNIT V: ELECTROCHEMISTRY, pH AND BUFFER**

- 5.1 Electrochemistry: Specific and equivalent conductivity – their determination – effect of dilution on conductivity. Ostwald's Dilution law, Kohlrausch law, conductivity measurements, and conductometric titrations.
- 5.2 pH and buffer: Importance of pH and buffers – pH determination by colorimetric and electrometric methods.

### **REFERENCES**

1. B.R. Puri, L.R. Sharma, K.C. Kalia, 'Principles of Inorganic Chemistry', 21st edition, Vallabh Publications, 2004-2005.
2. Bahl, B.S. and Bahl, A., Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (2010)
3. Puri B.R., Sharma L.R. and Pathania M.S. (2013), Principles of Physical Chemistry, (35th edition), New Delhi: ShobanLalNagin Chand and Co.

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## **Core Course V**

### **ENVIRONMENTAL MICROBIOLOGY AND BIOTECHNOLOGY**

#### **General objectives**

- To understand the harmful and useful microbes in the Environment.
- To apply the Microbial Biotechnology as a tool for Bioremediation.

#### **Unit I**

History and scope of microbiology – Ultra structure of Prokaryotic and Eukaryotic cells, general structure and nutritional classification of bacteria, virus, fungi, yeast and algae, Growth and reproduction of bacteria and fungi.

#### **Unit II :Geomicrobiology**

Distribution of microorganisms in soil - Factors influencing the soil microflora – Role of microorganisms in soil fertility - Interactions among microorganisms: Mutualisms, commensalism, competition, amensalism, parasitism, predation - Interactions between microbes and plants: Rhizosphere, phyllosphere, mycorrhizae. Microbes in Biogeochemical cycles: Carbon cycle - Role of microbes in Carbon cycle - Nitrogen cycle - Mechanism of biological nitrogen fixation - Ammonification, Nitrification, Denitrification – Role of microbes in Phosphorous cycle

#### **Unit III : Microbes in Air and Water**

Microbial air pollutants – Bioaerosols, Aero allergens - Airborne diseases, Symptoms and preventive measures – Microbes involved in waterborne diseases - Assessment of microbiological quality of water - MPN technique and Biological Oxygen Demand.

#### **Unit IV**

Enzymes used in recombinant DNA technology. Steps involved in rDNA technology, Genomic and cDNA libraries. Cloning and expression vectors - plasmids, bacteriophage, phagmids, cosmids. Molecular tools and methods – Electrophoresis and PCR.

#### **UNIT V : Environmental Biotechnology**

Ecological Restoration: Wastewater treatment: Anaerobic and aerobic process, Methanogenesis, Bioreactors. immobilization techniques - Bioremediation: Biostimulation and Bioaugmentation, Phytoremediation. Biofertilizers – Biopesticides – Biofuels – Biomining. Genetically Modified organisms - merits and demerits.

## References

1. Atlas, R. M. and Bartha, R., Microbial Ecology – Fundamentals and Applications, Benjamin/Cummings Science Publishing, 1998.
2. Baker, K. H. and Herson, D. S.,
3. Bioremediation, McGraw-Hill Inc.,1994.Bitton, G., Wastewater Microbiology, Wiley-Liss Inc.,1994.
4. Mitchel, R., (ed.) Environmental Microbiology, Wiley-Liss Inc., 1992.
5. Pelczar, M. J., Chan, E. C. S. and Krieg, N. R., Microbiology – Concepts and Applications, McGraw-Hill Book Co., 1993.
6. Murugesan, A.G. and Rajakumari, C., Environmental Science and Biotechnology, MJP Publishers, Chennai, 2006.
7. Scrogg, A., Environmental Biotechnology, Second edition, Oxford University Press, New York, 2005.
8. Gupta, P.K., Elements of Biotechnology, Rastogi Publications, Meerut, 2007.
9. Abbasi, S.A. and Ramasami, E., Biotechnological Methods of Pollution Control, University Press, Hyderabad, 1999.
10. Gupta, H.C.L., Siddiqui, A.U. and Parihar, A., Biopest Management (Entomopathogenic Nematodes, Microbes & Bioagents), Agrotech Publishing Academy, Udaipur, 2010.
11. Somani, L.L., Shilpkar, P. And Shilpkar, D., Biofertilizers – Commercial Production Technology & Quality Control, Agrotech Publishing Academy, Udaipur, 2011.
12. Jemba, P.K., Environmental Microbiology, Science Publishers, New Hampshire, 2004.
13. Srivastava, M.L., Basic Environmental Microbiology, Manohar Books, New Delhi, 2003.
14. Raina, M., Pepper, I. and Gerba, C., Environmental Microbiology, Academic Press, New York,2006.

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## **Core Course VI**

### **ENVIRONMENTAL TOXICOLOGY**

#### **General objectives**

- To impart the knowledge of principles and scope of toxicology.
- To gain the knowledge about the factors influence the toxicity

#### **UNIT I : Basic concepts of Toxicology**

Principles of Toxicology - Scope of Toxicology - Dose response relationship, concept of LC<sub>50</sub>, LD<sub>50</sub> and ED<sub>50</sub> - Types of toxic substances: Degradable and non-degradable - Acute and chronic toxicity – Synergism and Antagonism - Sigmoid relationships - Chemical and biological factors influencing toxicity

#### **UNIT II : Toxicants in the Environment**

Toxic substances in the environment, their sources and entry routes - exposure of toxicants by air, water, soil and diet. Bioaccumulation, biomagnifications and biotransformation of toxic materials in food chain.

#### **UNIT III : Dose-Response Relationships**

Graded response - Quantal response, Time action curves - Threshold limit value (TLV) - Margin of safety - Toxicity curves. Physiological and metabolic effects on flora and fauna.

#### **UNIT IV : Toxicity Testing**

Methods used to assess toxicity, Bioassay – types, characteristics, significance and Limitations. Bioassay methods using plant, animal and microbial models - Teratogenicity, carcinogenicity and mutagenicity

#### **UNIT V : Organ toxicity**

Hepatotoxicity: Common examples of hepatotoxicants, Nephrotoxicity: Common examples of nephrotoxicants, Pulmonary toxicity: Common examples of pulmonary toxicants, Neurotoxicity: Common examples of neurotoxicants.

#### **References**

1. Casseret LJ and Doull J (1982) Toxicology. The Basic Science of Poisons. Macmillan Publishers, New York.
2. Curtis D. Klaassen, John B. Watkins (2015) Casarett&Doull's Essentials of Toxicology, Third Edition, McGraw Hill Professional.

3. David Woolley, Adam Woolley (2008) A Guide to Practical Toxicology: Evaluation, Prediction, and Risk, Second Edition, CRC Press, USA.
4. Donald W. Sparling (2017) Basics of Ecotoxicology, CRC Press/Taylor & Francis Group, USA.
5. Kaiden Higgins (2017) Environmental Toxicology, Larsen and Keller Education, USA.
6. Shaw I and Chadwick J (1998) Principles of Environmental Toxicology, CRC Press, USA.
7. Stephen M. Roberts, Robert C. James, Phillip L. Williams (2015) Principles of Toxicology: Environmental and Industrial Applications, John Wiley & Sons, New Jersey, USA.
8. William Hughes (1996) Essentials of Environmental Toxicology, Taylor & Francis, USA.

### **Web references**

- [www.fss.txstate.edu/ehsrm/safetymanual/chemical/toxchems.htm](http://www.fss.txstate.edu/ehsrm/safetymanual/chemical/toxchems.htm)
- <https://www.ncbi.nlm.nih.gov/pubmed/2671129>
- <https://onlinelibrary.wiley.com/doi/10.1002/0471646776.ch27/summary>
- <https://www.sciencedirect.com/topics/pharmacology-toxicology/pesticide-toxicology>
- <https://www.sciencedirect.com/topics/earth-and-planetary-sciences/biomagnification>
- [pubs.acs.org/doi/abs/10.1021/bk-1984-0239.ch004](https://pubs.acs.org/doi/abs/10.1021/bk-1984-0239.ch004)
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3917169/>
- [www.rroj.com/.../principles-involved-in-bioassay-by-different-methods-a-minireview](http://www.rroj.com/.../principles-involved-in-bioassay-by-different-methods-a-minireview)
- <https://www.sciencedirect.com/topics/pharmacology-toxicology-and.../organ-toxicity>

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## **Core Course VII**

### **SUSTAINABLE DEVELOPMENT**

#### **General objectives**

- To understand the concepts of sustainable development.
- To know the global issues and initiatives taken for sustainable development.

#### **Unit I**

Sustainable Development: Definitions and Goals, global energy policies and resources; Green movements; Green and Eco philosophy; Ecological-footprints; corporate response to sustainable development - Brundtland Commission; Human Development Index; Living Plant Index

#### **Unit II**

National policy statement of environment and development; National Environment Policy 2006: an overview; Legislative framework of environmental protection, historical perspectives and Indian constitutional provisions. Environmental Impact Assessment, Environmental Audit, Urban and Rural planning. Remote sensing and GIS applications.

#### **Unit III Environmental Acts and Rules**

Environmental Acts and rules - Water (Prevention and control of Pollution Act, 1974), Air (Prevention and control of Pollution Act, 1981), Environment (protection) Act 1986, International treaties on Environmental protection: Ramsar Convention, Montreal protocol, Kyoto protocol, Convention on International trade of endangered species.

#### **Unit IV : Biodiversity Management**

Protected Area, Current Practices in Conservation - In Situ Conservation and Ex Situ Conservation of Threatened Species - Cryopreservation, Gene Banks, Gene Pool and Species Conservation. National Parks and Sanctuaries. Common Flora and Fauna in India, The Biological Diversity Act, 2002, Agenda 21, Multilateral Treaties, Biodiversity Conventions. Patent Act - Intellectual Property Rights (IPR).

#### **Unit V : Environmental Education:**

Concepts, Principles and Characters of Environmental Education; Importance and history of Environmental Education; Global (UNEP, WII, CSE, IPCC, IUCN) and National (WWF- I, CPR Environmental Education Centre, Centre for Environmental Education) Environmental organizations – objectives and

activities, Major Environmental Activism Movements – Bishnoi, Chipko& Silent Valley. Environmental Ethics.

## **References**

1. Nick Hanley, Jainsan F. Shorgen and Ben White, Environmental Economics – In Theory and Practice, Macmillan India Ltd, New Delhi,1999.
2. Roger Perman, Yue Ma and James McGilvray, Natural Resources and Environmental Economics, II Edition, Addison Weley Longman Ltd, Singapore,1997.
3. John Bowers, Sustainability and Environmental Economics, Addison Weley Longman Ltd, Singapore,1997.
4. David W. Pearce and Kerry R Turner, Economics of Natural Resources and The Environment, The Johns Hopkins University Press, Baltimore,1999.
5. Uberoi, N. K, Environmental Management, Excel Book, New Delhi,2004.
6. Kerry R. Turner, David W. Pearce and Ian Bateman, Environmental Economics – An Elementary Introduction, The Johns Hopkins University Press, Baltimore,1993.

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## **Core Practical III**

### **Environmental Monitoring and Assessment**

#### **General objectives**

- To make understand the effects of pollutants on the environment.
  - To provide solutions for restoring the environment
1. Quantitative analysis of soil and water pH.
  2. Measurement soil temperature and moisture.
  3. Estimation of dissolved oxygen in the given water sample.
  4. Estimation of Kjeldahl Nitrogen and phosphorous in given water sample
  5. Determination of Total Dissolved Solids in given water sample
  6. Estimation of the Total Hardness given water sample
  7. Demonstration of the working of flame photometer/ AAS for detecting heavy metals.

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## **MAJOR BASED ELECTIVE I**

### **GLOBAL WARMING AND CLIMATE CHANGE**

#### **General objectives**

- To understand the main aspects of climate and how it is affected due to various anthropogenic activities.
- To impart the potential social, economic and environmental consequences of climate change and the actions plans involved in its mitigation.

#### **UNIT I : Climatology**

Definition, Types – Physical, Regional & Applied, Climate Classification – Empirical, Genetic & Applied. Geographical Classification – Tropical Zone, Temperate & Polar Zone. Koppen’s Climate Classification. World Classification Based on Climate Profile.

#### **UNIT II : Climate Change & Green House Gases**

Definition of Climate Change – Causes and Impacts of Climate Change, Green House Gases (Sources, Effects). Role of Oceans and Forests as Carbon Sinks, Stratospheric Ozone Shield and Ozone depletion. Effect of Climate Change on Weather and Climatic Patterns, Ice Caps, Glaciers, Agriculture, Biodiversity, Sea Level, Tourism.

#### **UNIT III : Global Warming**

Global Temperature, Influence of Green House Gases on Global Warming, Intergovernmental Panel on Climate Change (IPCC), Projections for Future Climate Change. Extreme Climate Events and Vulnerability

#### **UNIT IV : Mitigation Strategies**

Importance of Climate Mitigation, Strategies – Renewable Energy, Green Building, Energy Efficiency, Reducing Consumption, Low Carbon Development Sectors with High Mitigation Potential. Emission Trading & Carbon Credits.

#### **UNIT V : Action Plans on Climate Change**

National and International Action Plan, Policies, Protocols and Agreements. United Nation Framework Convention on Climate Change (UNFCCC) - The Kyoto Protocol. Montreal Protocol. Overview of Conference of Parties (CoP). Highlights of Key Issues for Future Climate Change Regime.

#### **References**

1. Climate Change and Biodiversity: Perspectives and Mitigation Strategies - PrabhaShastriRanade, (2008), ICFAI University press, M.Sc.Environmental Sciences-UD-2017-18 onwards Annexure No: 73A Page 36 of 43 SCAA Dated:03.07.2017
2. Environmental Science: Earth as a Living Planet. Botkin, Daniel B. and Keller, Edward A. (2007), 6th ed. John Wiley & Sons,USA.
3. Climate Change: A Multidisciplinary Approach. Burroughs, W.J. (2007), 2nd ed. Cambridge University Press. 2007.
4. The Global Environment in the Twenty-First Century -Prospects for International Co-operation. Chasek, P. S. (2004), Indian Reprint by Manas Publications, New Delhi.
5. Climate Change: Scenario, Strategies and Solutions. Claussen, E. ed. (2001), Arlington VA.
6. Climate Change-An Indian Perspective. Dash, S. K. (2007), Centre for Environment Education and Cambridge University Press Pvt. Ltd., New Delhi.
7. Earth Summit. Dodds, F. (ed.). (2002), A New Deal. Earthscan Publications Ltd., UK.
8. Environmental Science: A Study of Interrelationships. Enger, E.D. and Smith, B. F.(2006),11th ed. McGraw Hill Inc., USA. 2006.
9. Climate Change: Causes, Effects, Solutions. Hardy, John T. (2003),Wiley & Sons, USA.
10. Global Environmental Issues. Harris, F. (2004),Wiley & Sons, Inc., USA.
11. Global Warming: The Hard Science. Harvey L. D. D. (2000),NY: Prentice-Hall.IPCC, Emission Scenarios, Inter Governmental Panel on Climate Change, Cambridge University Press, 2000.
12. One Earth one Future: -Our Changing Global Environment, Silver C. S. and De Fries, R. S.(1991), East-West Press Edition.
13. Global Environmental Challenges -Transitions to a Sustainable World. Speth, J. C. (2004), Orient Longman Pvt. Ltd., New Delhi. UNEP.

#### **e- Resources**

- [climate.nasa.gov/](http://climate.nasa.gov/)
- [www.ucsusa.org](http://www.ucsusa.org)
- [www.eesi.org](http://www.eesi.org)
- [www.climate.gov](http://www.climate.gov)
- [www.renewableenergyworld.com](http://www.renewableenergyworld.com)

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## **Core Course VIII**

### **WASTE MANAGEMENT**

#### **General objectives**

- To impart the importance of wastemangement for better living
- To gain the knowledge on the waste treatment techniques for different kinds of wastes

#### **UNIT I : Municipal Solid Waste Management**

Municipal Solid Wastes – Source, Types, Collection and Transportation Methods, Waste Processing and Material Recovery, Effects of Municipal Solid Wastes on Environment. Disposal Methods (Landfill, Composting, Burning, Incineration, Pyrolysis, Anaerobic Digestion).

#### **UNIT II : Hazardous Waste Management**

Hazardous wastes: Characteristics, Classification of Hazardous Waste (Industrial, Hospital and Domestic) – Labeling and Handling of Hazardous Solid Wastes (Segregation, Recovery of Hazardous Waste Substances) - Hazardous Waste Disposal Techniques.

#### **UNIT III : Biomedical and Radioactive Waste Management**

Biomedical Wastes: Sources, Types of Biomedical Wastes, Impacts of Biomedical Wastes on Environment - Control Measures of Biomedical Wastes. Radioactive Wastes: Sources, Types, Effects, Control and Disposal Methods.

#### **UNIT IV : Plastic & e-waste Management**

Plastic Wastes: Sources, Types, Effects of Plastic Wastes on Environment, Control Measures of Plastic Wastes. E-wastes: Sources, Types of e-wastes – Impacts of e-wastes on Environment - Control measures of e-wastes.

#### **UNIT V : Waste to Energy**

4R concepts - Reduce, reuse, recycle and recover - Biological processing - Composting, anaerobic digestion, aerobic treatment - Waste- to- energy: Concept of energy recovery from waste; Refuse derived fuel (RDF); Different WTE processes: Combustion, pyrolysis, landfill gas (LFG) recovery; gasification.

#### **References**

1. Charles R. Rhyner, Leander J. Schwartz, Robert B. Wenger, Mary G. Kohrell (1995) Waste Management and Resource Recovery, CRC Press, USA.



2. CPHEEO (2010) Technical EIA Guidance Manual for Common Municipal Solid Waste Management Facilities.
3. Jayarama Reddy P (2011) Municipal Solid Waste Management: Processing - Energy Recovery - Global Examples, Book Syndicate.
4. Prasad MNV and Kaimin Shih (2016) Environmental Materials and Waste: Resource Recovery and Pollution Prevention, Academic Press, UK.
5. RameshaChandrappa, Jeff Brown, (2012). Solid Waste Management: Principles and Practice, Springer Science and Business Media Publishers.
6. Rao MN, Razia Sultana, Sri Harsha Kota, Anil Shah, NareshDavergave (2017) Solid and Hazardous Waste Management: Science and Engineering, Elsevier Inc, UK.
7. SudhaGoel (2017) Advances in Solid and Hazardous Waste Management, Springer International Publishing, Switzerland with Capital Publishing Company, New Delhi.
8. Thomas C. Kinnaman, Kenji Takeuchi (2014) Handbook on Waste Management, Edward Elgar Publishing, UK.

### **e-Resources**

- [www.cpmfg.com](http://www.cpmfg.com) Material Recovery Facility
- [apps.who.int/medicinedocs/en/d/Js4885e/8.3.html](http://apps.who.int/medicinedocs/en/d/Js4885e/8.3.html)
- <https://www.epa.gov/hw/learn-basics-hazardous-waste>
- [nptel.ac.in/courses/120108005/module9/lecture9.pdf](http://nptel.ac.in/courses/120108005/module9/lecture9.pdf)
- [gmch.gov.in/e-study/e%20lectures/.../Biomedical%20Waste%20Management.pdf](http://gmch.gov.in/e-study/e%20lectures/.../Biomedical%20Waste%20Management.pdf)
- <https://www.epa.gov/sites/production/files/2015-03/documents/000003ob.pdf>
- [www.irsn.fr/EN/publications/thematic/Documents/irsn\\_booklet\\_radioactive\\_waste.pdf](http://www.irsn.fr/EN/publications/thematic/Documents/irsn_booklet_radioactive_waste.pdf)
- <https://ehp.niehs.nih.gov/wp-content/uploads/124/6/ehp.124-A106.alt.pdf>
- <https://assets.publishing.service.gov.uk/...data/.../pb14130-energy-waste-201402.pdf>

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## **Core Course IX**

### **ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT**

#### **General objectives**

- To understand the significance of occupational health and industrial safety.
- To learn about the safety management system.

#### **Unit I**

Definition- need for good health- factors affecting health. Types of diseases (deficiency, infection, pollution diseases); Personal hygiene food (balanced diet): Food habits & cleanliness, food adulterants, avoiding smoking, drugs & alcohols.

#### **Unit II**

Public health: communicable diseases, mode of transmission (epidemic and endemic diseases). Management of hygiene in public places (railway stations, bus stands and other public places).

#### **Unit III**

Occupational health and safety: Occupational health and hazards-physical-chemical and biological; Occupational diseases- prevention and control.

#### **Unit IV**

Industrial safety and management techniques: Industrial safety standards and regulations; Accidents- definitions-prevention and control. Examples: Cement, Sugar, Distilleries and limestone mining

#### **Unit V**

Safety management system: concepts of safety management systems- EMS ISO 14000 and 14001 OSHA, Public Liability Insurance Act.

#### **References**

1. Scoot, R. M, Basic concepts of industrial hygiene, Lewis Publisher, New York,1997.
2. Diberardins L.J, Hand book of occupational safety and health, John Willey, New York,1998.
3. Park J.E. and Park, Preventive and social medicine, BHANOT Publisher,2015.
4. Schilling R.S.E, Occupational health practice, Buffer Worth, London,1973.
5. Khan M.A.O., John. P, Bederka. S, Survival in Toxic Environment, Academic Press, New York,1974.

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## **Core Practical IV**

### **Environmental Remediation and Restoration**

#### **General Objectives**

- To reduce the contamination by pollutants on the environment
  - To suggest alternative techniques to maintain the sustainable environment.
1. Collection, Processing and Storage of Effluent Samples
  2. Demonstration of composting techniques.
  3. Visit to sewage/effluent treatment plants.
  4. Anaerobic digestion of cattle waste.
  5. Study of soil microbial activity
  6. Demonstration of Biogas plant
  7. Techniques of vegetative propagation of forestry trees.
  8. Demonstration of soil conservation techniques.
  9. Demonstration of water conservation techniques.
  10. Preparation of report on Energy Plantation.
  11. Demonstration of use of solar devices, photo-cells, wind-mills.

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## **MAJOR BASED ELECTIVE II**

### **ECOTOURISM**

#### **General Objectives**

- This course introduces the students to the economic, cultural and environmental impacts of ecotourism.
- To aware of the different ecotourist spots and its activities.
- To understand ecotourism as a significant aspect of tourism in future.

#### **UNIT I : Introduction to Ecotourism**

Concepts of Tourism – Types of Tourism – Religious – Cultural – Heritage – Monumental – Adventure – Mass – Sustainable – Consumptive and Non-Consumptive Tourism. Ecotourism - Concepts, History and Origin, Objectives and Benefits. Factors affecting Ecotourism.

#### **UNIT II : Ecotourism Spots**

Places of interests of Ecotourism – Eco-circuit of the Eastern and Western Ghats, Himalayas, Coastal regions (India) – Infrastructural Facilities. Maintenance of Ecological Centers – Important Biosphere Reserves. Target group of Ecotourism.

#### **UNIT III : Ecotourism, Types and Conservation**

Types of Ecotourism - Rain forest – Mountain, Polar, Islands and Coasts – Wilderness –Total Quality Management (TQM) of Ecotourism Resorts, Knowledge, skills, attitude and commitment of ecotourism service providers. Biodiversity Conservation and Sustainable Ecotourism, Community Based Tourism for Conservation and Development. Conservation – Insitu and Exsitu (Sanctuaries, National Parks, Gene Banks, Seed Banks, Ova Bank)

#### **UNIT IV : Impact of Ecotourism**

Economic Impacts (Fiscal Impacts, Concept and Methods) – Types and Degree of Impacts from Ecotourism activities – Socio-cultural Impacts – Ecotourism related organization – Ecotourism Research-Disasters and Ecotourism-Role of ethics in ecotourism - Advantages and Disadvantages of Ecotourism- Eco-branding and Eco-labeling of Ecotourism Products - Marketing of Ecotourism, Ecotourism and Sustainable Development - Management Issues in Ecotourism, Ecotourism-based/related employment, Scope and areas of employment.

#### **UNIT V : Significance of Ecotourism**

Parambikulam Tiger Reserve, Kaziranga National Park, Ecotourism spots in Tamil Nadu (Ooty, Kodaikanal, Yelagiri, Yerkaud, Pachamalai). Gulf of Mannar, Point

Calimere, Vedanthangal Bird Sanctuary. A World Heritage Site in Assam, The Kabini River, Joke falls, Snow fall mountains in Kulumanali, Ganktok.

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- Facing the wild: ecotourism, conservation, and animal encounters, Bulbeck, C. (2005), London: Earthscan.
- Tourism, ecotourism, and protected areas. Ceballos-Lascurain, H. (1996), Gland: IUCN
- Ecotourism: Management and Assessment, Diamantis, D. (2004), London: Thomson.
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- Ecotourism, Page, S.J. and R.K. Dowling. (2002). New York: Prentice Hall.
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- <http://www.vecotourism.org/news/category/internet-technology/>
- <https://parasitesandvectors.biomedcentral.com/articles/10.1186/1756-3305-6-325>
- <http://media.unwto.org/press-release/2013-01-03/un-general-assembly-ecotourism-key-eradicating-poverty-and-protecting-envir>
- <http://sdt.unwto.org/content/ecotourism-and-protected-areas>
- <http://tourism.gov.in/eco-tourism>

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## **MAJOR BASED ELECTIVE III**

### **DISASTER MANAGEMENT**

#### **General Objectives**

- The course focuses on the reasons responsible for disaster, its impact on the environment and society.
- To impart the knowledge on the measures and steps to **minimise** or overcome the burden on the ecosystem.

#### **UNIT I : Introduction to Disasters**

Natural Disasters –Educative – Trends in Climatology, Meteorology and Hydrology. Seismic Activities. Changes in Coastal Zone, Coastal Erosion, Beach Protection. Coastal Erosion due to Natural and Manmade Structures.

#### **UNIT II : Types of Disasters – Natural**

Disasters – Nature and characteristics of Cyclones – Tornadoes – Avalanches – Flood –Drought – Volcanic – Earthquakes – Fire – Landslides – Causes and effects - Impact on Environment- Forecasting and Warning System – Disaster Profile of India.

Manmade disasters: Nuclear, chemical, fire explosion, accidents, bioweapons. Deforestation, monoculture, Building construction.

#### **UNIT III : Disaster Management**

Disaster Management Cycle- Predisaster Planning -Training of Disaster – Prone Areas – Prioritization – Regulations – Protection Measures during Disaster and Post Disaster. Relief Camp Organization — Disaster Training – Role of Information and Communication Technology, GPS, Remote Sensing and Geographic Information System in Disaster Management.

#### **UNIT - IV : Disaster Preparedness and Training**

Community Preparedness in Natural Disasters- Role of Information, Education, Communication and Training- Roles and Responsibilities of Different National and International Agencies and Government - NGO, Armed Forces, Paramilitary Forces, Community Based Organizations (CBO) - Army Training for Disaster Reduction –Role of Team and Co-Ordination -Training Needs.

#### **Unit V : Mitigation Strategies**

Disaster Mitigation – Emerging Trends in Disaster Management - UN Draft Resolution on Strengthening of Coordination of Humanitarian Emergency Assistance, International Decade for Natural Disaster Reduction (IDNDR), Policy for Disaster Reduction, Problems of Financing and Insurance. Training

for Emergency. Regulation/Guidelines for Disaster Tolerance Building Structures.

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1. Natural Hazards, Bryant Edwards (2005), Cambridge University Press, U.K.
2. Space Technology for Disaster management: A Remote Sensing & GIS Perspective, Roy, P.S. (2000), Indian Institute of Remote Sensing (NRSA), Dehradun.
3. Natural Disaster, Sharma, R.K. & Sharma, G. (2005), (ed) APH Publishing Corporation, New Delhi
4. Disaster Management : A disaster Manager's Handbook, Carter, N W. (1992), Asian Development Bank, Manila.
5. Earthquake : A Natural Disaster. GautamAshutosh (1994), Ashok Publishing House. New Delhi.
6. Natural Hazards and Disaster Management ; Vulnerability and Mitigation. R.B. Singh. (2006), Rawat Publications.
7. Early warning Systems for Natural Disaster Reduction. JochenZschau, Andreas N. Kuppers. (2003). Springer-Verlag, Berlin Heidelberg.
8. A Manual on Disaster Management. Dr. ParagDiwan. (2010). Pentagon Earth.

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- [ndma.gov.in/](https://ndma.gov.in/en/en) [HYPERLINK "https://ndma.gov.in/en/en"](https://ndma.gov.in/en/en) [HYPERLINK "https://ndma.gov.in/en/"](https://ndma.gov.in/en/)
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