



# **Savitribai Phule Pune University**

*(Formerly University of Pune)*

**Three Year B.Sc. Degree Program in Environmental Science**

**(Faculty of Science & Technology)**

**F.Y.B.Sc. (Environmental Science)**

**Choice Based Credit System Syllabus**

**To be implemented from Academic Year 2019-2020**

**Title of the Course: B. Sc. (Environmental Science)**

**Structure of the Course -**

1	Compulsory Course	Course code	Title of Paper	Marks Distribution I + E = T	Credits
		EVS-111	Fundamental of Environmental Biology	15 + 35 = 50	2 credits
		EVS-112	Fundamental of Environmental Chemistry & Physics	15 + 35 = 50	2 credits
		EVS-113	Environmental Science Practical Paper		1.5 credits
2	Compulsory Course	EVS-121	Fundamental of Environmental Geosciences	15 + 35 = 50	2 credits
		EVS-122	Fundamental of Environmental Pollution	15 + 35 = 50	2 credits
		EVS-123	Environmental Science Practical Paper		1.5 credits

## Paper - I, Semester I, EVS – 112

### Fundamentals of Environmental Chemistry (Total Lectures – 30 == 2 Credits)

Unit No.	Name of the Unit	Contents	No. of Lectures
1	Introduction	<ul style="list-style-type: none"> <li>• Definition and Scope of Environmental Chemistry.</li> <li>• Segments of Environment and various interactive reactions occurring between these segments.</li> <li>• Chemical Aspects of Bio-geo-chemical cycles</li> <li>• Green Chemistry</li> </ul>	06
2	Chemistry of Some Atmospheric Gases	<ul style="list-style-type: none"> <li>• Characteristic of the Chemical Reactions involved in atmosphere.</li> <li>• Pollutants in Atmosphere</li> <li>• Sulphur- Oxides Chemistry.</li> <li>• Nitrogen-Oxides Chemistry</li> <li>• Carbon Oxides Chemistry</li> <li>• Climate Change in Atmosphere</li> </ul>	06
3	Chemistry of some Heavy Metals	<ul style="list-style-type: none"> <li>• Chemistry of Pb, Hg, Cd and As</li> <li>• Physical and chemical properties</li> <li>• Behavior of these heavy metals and their compounds</li> <li>• Human exposure-absorption and influence</li> <li>• Prevention and Control measures of these heavy metals</li> <li>• Case studies related to above heavy metals</li> </ul>	06
4	Chemistry of Surfactants and chemicals in food	<ul style="list-style-type: none"> <li>• Soaps and Detergents, Need, Classification , Characteristic and Composition</li> <li>• Environmental Impacts and Toxicity of Soaps and Detergents</li> <li>• Cationic, Anionic and Non-anionic, modified detergents</li> <li>• Food Additives and Contaminants ( Preservatives, Flavoring and coloring agents)</li> <li>• Adulterants –Properties and their effects</li> </ul>	06
5	Environmental Analysis and Environmental Physics	<ul style="list-style-type: none"> <li>• Solution concentration (Normality, Molarity, Molality, ppm, Equivalent weight etc.)</li> <li>• Titrimetric methods.</li> <li>• Basic Principle and working of pH meter and conductivity meter.</li> <li>• Scope of Environmental Physics</li> <li>• Transport and Exchange of Heat</li> <li>• Mass and Energy in environment</li> <li>• Types of radiations in the Environment</li> <li>• Gibbs Energy Equation</li> </ul>	06

**Reference Books –**

- 1) Environmental Chemistry, A. K. De, New Age International Publishers, 7thEdtn.
- 2) Elements of Environmental Chemistry, H. V. Jadhav, Stosius Incorporated/Advent Books Division, 1992
- 3) Environmental Chemistry, H. Kaur, A Pragati Edtn., 2ndEdtn. (2007)
- 4) Environmental Chemistry, S. K. Banerjee, PHI Learning Pvt. Ltd., 2nd Edtn.
- 5) Forinash K.2010.Foundation of Environmental Physics, Island Press

## Paper - II, Semester I, EVS – 111

### Fundamentals of Environmental Biology (Total Lectures – 30 == 2 Credits)

Unit No.	Name of the Unit	Contents	No. of Lectures
1	Biology	<ul style="list-style-type: none"> <li>• Introduction to Biology, Branches, Scope and Importance in today's context from environmental point of view.</li> <li>• Charles Darwin's Voyage of HMS Beagle His theory of 'Survival of the Fittest'. Biological diversity of</li> <li>• India – Major genera, species, sub-species of flora and fauna. Major ecological types of India</li> </ul>	06
2	Origin of Life	<ul style="list-style-type: none"> <li>• The origin of Life; Evolution of Life through the geological time i.e. – Eras, Periods, Epochs;</li> <li>• Events of (Evolutionary) 'Explosions' and 'Mass Extinctions' &amp; Paleontological Evidences for these.</li> <li>• The current 'Mass Extinction' with reference to rate of extinction, factors responsible and possible remedies.</li> </ul>	06
3	Biogeography	<ul style="list-style-type: none"> <li>• A glimpse of the present day distribution of Life on Earth; The factors responsible –               <ol style="list-style-type: none"> <li>i) Geological - Continental Drift- Barriers and Bridges,</li> <li>ii) Climatic - Barriers and Bridges,</li> <li>iii) Evolutionary - Speciation etc.</li> </ol> </li> <li>• Biogeography – The meaning; Biographical profile of the world; The physical, microbial, floral and faunal characteristics of each Bio geographical zone.</li> </ul>	06
4	Taxonomy	<ul style="list-style-type: none"> <li>• Taxonomic Principles - aim, objectives, hierarchy, kingdoms.</li> <li>• History; Linnaeus system of classification; Bentham &amp; Hooker system of classification.</li> <li>• Components of systematic - characterization, classification, identification &amp; nomenclature.</li> <li>• The concept of species- morphological, biological, phylogenetic, ecological etc.</li> </ul>	06
5	Ecology and Bio-resources	<ul style="list-style-type: none"> <li>• Ecological Adaptations under various environmental conditions –               <ol style="list-style-type: none"> <li>i) In plants - hydrophytes, mesophytes, epiphytes, xerophytes &amp; halophytes</li> <li>ii) In animals - mimicry, vestigiality etc.</li> </ol> </li> <li>• Bio-resources---               <ol style="list-style-type: none"> <li>i) Forests- major types of the world &amp; India</li> <li>ii) Agricultural crops - major food plants of the world &amp; India</li> <li>iii) Livestock – major varieties of the world &amp; India</li> </ol> </li> </ul>	06

		iv) Fisheries resources - saline & fresh water • Significances / use of the Bioresources; Extraction of Bioresources by traditional & modern methods; Threat to local bioresources - overexploitation, habitat loss, invasive species etc.	
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### Reference Books –

- 1) 'A Textbook of Plant Ecology' Ambashta R.S. & Ambashta N.K (1999) CBS Publ. & Distributers, New Delhi
- 2) 'Ecology: Principles and Applications' Chapman J.L. & Reiss M.J. (1995) Cambridge University Press
- 3) 'Environmental Science: A Global Concern' Cunningham W.P. & Saigo S.W. (1997) WCB, McGraw Hill
- 4) 'Elements of Ecology' Sharma P.D. Rastogi Publication
- 5) 'Environmental Science' Tyler M.G. Jr. (1997) Wadsworth Publ. Co.
- 6) 'Environmental Studies' Benny Joseph (2005) Tata McGraw Hill Publ. Co. Ltd.
- 7) 'Patterns in the Living World' – Biology-an Environmental approach, John Murray, London
- 8) 'Diversity Among Living Things' Biology-an Environmental approach, John Murray, London
- 9) 'Paleobotany and the Evolution of Plants' Wilson N. Stewart (1983) Cambridge University Press
- 10) Biological science, D. J. Taylor, N.P.O. Green & G.W Stout, Cambridge Low Price Edition, 3rdEdtn.
- 11) Holmes' Principles of Physical Geology, Edt. By P. McL. D. Duff, ELBS with Chapman & Hall, 4thEdtn.
- 12) An Advanced textbook on Biodiversity – Principles & Practice, K. V. Krishnamurthy, Oxford & IBH Publishing Co. Pvt. Ltd., Special Indian Edtn

## Paper - I, Semester II, EVS – 121

### Fundamentals of Environmental Geosciences (Total Lectures – 30 == 2 Credits)

Unit No.	Name of the Unit	Contents	No. of Lectures
1	Earth & it's Structural Components	<ul style="list-style-type: none"> <li>• Internal Structure of Earth</li> <li>• Theories of geological evolution – Wager's</li> <li>• Continental Drift Theory, Plate Tectonic Theory</li> <li>• Types of Rocks – Igneous, Sedimentary,</li> <li>• Metamorphic Rock cycle Rock forming minerals – quartz, feldspar, micas,</li> <li>• clay minerals, calcite, dolomite etc.</li> </ul>	06
2	Soil	<ul style="list-style-type: none"> <li>• Formation – weathering processes (types),</li> <li>• biomass addition</li> <li>• Physical &amp; chemical properties; composition;</li> <li>• macro &amp; micro plant nutrients</li> <li>• Soil Profile</li> <li>• Soil classification Soils of India – with respect to their agriculture significances.</li> </ul>	06
3	Earth's Atmosphere and Atmospheric temperature	<ul style="list-style-type: none"> <li>• Introduction, general properties</li> <li>• Vertical &amp; horizontal structures</li> <li>• Chemical composition – in each of the vertical layers; past &amp; present Significance</li> <li>• Atmospheric temperature measurement –</li> <li>• Instruments;</li> <li>• Methods (maximum, minimum, mean temperature, temperature range);</li> <li>• Factors regulating atmospheric temperature/ temperature controls</li> <li>• Lapse rate; Types – ELR, DALR &amp; WALR</li> </ul>	06
4	Hydrological cycle & Atmospheric pressure	<ul style="list-style-type: none"> <li>• Hydrological cycle –               <ol style="list-style-type: none"> <li>i) Introduction &amp; significance</li> <li>ii) Evaporation; Factors affecting the rate of Evaporation</li> <li>iii) Condensation; Factors affecting the rate of forms of condensation – dew, frost, fog &amp; cloud.</li> <li>iv) Precipitation; Factors affecting precipitation; Forms of precipitation – rain, drizzle, snow, hail, sleet etc.</li> </ol> </li> <li>• Atmospheric pressure – Introduction; Measurement; Factors affecting the atmospheric pressure, Spatial &amp; Temporal variations ,Atmospheric pressure &amp; Generation of winds; Factors affecting winds</li> </ul>	06
5	Natural Calamities & Resources	<ul style="list-style-type: none"> <li>• Natural Calamities – Volcanoes, Earthquakes, Landslides, Cyclones, Floods &amp; Droughts;</li> <li>• Causes; Planning &amp; Management to prevent/</li> </ul>	06

		mitigate their effects; Case studies for each. <ul style="list-style-type: none"><li>• Significance of wind, geothermal &amp; solar energy as alternative energy resources</li></ul>	
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**Reference Books -**

- 1) Environmental Geology ;Valdiya K.S.; Indian Context. Tata McGraw Hill
- 2) Essentials of Climatology ; D. S. Lal; Chaitanya Publishing House, Allahabad, 1989.
- 3) Holmes' – Principles of Physical Geology; Edt. by P. McL. D. Duff; ELBSChapman & Hall Low Priced Edtn; 4thEdtn.
- 4) A Textbook of soil Science; T.D. Biswas& S.K. Mukharjee; Tata McGraw-Hill Education
- 5) Introductory Soil Science; Dilip Kumar Das; Kalyani Publishers; 2ndEdtn.
- 6) Environmental Geology; Kellar E.A. (2011); Prentice Hall, 624 p; 9thEdtn.



## Paper - I, Semester II, EVS – 122

### Fundamentals of Environmental Pollution (Total Lectures – 30 == 2 Credits)

Unit No.	Name of the Unit	Contents	No. of Lectures
1	Introduction	<ul style="list-style-type: none"> <li>• Pollution – Definition;</li> <li>• Types –Air, Water Soil, Noise, Thermal, Radioactive and Solid waste</li> <li>• Natural and Anthropogenic</li> </ul>	06
2	Air and Radioactive Pollution	<ul style="list-style-type: none"> <li>• Definition; Major air pollutants and their sources;</li> <li>• Effects – On Biological system – Animals, humans &amp; plants On Non Biological systems – material; physical environment</li> <li>• Green House Effect, Ozone depletion, Smog, Acid Rain, Global warming</li> <li>• Case studies – London smog; Los Angeles smog; Taj-Mahal, Asian Brown Cloud</li> <li>• Radioactive pollution- Definition, Sources and Effects</li> </ul>	06
3	Water and Thermal pollution	<ul style="list-style-type: none"> <li>• Definition, Types ( Ground, Surface and Marine) Sources, Effects &amp; control measures</li> <li>• Detergent – Eutrophication</li> <li>• Pesticide – Bioaccumulation, biomagnifications</li> <li>• Heavy metal pollution – Pb, Hg, Cd &amp; As</li> <li>• Case studies – Itai- Itai &amp;Minamata (Japan); Arsenic poisoning (West Bengal) etc.</li> <li>• Definition, Sources ,Effects and Control measures of Thermal pollution, Case studies</li> </ul>	06
4	Soil pollution	<ul style="list-style-type: none"> <li>• Definition; Sources/ routes of contamination</li> <li>• Effects –On soil quality/ productivity – Acidification, Alkalinization, Salinization, Sodification, Desertification, Heavy metal deposition etc.</li> <li>• On Biological system – on soil microorganisms, on plants.</li> <li>• Control measures/ Alternatives –               <ol style="list-style-type: none"> <li>i) Biofertilizers &amp; biological pest management;</li> <li>ii) Organic farming &amp; other agricultural interventions;</li> <li>iii) Appropriate irrigation &amp; drainage techniques;</li> <li>iv) Lime&amp; gypsum application. Case studies – Declining soil productivity in the Punjab &amp; Haryana; desertification in India, Western Maharashtra</li> <li>v)</li> </ol> </li> </ul>	06

**Reference Books -**

- 1) Air Pollution- M. N. Rao&H. V .N. Rao; Tata McGraw Hill, New Delhi, 1989.
- 2) "Environment Pollution Control and Environmental Engg." C. S. Rao , Tata McGraw Hill, New Delhi, 1994.
- 3) Soil pollution & Soil Organism - P.V. Mishra
- 4) Water Pollution—A.K. Tripathy& S.N. Pandey; A. P. H. Publishing Corporation
- 5) Environmental Air pollution & it's control—G.R. Chatwal; Anmol Publications, New Delhi, 1989
- 6) Environmental Chemistry; A. K. De; New Age International Publishers; 6thEdtn.
- 7) Understanding Environment; Edt by Kiran B. Chhokar, MamataPandya, MeenaRaghunathan; Centre for Environment Education; Sage Publication.
- 8) Prespective in Environmental Studies; Kaushik&Kaushik; New Age International Pvt. Ltd Publishers
- 9) Environmental Science; S. C. Santra; New Central Book Agency (P) Ltd.; 2ndEdtn.
- 10) Water Pollution, P.K. Goel,New Age International, 2006 Revised Edtn

## Practical Paper Semester - I, EVS – 113 based on EVS-111 & 112

(Total Lectures – 1.5 Credits)

(Any 15 Practicals are to be conducted out of the following 17 Practicals)

Sr. No.	Description	Practical Sessions
1	Laboratory safety rules and introduction to laboratory equipments	01
2	Collection and preservation of water and soil samples (Field Practical).	02
3	Determination of pH and Electrical Conductivity of Water samples	01
4	Determination of pH and Electrical Conductivity of Soil samples	01
5	Determination of Alkalinity from water sample	01
6	Determination of Total Hardness (Ca & Mg) from water.	01
7	Determination of Chlorides from water.	01
8	Determination of TDS, TSS & TS from water	01
9	Identification of Food adulterants in various food samples	01
10	Determination of Organic Content from soil.	01
11	Identifying native plants for plantation with respect to Geography and Climate	01
12	Study of the working of PUC machine-Gas Analyser (Demonstration).	01
13	Study of Plant / Animal Fossil Forms from different geological periods/visit to Paleo-botanical museum	01
14	Study of Plant Adaptations under various environmental conditions (Hydrophytes, mesophytes, epiphytes, halophytes & xerophytes).	01
15	Study of Animal Adaptations under various ecological conditions	01
16	Visit to study different Fishery resources in the local market	01
17	Visit to study and Inventarise the various Agricultural/ Horticultural resources in the local market	01

## Practical Paper Semester II, EVS – 123 based on EVS-121 & 122

(Total Lectures – 1.5 Credits)

(Any 15 Practicals are to be conducted out of the following 17 Practicals)

Sr. No.	Description	Practical Sessions
1	Measurement of Noise using Sound Level Meter (Field Practical).	01
2	Collection and characterization of planktons as bio-indicators from Eutrophic lake(Field Practical).	01
3	Identification of different Rock specimens from their physical properties.	
4	Identification of different Mineral specimens from their physical properties	
5	Visit to a Natural Area/ Wildlife Sanctuary/ National Park	
6	Visit to Weather Station.	
7	Determination of Turbidity in water by Secchi disc (Field practical).	
8	Reading Topographic Maps and Symbols	
9	Plotting Climatological data on graph papers using toposheet maps	
10	Visit to Industrial Site/ ETP/ STP	
11	Visit to garbage Disposal site	
12	Study of soil properties – Temperature, texture and particle size	
13	Study of various Soils found in India	
14	Estimation of the Moisture Content & Water Holding Capacity of soil	
15	Estimation of Gypsum required for Alkaline soil.	
16	Use of social media for e-networking and dissemination of ideas on environmental issues.	
17	Estimation of Lapse Rate	

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